UNITED STATES OF AMERICA

DEPARTMENT OF ENERGY

OFFICE OF FOSSIL ENERGY

CAMERON LNG, LLC	)))	FE DOCKET NO. 15-90-LNG

OPINION AND ORDER GRANTING LONG-TERM, MULTI-CONTRACT AUTHORIZATION TO EXPORT LIQUEFIED NATURAL GAS BY VESSEL FROM TRAINS 4 AND 5 OF THE CAMERON LNG TERMINAL IN CAMERON AND CALCASIEU PARISHES, LOUISIANA, TO NON-FREE TRADE AGREEMENT NATIONS

DOE/FE ORDER NO. 3846

JULY 15, 2016

TABLE OF CONTENTS

FREQUENTLY USED ACRONYMS

AEO	Annual Energy Outlook
API	American Petroleum Institute
Bcf/d	Billion Cubic Feet per Day
Bcf/yr	Billion Cubic Feet per Year
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CPP	Clean Power Plan
DOE	U.S. Department of Energy
EA	Environmental Assessment
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
EUR	Estimated Ultimate Recovery
FE	Office of Fossil Energy, U.S. Department of Energy
FERC	Federal Energy Regulatory Commission
FONSI	Finding of No Significant Impact
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GEM	Global Economic Model
GHG	Greenhouse Gas
GIM	Global Industry Model
GWP	Global Warming Potential
IECA	Industrial Energy Consumers of America
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt-Hour
LCA	Life Cycle Analysis
LNG	Liquefied Natural Gas
Mcf	Thousand Cubic Feet
MMBtu	Million British Thermal Units
mtpa	Million Metric Tons per Annum
MWh	Megawatt-Hour
NEMS	National Energy Modeling System
NEPA	National Environmental Policy Act
NERA	NERA Economic Consulting
NETL	National Energy Technology Laboratory
NGA	Natural Gas Act
NOx	Nitrogen Oxides
PM	Particulate Matter
RWGTM	Rice World Gas Trade Model
Tcf	Trillion Cubic Feet
TRR	Technically Recoverable Resources
VOC	Volatile Organic Compound

I. INTRODUCTION

On May 28, 2015, Cameron LNG, LLC (Cameron LNG) filed an application (Application)[1] with the Office of Fossil Energy (FE) of the Department of Energy (DOE) under section 3 of the Natural Gas Act (NGA)[2] for long-term, multi-contract authorization to export liquefied natural gas (LNG) produced from domestic sources in a volume equivalent to approximately 515 billion cubic feet per year (Bcf/yr) of natural gas (1.41 Bcf per day (Bcf/d)), which Cameron LNG states is approximately 9.97 million metric tons per annum (mtpa) of LNG. Cameron LNG seeks authorization to export the LNG by vessel from the existing Cameron LNG Terminal (Cameron Terminal), which Cameron LNG owns and operates in Cameron and Calcasieu Parishes, Louisiana. As discussed below, Cameron LNG already has received authorizations from the Federal Energy Regulation Commission (FERC) and DOE/FE, respectively, to construct and develop three liquefaction trains (Trains 1, 2, and 3) to liquefy natural gas at the Cameron Terminal (Liquefaction Project) and to export the LNG to foreign markets. In this Application, Cameron LNG seeks authorization from DOE/FE to export an additional volume of LNG from two new liquefaction trains to be constructed at the Liquefaction Project—Trains 4 and 5 (Expansion Project).

Cameron LNG seeks authorization to export this LNG for a 20-year term from the Expansion Project to any country with which the United States does not have a free trade agreement (FTA)[3] requiring national treatment for trade in natural gas, and with which trade is

[1] Cameron LNG, LLC, Application for Long-Term Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Nations, FE Docket No. 15-90-LNG (May 28, 2015) [hereinafter Cameron LNG App.].

[2] The authority to regulate the imports and exports of natural gas, including liquefied natural gas, under section 3 of the NGA (15 U.S.C. § 717b) has been delegated to the Assistant Secretary for FE in Redelegation Order No. 00-006.02 issued on November 12, 2014.

[3] The United States currently has FTAs requiring national treatment for trade in natural gas with Australia, Bahrain, Canada, Chile, Colombia, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Mexico, Morocco, Nicaragua, Oman, Panama, Peru, Republic of Korea, and Singapore. FTAs with Israel and Costa Rica do not require national treatment for trade in natural gas.

not prohibited by U.S. law or policy (non-FTA countries).[4] Cameron LNG seeks to export this LNG on its own behalf and as agent for other entities that hold title to the LNG at the time of export. Cameron LNG requests that this authorization commence on the earlier of the date of first commercial export from the Expansion Project or seven years from the date this authorization is issued.

In granting Cameron LNG's Application, we find that the authorized export volume for Trains 4-5 (515 Bcf/yr) is additive to the authorized LNG export volumes set forth in Cameron LNG's two existing non-FTA orders, both for Trains 1-3: DOE/Order No. 3391-A (FE Docket No. 11-162-LNG)[5] and DOE/FE Order No. 3797 (FE Docket No. 15-67-LNG).[6] These orders authorize Cameron LNG to export LNG from Trains 1-3 to non-FTA countries in volumes equivalent to 620 and 152 Bcf/yr of natural gas, respectively. Accordingly, the grant of this Order—Cameron LNG's third long-term non-FTA export authorization—brings its total authorized non-FTA export volume to 1,287 Bcf/yr from Trains 1-5 of the Terminal.[7] DOE/FE is issuing this Opinion and Order subject to the additional conditions set forth below.

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[4] In a separate application filed in February 2015, Cameron LNG requested authorization to export the same volume of LNG from the Expansion Project to FTA countries. On July 10, 2015, DOE/FE granted that request in Order No. 3680 pursuant to NGA § 3(c), 15 U.S.C. § 717b(c). *See Cameron LNG, LLC*, DOE/FE Order No. 3680, FE Docket No. 15-36-LNG, Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Cameron LNG Terminal in Cameron and Calcasieu Parishes, Louisiana, to Free Trade Agreement Nations (July 10, 2015) [hereinafter FTA Expansion Order]. The volume approved in that FTA order and this Order are not additive. *See infra* at § IV.C.

[5] *Cameron LNG, LLC*, DOE/FE Order No. 3391-A, FE Docket No. 11-162-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Cameron LNG Terminal in Cameron Parish, Louisiana, to Non-Free Trade Agreement Nations (Sept. 10, 2014). We note that DOE/FE also issued a conditional order to Cameron LNG in that proceeding (DOE/FE Order No. 3391), but that order was incorporated by reference in DOE/FE Order No. 3391-A, the final order.

[6] *Cameron LNG, LLC*, DOE/FE Order No. 3797, FE Docket No. 15-67-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas from the Cameron Terminal Located in Cameron and Calcasieu Parishes, Louisiana, to Non-Free Trade Agreement Nations (Mar. 18, 2016).

[7] *See infra* § IV.C (Table 1). In that section, we also address Cameron LNG's existing FTA export volumes.

<u>DOE/FE Proceeding.</u> On August 6, 2015, DOE/FE published a Notice of Cameron LNG's Application in the *Federal Register*.[8] The Notice of Application called on interested persons to submit protests, motions to intervene, notices of intervention, and comments by October 5, 2015. DOE/FE received nine comments in support of the Application (including one local resolution passed by the Cameron Parish Police Jury), and one motion to intervene submitted by the American Petroleum Institute (API) taking no position on the Application. DOE/FE has considered these filings in its review of Cameron LNG's Application. No filings were submitted opposing the Application. *See infra* §§ XI, XII.

Additionally, in evaluating the public interest under NGA section 3(a), DOE/FE has considered the following economic and environmental studies in its review of Cameron LNG's Application:

(1) Economic Studies:

In 2011, DOE/FE engaged the U.S. Energy Information Administration (EIA) and NERA Economic Consulting (NERA) to conduct a two-part study of the economic impacts of U.S. LNG exports, which together was called the "2012 LNG Export Study." DOE/FE published a notice of availability of the 2012 LNG Export Study in the *Federal Register* for public comment. The 2012 LNG Export Study is described below (*infra* § VI.A), and DOE/FE responded to the public comments in connection with the LNG export proceedings identified in that notice.[9] In relevant part, the NERA study projected that, across all scenarios studied—assuming either 6 Bcf/d or 12

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[8] Cameron LNG, LLC, Application for Long-Term, Multi-Contract Authorization To Export Liquefied Natural Gas to Non-Free Trade Agreement Nations for a Period of 20 Years, 80 Fed. Reg. 46,970 (Aug. 6, 2015) [hereinafter Notice of Application].

[9] *See, e.g., Sabine Pass Liquefaction, LLC,* DOE/FE Order No. 3792, FE Docket No. 15-63-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel From the Sabine Pass LNG Terminal Located in Cameron Parish, Louisiana, to Non-Free Trade Agreement Nations, at 66-121 (Mar. 11, 2016).

Bcf/d of LNG export volumes—the United States would experience net economic benefits from allowing LNG exports.

By May 2014, in light of the volume of LNG exports to non-FTA countries then-authorized by DOE/FE and the number of non-FTA export applications still pending, DOE/FE determined that an updated study was warranted to consider the economic impacts of exporting LNG from the lower-48 states to non-FTA countries.[10] On May 29, 2014, DOE announced plans to undertake new economic studies to gain a better understanding of how potentially higher levels of U.S. LNG exports—at levels between 12 and 20 Bcf/d of natural gas—would affect the public interest.[11]

DOE/FE commissioned two new macroeconomic studies. The first, *Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets*, was performed by EIA and published in October 2014 (2014 EIA LNG Export Study or 2014 Study).[12] The 2014 Study assessed how specified scenarios of increased natural gas exports could affect domestic energy markets. At DOE's request, this 2014 Study served as an update of EIA's January 2012 study of LNG export scenarios and used baseline cases from EIA's 2014 *Annual Energy Outlook* (AEO 2014).[13]

The second study, *The Macroeconomic Impact of Increasing U.S. LNG Exports*, was performed jointly by the Center for Energy Studies at Rice University's Baker Institute and

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[10] Because there is no natural gas pipeline interconnection between Alaska and the lower 48 states, DOE/FE generally views those LNG export markets as distinct. DOE/FE therefore focuses on LNG exports from the lower-48 states for purposes of determining macroeconomic impacts.

[11] *See* U.S. Dep't of Energy, Office of Fossil Energy, Request for an Update of EIA's January 2012 Study of Liquefied Natural Gas Export Scenarios, *available at*: http://energy.gov/fe/downloads/request-update-eia-s-january-2012-study-liquefied-natural-gas-export-scenarios (May 29, 2014) (memorandum from FE to EIA).

[12] U.S. Energy Information Administration, *Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets* (Oct. 2014), *available at*: https://www.eia.gov/analysis/requests/fe/pdf/lng.pdf.

[13] Each Annual Energy Outlook (AEO) presents EIA's long-term projections of energy supply, demand, and prices. It is based on results from EIA's National Energy Modeling System model. *See infra* § VI.A.

Oxford Economics under contract to DOE/FE (together, Rice-Oxford) and published in October 2015 (2015 LNG Export Study or 2015 Study).[14] The 2015 Study is a scenario-based assessment of the macroeconomic impact of levels of U.S. LNG exports, sourced from the lower-48 states in volumes ranging from 12 to 20 Bcf/d of natural gas under a range of assumptions, including U.S. resource endowment, U.S. natural gas demand, international LNG market dynamics, and other factors. The analysis covers the 2015 to 2040 time period. Additional information about the 2014 and 2015 Export Studies is set forth below. *See infra* §§ VI.B, VI.C, VII.

On December 29, 2015, DOE/FE published a Notice of Availability of the 2014 and 2015 LNG Export Studies in the *Federal Register*, and invited public comment on those Studies.[15] DOE received 38 comments in response to the Notice of Availability, of which 14 comments opposed the 2014 and 2015 Studies and/or LNG exports generally, 21 expressed support for the Studies, and three took no position. *See infra* § VII.

As of May 20, 2016, DOE/FE had issued final, long-term non-FTA export authorizations for LNG and compressed natural gas (CNG) in a cumulative volume equivalent to 11.81 Bcf/d of natural gas—*i.e.*, just under the 12 Bcf/d level considered in the 2012 LNG Export Study.[16] The grant of this Order—in a volume of LNG equivalent to 1.41 Bcf/d of natural gas—brings

[14] Center for Energy Studies at Rice University Baker Institute and Oxford Economics, *The Macroeconomic Impact of Increasing U.S. LNG Exports* (Oct. 29, 2015), *available at*: http://energy.gov/sites/prod/files/2015/12/f27/20151113_macro_impact_of_lng_exports_0.pdf.

[15] U.S. Dep't of Energy, Macroeconomic Impacts of LNG Exports Studies; Notice of Availability and Request for Comments, 80 Fed. Reg. 81,300, 81,302 (Dec. 29, 2015) [hereinafter Notice of Availability] (providing a 45-day public comment period "to help inform DOE in its public interest determinations of the authorizations sought in the 29 non-FTA export applications identified …").

[16] *See Flint Hills Resources, LP*, DOE/FE Order No. 3829, FE Docket No. 15-168-LNG, Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas in ISO Containers and in Bulk Loaded at the Stabilis LNG Eagle Ford Facility in George West, Texas, and Exported by Vessel to Non-Free Trade Agreement Nations, at 23 (May 20, 2016); *see also infra* § XII.D (identifying each non-FTA LNG export authorization granted to date).

DOE/FE's cumulative volume for approved non-FTA LNG exports to 13.22 Bcf/d of natural gas. Because the 2014 and 2015 Studies examined U.S. LNG exports in excess of 12 Bcf/d, we find it appropriate to review those Studies as part of our public interest review in this proceeding.

(2) Environmental Studies:

On June 4, 2014, DOE/FE issued two notices in the *Federal Register* proposing to evaluate different environmental aspects of the LNG production and export chain. First, DOE/FE announced that it had conducted a review of existing literature on potential environmental issues associated with unconventional natural gas production in the lower-48 states. The purpose of this review was to provide additional information to the public concerning the potential environmental impacts of unconventional natural gas exploration and production activities, including hydraulic fracturing. DOE/FE published its draft report for public review and comment, entitled *Draft Addendum to Environmental Review Documents Concerning Exports of Natural Gas from the United States* (Draft Addendum).[17] DOE/FE received comments on the Draft Addendum and, on August 15, 2014, issued the final Addendum with its response to the public comments contained in Appendix B.[18]

Second, DOE/FE commissioned the National Energy Technology Laboratory (NETL), a DOE applied research laboratory, to conduct an analysis calculating the life cycle greenhouse gas (GHG) emissions for LNG exported from the United States. *See infra* § IX.A. The purpose of this analysis was to determine: (i) how domestically-produced LNG exported from the United States compares with regional coal (or other LNG sources) for electric power generation in

[17] Dep't of Energy, Draft Addendum to Environmental Review Documents Concerning Exports of Natural Gas From the United States, 79 Fed. Reg. 32,258 (June 4, 2014). DOE/FE announced the availability of the Draft Addendum on its website on May 29, 2014.

[18] Dep't of Energy, Addendum to Environmental Review Documents Concerning Exports of Natural Gas From the United States, 79 Fed. Reg. 48,132 (Aug. 15, 2014) [hereinafter Addendum]; *see also* http://energy.gov/fe/addendum-environmental-review-documents-concerning-exports-natural-gas-united-states; *infra* § VIII.

Europe and Asia from a life cycle GHG perspective, and (ii) how those results compare with natural gas sourced from Russia and delivered to the same markets via pipeline. DOE/FE published NETL's report entitled, *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States* (LCA GHG Report).[19] DOE/FE also received public comment on the LCA GHG Report, and provides its response to those comments in this Order. *See infra* § IX.B.

With respect to both the Addendum and the LCA GHG Report, DOE/FE has taken all public comments into consideration in this decision and has made those comments, as well as the underlying studies, part of the record in this proceeding. As explained below, neither the Addendum nor the LCA GHG Report are required by the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. § 4321 *et seq*., but DOE/FE believes that these documents will inform its review of the public interest under NGA section 3(a), and are responsive to concerns previously raised in this proceeding.

Parallel FERC Proceeding. In September 2015, Cameron LNG filed an application with FERC in FERC Docket No. CP15-560-000 to site, construct, and operate the Expansion Project.[20] As detailed below, DOE/FE participated as a cooperating agency in FERC's environmental review proceeding under NEPA, which culminated in the issuance of an Environmental Assessment (EA) for the Expansion Project.[21] On February 12, 2016, FERC issued the EA and placed it into the public record. The EA recommended that FERC subject any

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[19] Dep't of Energy, Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas From the United States, 79 Fed. Reg. 32,260 (June 4, 2014) [hereinafter LCA GHG Report]. DOE/FE announced the availability of the LCA GHG Report on its website on May 29, 2014.

[20] Cameron LNG, LLC, Application for Authorization Under the Natural Gas Act, FERC Docket Nos. CP15-560-000 and PF15-13-000 (Sept. 28, 2015); *see also* Federal Energy Regulatory Comm'n, Cameron LNG, LLC; Notice of Application, 80 Fed. Reg. 63,551 (Oct. 20, 2015).

[21] Federal Energy Regulatory Comm'n, Environmental Assessment for the Cameron LNG Expansion Project, Docket No. CP15-560-000 (Feb. 2016) [hereinafter EA].

approval of the Expansion Project to 70 environmental conditions.[22] FERC did not receive any comments on the EA.[23]

On May 5, 2016, FERC issued an Order Granting Authorization Under Section 3 of the Natural Gas Act, which authorized Cameron LNG to site, construct, and operate the proposed Expansion Project subject to 72 environmental conditions contained in the Appendix of the Order (the 70 environmental conditions recommended in the EA and two others imposed by FERC).[24] FERC determined that, "with the conditions required …, Cameron's Expansion Project results in minimal environmental impacts and can be constructed and operated safely."[25] Details of the FERC Order are discussed below. *See infra* § X.C. No party sought rehearing of the FERC Order.

DOE/FE's Adoption of the EA and Issuance of a Finding of No Significant Impact (FONSI) Under NEPA, and NGA Section 3(a) Authorization. After an independent review, DOE/FE is concurrently adopting FERC's EA for the Expansion Project (DOE/EA-2041) and issuing a Finding of No Significant Impact (FONSI) for the proposed Expansion Project and other related facility modifications.[26] As discussed below, this Order grants the Application and is conditioned on Cameron LNG's compliance with the 72 environmental conditions adopted in the FERC Order.

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[22] *See id*. at 118-29.
[23] *Cameron LNG, LLC.*, Order Granting Authorization Under Section 3 of the Natural Gas Act, 155 FERC ¶ 61,141, at P 14 (May 5, 2016) [hereinafter FERC Order].
[24] *See id*.
[25] *Id*. at P 11.
[26] U.S. Dep't of Energy, Finding of No Significant Impact for Cameron Terminal Expansion Project, DOE/EA-2041 (July 15, 2016) [hereinafter Cameron LNG FONSI].

II. SUMMARY OF FINDINGS AND CONCLUSIONS

This Order presents DOE/FE's findings and conclusions on all issues associated with Cameron LNG's proposed exports under NGA section 3(a), including both environmental and non-environmental issues. As the basis for this Order, DOE/FE has reviewed a substantial administrative record that includes (but is not limited to) the following: Cameron LNG's uncontested Application; the non-intervenor comments filed in support of the Application; the motion to intervene filed by API taking no position on the Application; DOE/FE's 2014 and 2015 LNG Export Studies; the Addendum; the LCA GHG Report; public comments received on DOE/FE's various analyses; FERC's EA on the proposed Expansion Project; and the FERC Order granting authorization for Cameron LNG to site, construct, and operate the Expansion Project.

On the basis of this record, DOE/FE has determined that it has not been shown that Cameron LNG's proposed exports will be inconsistent with the public interest, as is required to deny Cameron LNG's Application under NGA section 3(a). DOE/FE therefore authorizes Cameron LNG's export of domestically produced LNG from the Cameron Terminal's Expansion Project to non-FTA countries in a total volume equivalent to 515 Bcf/yr of natural gas. This authorization is subject to the Terms and Conditions and Ordering Paragraphs set forth herein, which incorporate by reference the 72 environmental conditions imposed by FERC. *See infra* §§ XIII-XV.

III. PUBLIC INTEREST STANDARD

Section 3(a) of the NGA sets forth the standard for review of the Application:

> [N]o person shall export any natural gas from the United States to a foreign country or import any natural gas from a foreign country without first having secured an order of the [Secretary of Energy[27]] authorizing it to do so. The [Secretary] shall issue such order upon application, unless after opportunity for hearing, [he] finds that the proposed exportation or importation will not be consistent with the public interest. The [Secretary] may by [the Secretary's] order grant such application, in whole or part, with such modification and upon such terms and conditions as the [Secretary] may find necessary or appropriate.

15 U.S.C. § 717b(a). This provision creates a rebuttable presumption that a proposed export of natural gas is in the public interest. DOE/FE must grant such an application unless opponents of the application overcome that presumption by making an affirmative showing of inconsistency with the public interest.[28]

While section 3(a) establishes a broad public interest standard and a presumption favoring export authorizations, the statute does not define "public interest" or identify criteria that must be considered. In prior decisions, however, DOE/FE has identified a range of factors that it evaluates when reviewing an application for export authorization. These factors include economic impacts, international impacts, security of natural gas supply, and environmental impacts, among others. To conduct this review, DOE/FE looks to record evidence developed in the application proceeding.[29]

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[27] The Secretary's authority was established by the Department of Energy Organization Act, 42 U.S.C. § 7172, which transferred jurisdiction over imports and export authorizations from the Federal Power Commission to the Secretary of Energy.

[28] *See, e.g.*, *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 2961, FE Docket No. 10-111-LNG, Opinion and Order Conditionally Granting Long-Term Authorization to Export Liquefied Natural Gas From Sabine Pass LNG Terminal to Non-Free Trade Agreement Nations, at 28 (May 20, 2011) [hereinafter *Sabine Pass*]; *see also Phillips Alaska Natural Gas Corp. & Marathon Oil Co.*, DOE/FE Order No. 1473, FE Docket No. 96-99-LNG, Order Extending Authorization to Export Liquefied Natural Gas from Alaska, at 13 (April 2, 1999) [hereinafter *Phillips Alaska Natural Gas*], citing *Panhandle Producers & Royalty Owners Ass'n v. ERA*, 822 F.2d 1105, 1111 (D.C. Cir. 1987).

[29] *See, e.g.*, *Sabine Pass*, DOE/FE Order No. 2961, at 28-42 (reviewing record evidence in issuing conditional authorization).

DOE/FE's prior decisions have also looked to certain principles established in its 1984 Policy Guidelines.[30] The goals of the Policy Guidelines are to minimize federal control and involvement in energy markets and to promote a balanced and mixed energy resource system. The Guidelines provide that:

> The market, not government, should determine the price and other contract terms of imported [or exported] natural gas …. The federal government's primary responsibility in authorizing imports [or exports] will be to evaluate the need for the gas and whether the import [or export] arrangement will provide the gas on a competitively priced basis for the duration of the contract while minimizing regulatory impediments to a freely operating market.[31]

While nominally applicable to natural gas import cases, DOE/FE subsequently held in Order No. 1473 that the same policies should be applied to natural gas export applications.[32]

In Order No. 1473, DOE/FE stated that it was guided by DOE Delegation Order No. 0204-111. That delegation order, which authorized the Administrator of the Economic Regulatory Administration to exercise the agency's review authority under NGA section 3, directed the Administrator to regulate exports "based on a consideration of the domestic need for the gas to be exported and such other matters as the Administrator finds in the circumstances of a particular case to be appropriate."[33] In February 1989, the Assistant Secretary for Fossil Energy assumed the delegated responsibilities of the Administrator of ERA.[34]

Although DOE Delegation Order No. 0204-111 is no longer in effect, DOE/FE's review of export applications has continued to focus on: (i) the domestic need for the natural gas

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[30] New Policy Guidelines and Delegations Order Relating to Regulation of Imported Natural Gas, 49 Fed. Reg. 6684 (Feb. 22, 1984) [hereinafter 1984 Policy Guidelines].
[31] *Id*. at 6685.
[32] *Phillips Alaska Natural Gas*, DOE/FE Order No. 1473, at 14 (citing *Yukon Pacific Corp.*, DOE/FE Order No. 350, Order Granting Authorization to Export Liquefied Natural Gas from Alaska, 1 FE ¶ 70,259, at 71,128 (1989)).
[33] DOE Delegation Order No. 0204-111, at 1; *see also* 1984 Policy Guidelines, 49 Fed. Reg. at 6690.
[34] *See* Applications for Authorization to Construct, Operate, or Modify Facilities Used for the Export or Import of Natural Gas, 62 Fed. Reg. 30,435, 30,437 n.15 (June 4, 1997) (citing DOE Delegation Order No. 0204-127, 54 Fed. Reg. 11,436 (Mar. 20, 1989)).

proposed to be exported, (ii) whether the proposed exports pose a threat to the security of domestic natural gas supplies, (iii) whether the arrangement is consistent with DOE/FE's policy of promoting market competition, and (iv) any other factors bearing on the public interest described herein.

IV. DESCRIPTION OF REQUEST

Cameron LNG requests long-term, multi-contract authorization to export domestically produced LNG, on its own behalf and as agent for other entities that will hold title to the LNG, from the proposed Expansion Project to non-FTA countries in a volume equivalent to 515 Bcf/yr of natural gas (1.41 Bcf/d). Cameron LNG requests a 20-year term of authorization, commencing on the earlier of the date of first export or seven years from the date of the issuance of this Order.

A. Description of Applicant

Cameron LNG is a Delaware limited liability company with its principal place of business in Houston, Texas. Cameron LNG is an indirect subsidiary of Sempra Energy, GDF SUEZ S.A., Mitsui & Co., Ltd., Mitsubishi Corporation, and Nippon Yusen Kabushiki Kaisha.[35]

Cameron LNG owns the Cameron Terminal, which has an existing interconnection with Cameron Interstate Pipeline, LLC. Cameron Interstate, an affiliate of Cameron LNG, is an interstate pipeline regulated by FERC. Cameron Interstate's facilities consist primarily of a 36.2 mile pipeline connecting the Cameron Terminal with five other interstate pipelines.[36]

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[35] Cameron LNG App. at 3; *see also Cameron LNG, LLC*, DOE/FE Order No. 3452, FE Docket Nos. 14-001-CIC, *et al*., Order Approving Change in Control of Export Authorizations (June 27, 2014).
[36] *See* Cameron LNG App. at 4.

B. Description of Facility

1. Cameron Terminal

According to Cameron LNG, FERC initially authorized the construction and operation of the Cameron Terminal in 2003, and approved the first capacity expansion in 2007. Cameron LNG completed construction of the Cameron Terminal and placed it into service in July 2009. The Terminal initially was used for the sole purpose of receiving and storing foreign-sourced LNG, re-gasifying such LNG, and sending it out for delivery to domestic markets. In January 2011, FERC authorized Cameron LNG to operate the Cameron Terminal for the additional purpose of exporting previously imported (*i.e.*, foreign sourced) LNG on behalf of its customers.[37]

2. Liquefaction Project (Trains 1-3)

Cameron LNG states that the Liquefaction Project facilities, which are currently under construction, will permit natural gas to be received by pipeline at the Cameron Terminal, liquefied, and loaded from the Terminal's storage tanks onto vessels berthed at the existing marine facility. The Liquefaction Project has been designed to allow bi-directional service.[38]

FERC conducted an environmental review process under NEPA for Trains 1-3, which culminated in FERC's issuance of a final environmental impact statement (EIS) in April 2014. DOE participated as a cooperating agency in that environmental review process. On June 19, 2014, FERC issued an order granting Cameron LNG's request for authorization to site, construct, and operate the Liquefaction Project subject to 76 environmental conditions contained in that order.[39] The FERC Order also authorized Cameron Interstate to construct and operate pipeline

[37] *Cameron LNG, LLC*, 134 FERC ¶ 61,049 (2011); *see also Cameron LNG, LLC*, DOE/FE Order No. 3391-A, at 10-11.
[38] *See Cameron LNG, LLC*, DOE/FE Order No. 3391-A, at 13.
[39] *Cameron LNG, LLC, and Cameron Interstate Pipeline, LLC.*, Order Granting Authorization Under Section 3 of the Natural Gas Act and Issuing Certificates, 147 FERC ¶ 61,230 (Jun. 19, 2014), Notice Denying Rehearing, 148 FERC ¶ 61,073 (July 29, 2014), Order Denying Rehearing, 148 FERC ¶ 61,237 (Sept. 26, 2014), appeal taken *sub*

and compression facilities for purposes of supporting the Liquefaction Project. As authorized by FERC, the aggregate maximum liquefaction capacity of Trains 1-3 equates to approximately 14.95 mtpa of LNG.[40]

3. Expansion Project (Trains 4-5)

In this proceeding, Cameron LNG requests authorization from DOE/FE to export LNG from two additional liquefaction trains—Trains 4 and 5—to be constructed within the existing Cameron Terminal boundaries. Cameron LNG states that the design of Trains 4-5 is identical to the design of Trains 1-3, and will be integrated with those trains.[41]

Cameron LNG states that Trains 4-5 will increase the Terminal's capacity by 515 Bcf/yr of natural gas, or approximately 9.97 mtpa of LNG.[42] This addition would increase the total export capability of the Cameron Terminal from Trains 1-5 to approximately 1,287 Bcf/yr of natural gas (1.29 trillion cubic feet per year (Tcf/yr)), or approximately 24.92 mtpa of LNG.[43]

As discussed below, FERC conducted an environmental review of the Expansion Project under NEPA, and has issued a final order approving Cameron LNG's construction of Trains 4-5 and related facility modifications.[44]

C. Procedural History

1. Related DOE/FE Export Authorizations

Pertinent aspects of Cameron LNG's procedural history with DOE/FE are summarized below.

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nom. Sierra Club and Gulf Restoration Network v. FERC (D.C. Cir., Case No. 14-1190), dismissed by Court order on March 16, 2015.

[40] *See Cameron LNG, LLC*, DOE/FE Order No. 3391-A, at 2-3, 13-14.

[41] FERC Order at P 3.

[42] Cameron LNG incorporates by reference the description of the Cameron Terminal and the Liquefaction Project set forth in its application in FE Docket No. 11-162-LNG and in DOE/FE Order No. 3391-A. Cameron LNG App. at 4.

[43] FERC Order at P 4.

[44] *See id*. at P 3 (describing Expansion Project facilities to include an additional LNG storage tank and Trains 4-5).

FTA Order – Liquefaction Project (DOE/FE Order No. 3059): On January 17, 2012, DOE/FE issued Order No. 3059, in which it authorized Cameron LNG to export LNG, on its own behalf and as agent for other entities, from the Cameron Terminal (Trains 1-3) to FTA countries in a volume equivalent to approximately 620 Bcf/yr of natural gas (1.7 Bcf/d) for a 20-year period.[45]

Non-FTA Order – Liquefaction Project (DOE/FE Order No. 3391-A): On September 10, 2014, DOE/FE issued Order No. 3391-A, in which it authorized Cameron LNG to export LNG, on its own behalf and as agent for other entities, from the Cameron Terminal (Trains 1-3) to non-FTA countries in a volume equivalent to 620 Bcf/yr of natural gas for a 20-year period. The volumes authorized for export in DOE/FE Order Nos. 3059 and 3391-A are not additive to one another.

FTA Order – Design Increase (DOE/FE Order No. 3620): On April 9, 2015, in Order No. 3620, DOE/FE authorized Cameron LNG to export LNG, on its own behalf and as agent for other entities, from the Cameron Terminal (Trains 1-3) to FTA countries in a volume equivalent to 152 Bcf/yr of natural gas for a 20-year period. This authorized volume of natural gas equates to 2.95 mtpa of LNG, which represents the difference between DOE/FE's FTA authorization in Order No. 3059 (12 mtpa of LNG) and the capacity of the Cameron Terminal as approved by FERC in its June 19, 2014 Order (14.95 mtpa of LNG).[46]

Non-FTA Order – Design Increase (DOE/FE Order No. 3797): On March 18, 2016, in Order No. 3797, DOE/FE authorized Cameron LNG to export LNG, on its own behalf and as

[45] *Cameron LNG, LLC*, DOE/FE Order No. 3059, FE Docket No. 11-145-LNG, Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Cameron LNG Terminal to Free Trade Agreement Nations (Jan. 17, 2012).

[46] *Cameron LNG, LLC*, DOE/FE Order No. 3620, FE Docket No. 14-204-LNG, Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Cameron LNG Terminal in Cameron Parish, Louisiana, to Free Trade Agreement Nations (April 9, 2015).

agent for other entities, from the Cameron Terminal (Trains 1-3) to FTA countries in a volume equivalent to 152 Bcf/yr of natural gas for a 20-year period. As in DOE/FE Order No. 3620, this authorized volume of natural gas equates to 2.95 mtpa of LNG, which represents the difference between DOE/FE's non-FTA authorization in Order No. 3391-A (12 mtpa of LNG) and the capacity of the Cameron Terminal as approved by FERC in its June 19, 2014 Order (14.95 mtpa of LNG). The volumes authorized for export in DOE/FE Order Nos. 3620 and 3797 are not additive to one another.[47]

FTA Order – Expansion Project (DOE/FE Order No. 3680): On July 10, 2015, in Order No. 3680, DOE/FE authorized Cameron to export LNG, on its own behalf and as agent for other entities, from the Expansion Project (Trains 4-5) to FTA countries in a volume equivalent to 515 Bcf/yr of natural gas for a 20-year period.[48]

2. Summary of Cameron LNG's Non-FTA Export Authorizations

In the current Application, Cameron LNG requests long-term authorization for the export of LNG to non-FTA countries in a volume equivalent to 515 Bcf/yr of natural gas, representing the FERC-authorized capacity for the Expansion Project (Trains 4 and 5). This volume represents the corresponding volume to DOE/FE Order No. 3680 for non-FTA countries.

As discussed below, DOE/FE is granting Cameron LNG's requested authorization in this Order. With this Order, Cameron LNG now holds three long-term non-FTA export authorizations for Trains 1-5 in a total volume of LNG not to exceed 1,287 Bcf/yr of natural gas, as summarized in Table 1.[49]

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[47] *Cameron LNG, LLC*, DOE/FE Order No. 3797, *supra* note 6.
[48] *Cameron LNG, LLC*, DOE/FE Order No. 3680, *supra* note 4.
[49] These are long-term authorizations only, and do not include blanket authorizations issued to Cameron LNG for the export of LNG on a short-term basis to non-FTA countries.

Table 1: Orders Issued by DOE/FE to Cameron LNG for the Export of Domestically Produced LNG from the Cameron Terminal to Non-FTA Countries

Docket No.	Order No.	Date Issued	Trains	Volume (Bcf/yr)	Type
11-162-LNG	3391-A	September 10, 2014	1-3	620	20 years, multi-contract
15-67-LNG (Design Increase)	3797	March 18, 2016	1-3	152	20 years, multi-contract
15-90-LNG (Expansion Project)	3846	July 15, 2016	4-5	515	20 years, multi-contract
Total Volume (Non-FTA)				**1,287**	

D. Business Model

Cameron LNG requests authority to export the LNG on its own behalf and as agent for other entities that will hold title to the LNG at the time of export. In those instances in which Cameron LNG exports LNG on its own behalf, Cameron LNG states that it either will take title to the natural gas at a point upstream of the Cameron Terminal, or it will purchase LNG from a customer of the Terminal prior to export. In other cases, Cameron LNG anticipates that it will act as agent for the customers of the Terminal without taking title.[50]

Cameron LNG states that it will comply with all DOE/FE requirements for exporters and agents, including registration requirements. Cameron LNG further states that, when acting as agent, it will register with DOE/FE each LNG title holder for which it seeks to export LNG as

[50] Cameron LNG App. at 5-6.

agent, and will comply with other registration requirements, as set forth in recent DOE/FE orders.[51]

E. Source of Natural Gas

Cameron LNG previously informed DOE/FE that natural gas will be delivered to the Cameron Terminal through the Cameron Interstate Pipeline from five major interstate pipelines, thereby allowing access to a variety of supply options.[52] According to Cameron LNG, the source of the natural gas will include the vast supplies of natural gas available from the Texas and Louisiana producing regions. The Barnett, Haynesville, and Eagle Ford Shale formations will serve as additional sources of natural gas for the Liquefaction and Expansion Projects.[53]

V. APPLICANT'S PUBLIC INTEREST ANALYSIS

Cameron LNG states that its proposed exports are not inconsistent with the public interest, and therefore meet the standard under NGA section 3(a). In support of this position, Cameron LNG addresses the following four factors: (i) U.S. natural gas supply; (ii) U.S. natural gas demand; (iii) impact on domestic natural gas prices; and (iv) other public interest considerations.

A. U.S. Natural Gas Supply

Cameron LNG states that drilling productivity gains and extraction technology enhancements have enabled rapid growth in supplies from unconventional gas-bearing shale formations in the United States. Cameron LNG further asserts that natural gas proved resources in the United States increased by 10 percent in 2013 (31.3 Tcf), reaching a high of 354 Tcf. Cameron LNG argues that this growth in resources, coupled with minor increases in natural gas

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[51] *See id*.
[52] *See Cameron LNG, LLC*, DOE/FE Order No. 3391-A, at 15.
[53] *See id*.

demand, demonstrate that there are more than sufficient natural gas resources to accommodate both domestic demand and Cameron LNG's proposed exports.

Cameron LNG asserts that domestic gas production has been on a significant upward trend in recent years as rapid growth in supply from unconventional discoveries has compensated for declines in production from conventional onshore and offshore fields. Citing an EIA report, Cameron LNG estimates that U.S. dry gas production was 2,197,834 thousand cubic feet (Mcf) in August 2014, a 5.8 percent increase compared to August 2013 dry production of 2,091,626 Mcf.[54] Cameron LNG further maintains that increased drilling productivity in certain prolific shale gas formations, including the Marcellus and Haynesville shales, has enabled domestic production to continue expanding despite a reduction in the number of wells drilled.

Next, citing EIA's AEO 2015, Cameron LNG asserts that EIA's projected U.S. dry natural gas production is more than seven percent higher than in EIA's 2013 analysis—an increase "largely due" to increasing shale gas production.[55] Cameron LNG points to AEO 2015 in stating that this increase in shale gas production is expected to continue through 2040, when it will comprise more than half of total domestic dry gas production.[56] Cameron LNG further observes that EIA has significantly increased its estimates of shale gas production compared with its estimates of several years ago. For example, EIA has projected shale gas and tight oil play production of 15.44 Tcf in 2020 and approximately 19.6 Tcf in 2040.[57]

Cameron LNG maintains that the growth in shale gas production has been accompanied by an increase in the overall volume of U.S. natural gas resources. Cameron LNG states that, in

[54] Cameron LNG App. at 10-11 (citing Energy Information Administration, *Natural Gas Gross Withdrawals and Production, available at:* http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_NUS_m.htm).
[55] *Id*. at 11.
[56] *Id.* (citing Energy Information Administration, *Annual Energy Outlook 2015* app. A at A-1).
[57] *Id.* (citing Energy Information Administration, *Annual Energy Outlook 2015* app. A at A-28 tbl.A14).

2014, EIA estimated the technically recoverable natural gas resources in the United States at 2,266 Tcf.[58] According to Cameron LNG, the growth in U.S. natural gas resources is reflected in other recent academic and industry evaluations. Cameron LNG cites the analysis of the Potential Gas Committee, which in April 2013 determined that the United States has future available natural gas supply of 2,688.5 Tcf—an increase of more than 500 Tcf from the Potential Gas Committee's April 2011 projections.[59] Of that amount, Cameron LNG states that the Potential Gas Committee projects 1,073 Tcf to be derived from shale gas production, which is 40 percent of the total available supply.[60]

Cameron LNG maintains that these studies and reports indicate that the United States has a "90-year to an over 100-year inventory of recoverable natural gas resources," with this inventory expected to grow as advancements in drilling technology are deployed to exploit additional shale gas opportunities.[61]

B. Domestic Natural Gas Demand

Cameron LNG asserts that growth in the demand for natural gas in the United States has been minimal. Citing EIA data, Cameron LNG states that natural gas demand in 2013 was only 11 percent higher than in 2000.[62] Cameron LNG also references AEO 2014, in which EIA estimated long-term annual U.S. demand growth of only 0.8 percent, with demand expected to reach 31.6 Tcf in 2040 (compared to 24.3 Tcf of actual demand in 2011).[63]

According to Cameron LNG, the consensus of estimates by EIA and academic and

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[58] *Id.* (citing Energy Information Administration, *Assumptions to the Annual Energy Outlook 2014* tbl. 9.2, *available at* http://www.eia.gov/forecasts/aeo/assumptions/pdf/oil_gas.pdf (2014)).
[59] Cameron LNG App. at 11-12.
[60] *Id.* at 12 (citing U.S. Potential Gas Committee 2010, "The Potential Supply of Natural Gas in the United States," *available at*: http://www.potentialgas.org/PGC%20Press%20Conf%202011%20slides.pdf (Apr. 2011)).
[61] *Id*.
[62] *Id.* (citing Energy Information Administration, *Natural Gas Consumption by End Use, available at:* http://www.eia.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm).
[63] *Id.* (citing Energy Information Administration, *Annual Energy Outlook 2014* app. A at A-27 tbl.A13).

industry experts is that the United States has between 2,000 and 2,384 Tcf of recoverable natural resources. Cameron LNG maintains that, even at 100 percent utilization, the proposed Expansion Project would result in maximum natural gas requirements of 10.3 Tcf over the 20-year term of the requested authorization—or 0.43 to 0.52 percent of total estimated recoverable U.S. natural gas resources.[64]

C. Impact on Domestic Natural Gas Prices

Pointing to EIA's 2014 LNG Export Study discussed herein, Cameron LNG asserts that EIA concluded that, in all circumstances and LNG export scenarios, the average delivered domestic natural gas price impact for residential consumers was estimated to range from 1-9 percent.[65]

Additionally, Cameron LNG commissioned ICF International, an independent consulting firm, to assess the impact of the proposed LNG exports on natural gas prices. ICF conducted an economic impact analysis (ICF Report)[66] to assess the effects of the export volume requested for the Expansion Project in this proceeding as compared to the "base case" authorization of 772 Bcf/yr in Cameron LNG's prior proceedings (*i.e.*, Cameron LNG's total export volumes authorized in DOE/FE Order Nos. 3059, 3391-A, and 3620). According to Cameron LNG, the ICF Report concluded that, with the introduction of the 515 Bcf/yr export volume at issue here, the price at Henry Hub increases on average by $0.08 per MMBtu between 2016 and 2038—an increase over the base case averaging just over one percent.[67]

Cameron LNG maintains that both EIA's 2014 Study and the ICF Report support the

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[64] Cameron LNG App. at 12.
[65] *See id*. at 14.
[66] ICF International, Economic Impacts of Cameron Liquefaction Trains 4-5 Expansion: Information for DOE Non-FTA Permit Application (May 18, 2015), attached to Cameron LNG Application as Appendix C.
[67] Cameron LNG App. at 15 (citing ICF Report at 46).

conclusion that its proposed exports from the Expansion Project will have a minimal impact on domestic natural gas prices.

D. Other Public Interest Considerations

Cameron LNG relies upon the ICF Report in asserting that the "incremental export volume" requested in the Application will result in substantial benefits to the national, regional, and local economies and will improve the U.S. balance of trade.[68] According to Cameron LNG, the ICF Report estimates an increase in annual LNG plant operating costs of $124.92 million by 2038,[69] or an annual average of $102.1 million between 2016 and 2038.[70] These additional costs over the base case include increased port fees, insurance costs, and equipment replacements. Cameron LNG asserts that the increased export volume of 515 Bcf/yr from the Expansion Project will result in the following benefits estimated by ICF International:

- **Production of natural gas and liquids.** The incremental export volumes will result in an increase in U.S. natural gas production of 1.4 Bcf/d over the base case by 2038, or 1.1 Bcf/d on an average annual basis between 2016 and 2038.[71]

- **Liquids Production.** The production of natural gas liquids (including lease condensate, ethane, propane, butane, and pentanes plus) is expected to increase by an additional 60,000 barrels per day over the base case on average between 2016 and 2038.[72]

- **Production values.** "Cumulative natural gas and liquids production value" will total nearly $164 billion more than the base case between 2016 and 2038, or about $7.2 billion annually over the period.[73]

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[68] *Id*.
[69] *Id*. at 16 (citing ICF Report at 33).
[70] *Id.* (citing ICF Report at 42).
[71] *Id.* at 17 (citing ICF Report at 38).
[72] Cameron LNG App. at 17 (citing ICF Report at 39).

- **Upstream capital expenditures.** There will be an increase in upstream capital expenditures as more production is needed to meet LNG export demand. Over the forecast period 2016 to 2038, there will be a total incremental impact on U.S. upstream capital expenditures of $22.1 billion as compared to the base case, or approximately $961 million annually.[74]

- **Natural gas consumption.** The additional export volumes correspond to a slight decrease in U.S. domestic natural gas consumption of 0.13 Bcf/d over the base case in 2038, due largely to a contraction in power generation gas use.[75]

- **Employment.** Total U.S. employment—including direct jobs in the oil and gas industry, indirect jobs in the industries that serve the oil and gas industry, and induced jobs from the effect of spending new job wages—is expected to increase by an average of nearly 35,500 annual job-years between 2016 and 2038 due to the proposed exports, giving a cumulative job-year impact of over 816,200 job-years.[76] Employment in Louisiana is expected to increase by nearly 2,800 job-years annually between 2016 and 2038, resulting in a cumulative job impact of close to 64,000 job-years over the period for the state.[77]

- **Taxes.** Federal, state, and local government revenues will increase by just over $4.4 billion annually as a result of the proposed exports, or by more than $101.2 billion cumulatively over the 23-year forecast period between 2016 and 2038.[78] Government revenues

[73] *Id.* (citing ICF Report at 47).
[74] *Id.* (citing ICF Report at 43).
[75] *Id.* (citing ICF Report at 45).
[76] *Id.* at 18 (citing ICF Report at 48).
[77] *Id.* (citing ICF Report at 52).
[78] Cameron LNG App. at 18 (citing ICF Report at 49).

within Louisiana are expected to increase by more than $131 million over the base case annually during the forecast period, indicating a cumulative impact of more than $3 billion.[79]

- **<u>Gross Domestic Product.</u>** The proposed exports are estimated to result in a $12.7 billion annual average increase to the U.S. economy over the 2016-2038 period, or a cumulative impact of $292 billion.[80]

- **<u>Trade Deficit.</u>** The proposed exports are expected to result in a $5 billion annual average decrease in the U.S. balance of trade deficit, or a cumulative impact of $114.4 billion.[81]

Based on the ICF Report (as well as the 2012 LNG Export Study), Cameron LNG argues that the proposed exports from the Expansion Project will provide numerous public interest benefits over the course of many years.[82]

VI. DOE/FE'S LNG EXPORT STUDIES

A. 2012 LNG Export Study

On May 20, 2011, DOE/FE issued Order No. 2961, DOE/FE's first order conditionally granting a long-term authorization to export LNG produced in the lower-48 states to non-FTA countries.[83] By August 2011, with several other non-FTA export applications then pending before it, DOE/FE determined that further study of the economic impacts of LNG exports was warranted to better inform its public interest review under section 3 of the NGA.[84] Accordingly,

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[79] *Id.* (citing ICF Report at 53).
[80] *Id.* (citing ICF Report at 50).
[81] *Id.* (citing ICF Report at 51).
[82] Cameron LNG also relies upon its existing non-FTA orders—specifically, DOE/FE Order Nos. 3391 and 3391-A in FE Docket No. 11-162-LNG. Cameron LNG points to the evidence it submitted in that proceeding, and DOE/FE's analysis of the public benefits associated with Cameron LNG's LNG exports from Trains 1-3, as set forth in those orders. Cameron LNG App. at 19.
[83] *Sabine Pass*, DOE/FE Order No. 2961, *supra* note 28.
[84] DOE/FE stated in *Sabine Pass* that it "will evaluate the cumulative impact of the [Sabine Pass] authorization and any future authorizations for export authority when considering any subsequent application for such authority." DOE/FE Order No. 2961, at 33.

DOE/FE engaged EIA and NERA Economic Consulting to conduct a two-part study of the economic impacts of LNG exports.[85]

First, in August 2011, DOE/FE requested that EIA assess how prescribed levels of natural gas exports above baseline cases could affect domestic energy markets. Using its National Energy Modeling System (NEMS), EIA examined the impact of two DOE/FE-prescribed levels of assumed LNG exports—equivalent to 6 Bcf/d and 12 Bcf/d of natural gas—under numerous scenarios and cases based on projections from EIA's 2011 *Annual Energy Outlook* (AEO 2011), the most recent EIA projections available at that time.[86] The new scenarios and cases examined by EIA included a variety of supply, demand, and price outlooks. EIA published its study, *Effect of Increased Natural Gas Exports on Domestic Energy Markets*, in January 2012.[87] EIA generally found that LNG exports will lead to higher domestic natural gas prices, increased domestic natural gas production, reduced domestic natural gas consumption, and increased natural gas imports from Canada via pipeline.

Second, DOE contracted with NERA to assess the potential macroeconomic impact of LNG exports by incorporating EIA's then-forthcoming case study output from the NEMS model into NERA's general equilibrium model of the U.S. economy. NERA analyzed the potential macroeconomic impacts of LNG exports under a range of global natural gas supply and demand scenarios, including scenarios with unlimited LNG exports. DOE published the NERA Study, *Macroeconomic Impacts of LNG Exports from the United States*, in December 2012 (NERA Study). Among its key findings, NERA projected that the United States would gain net

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[85] *See* 2012 LNG Export Study, 77 Fed. Reg. 73,627 (Dec. 11, 2012), *available at*: http://energy.gov/sites/prod/files/2013/04/f0/fr_notice_two_part_study.pdf (Notice of Availability of the LNG Export Study).

[86] The Annual Energy Outlook (AEO) presents long-term projections of energy supply, demand, and prices. It is based on results from EIA's NEMS model.

[87] *See* LNG Export Study – Related Documents, *available at*: http://energy.gov/fe/downloads/lng-export-study-related-documents (EIA Analysis (Study - Part 1)).

economic benefits from allowing LNG exports. For every market scenario examined, net economic benefits increased as the level of LNG exports increased.

In December 2012, DOE/FE published a Notice of Availability (NOA) of the EIA and NERA studies (collectively, the 2012 LNG Export Study or Study).[88] DOE/FE invited public comment on the Study, and stated that its disposition of the then-pending non-FTA LNG export applications would be informed by the Study and the comments received in response thereto.[89] DOE/FE received over 188,000 initial comments and over 2,700 reply comments, of which approximately 800 were unique.[90] The comments were posted on the DOE/FE website and entered into the public records of the 15 LNG export proceedings identified in the NOA.[91] DOE/FE responded to those public comments in connection with the LNG export proceedings identified in the NOA.[92]

B. 2014 EIA LNG Export Study, *Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets*

1. Methodology

DOE/FE asked EIA to evaluate the impact of increased natural gas demand, reflecting possible exports of U.S. natural gas, on domestic energy markets using the modeling analysis presented in AEO 2014 as a starting point. DOE/FE requested an assessment of how specified scenarios of increased exports of LNG from the lower-48 states could affect domestic energy

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[88] 77 Fed. Reg. at 73,627.
[89] *Id*. at 73,628.
[90] Because many comments were nearly identical form letters, DOE/FE organized the initial comments into 399 docket entries, and the reply comments into 375 entries. *See* http://www.fossil.energy.gov/programs/gasregulation/authorizations/export_study/export_study_initial_comments.html (Initial Comments – LNG Export Study) & http://www.fossil.energy.gov/programs/gasregulation/authorizations/export_study/export_study_reply_comments.html (Reply Comments – LNG Export Study).
[91] *See* 77 Fed. Reg. at 73,629 & n.4.
[92] *See, e.g.*, *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 3792, at 66-121 (Mar. 11, 2016).

markets, focusing on consumption, production, and prices. At DOE/FE's request, EIA assumed three LNG export scenarios, including exports of:

- 12 Bcf/d, phased in at a rate of 2 Bcf/d each year beginning in 2015;
- 16 Bcf/d, phased in at a rate of 2 Bcf/d each year beginning in 2015; and
- 20 Bcf/d, phased in at a rate of 2 Bcf/d each year beginning in 2015.

EIA noted that the ramp-up specified by DOE/FE for these scenarios is extremely aggressive and intended to provide results that show an outer envelope of domestic production and consumption responses that might follow from the approval of exports beyond 12 Bcf/d. Accordingly, EIA also included a 20 Bcf/d export scenario, applied to the AEO 2014 Reference case, with a delayed ramp-up to identify the impact of higher LNG exports implemented at a slower pace, referred to as the "Alt 20 Bcf/d scenario."

DOE/FE requested that EIA consider the above scenarios in the context of baseline cases from EIA's AEO 2014. These five cases are:

- The AEO 2014 Reference case;
- The High Oil and Gas Resource (HOGR) case, which reflects more optimistic assumptions about domestic natural gas supply than the Reference case;
- The Low Oil and Gas Resource (LOGR) case, which reflects less optimistic assumptions about domestic oil and natural gas supply than the Reference case;
- The High Economic Growth (HEG) case, in which the U.S. gross domestic product grows at an average annual rate 0.4 percentage points higher than in the Reference case, resulting in higher domestic energy demand; and
- The Accelerated Coal and Nuclear Retirements (ACNR) case, in which higher costs for running existing coal and nuclear plants result in accelerated capacity retirements and greater reliance on natural gas to fuel electricity generation than in the Reference case.

Taken together, the four scenarios and five cases presented 16 case scenarios:

Table 2: Case Scenarios Considered By EIA in Analyzing Impacts of LNG Exports

	AEO 2014 Cases	Export Scenarios
1	Reference	12 Bcf/d
2	Reference	16 Bcf/d
3	Reference	20 Bcf/d
4	Reference	Alt 20 Bcf/d
5	HOGR	12 Bcf/d
6	HOGR	16 Bcf/d
7	HOGR	20 Bcf/d
8	LOGR	12 Bcf/d
9	LOGR	16 Bcf/d
10	LOGR	20 Bcf/d
11	HEG	12 Bcf/d
12	HEG	16 Bcf/d
13	HEG	20 Bcf/d
14	ACNR	12 Bcf/d
15	ACNR	16 Bcf/d
16	ACNR	20 Bcf/d

EIA used the five AEO 2014 cases described above as the starting point for its analysis and made several changes to represent the export scenarios specified in the study request. EIA exogenously added LNG exports from the lower-48 states in its model runs, using the NEMS model, to reach the targeted LNG export levels.

The Mid-Atlantic and South Atlantic regions were each assumed to host 1 Bcf/d of LNG export capacity, the Pacific region was assumed to host 2 Bcf/d, with all of the remaining Lower 48 states' export capacity hosted along the Gulf Coast in the West South Central Census division. In addition to the volume of natural gas needed to satisfy the levels of LNG exports defined in the scenarios, a supplemental volume of gas is required in order to liquefy natural gas for export as LNG. EIA assumed that this volume would equal 10 percent of the LNG export volume. The additional natural gas consumed during the liquefaction process is counted as fuel use within the U.S. region where liquefaction occurs.

As in AEO 2014, U.S. natural gas pipeline imports and exports and U.S. LNG imports are endogenously determined in the model. However, LNG exports out of Alaska were set exogenously to the projected level from the corresponding baseline cases.

One further modeling change was applied only in export scenario runs using the Accelerated Coal and Nuclear Retirements case. This case was included in the Study to reflect a baseline with high use of natural gas and low use of coal for electricity generation that is driven by factors other than favorable natural gas supply conditions and low natural gas prices, which are considered in the High Oil and Gas Resource case. In order to represent a situation in which increased coal generation is not an available response to higher domestic natural gas prices, coal-fired generation was not allowed to rise above the Accelerated Coal and Nuclear Retirements baseline level when the DOE/FE export scenarios were implemented.

2. Scope of EIA Study

The EIA Study recognizes that projections of energy markets over a 25-year period are highly uncertain, and that many events—such as supply disruptions, policy changes, and technological breakthroughs—cannot be foreseen. Other acknowledged limitations on the scope of the EIA Study include:

- NEMS is not a world energy model and does not address the interaction between the potential for additional U.S. natural gas exports and developments in world natural gas markets;
- Global natural gas markets are not fully integrated, and their nature could change substantially in response to significant changes in natural gas trading patterns. Future opportunities to profitably export natural gas from the United States depend on the future of global natural gas markets, the inclusion of relevant terms in specific contracts to export natural gas, and the assumptions in the various cases analyzed;
- Given its focus on the domestic energy system, NEMS does not fully account for interactions between energy prices and the global economy that could benefit the U.S. economy; and

- Measures of domestic industrial activity in NEMS are sensitive to both the composition of final U.S. demand and changes in domestic energy prices. However, NEMS does not account for the impact of domestic and global energy price changes on the global utilization pattern for existing manufacturing capacity or the siting of new capacity inside or outside of the United States in energy-intensive industries.

3. Results of the 2014 EIA LNG Export Study

EIA generally found that LNG exports will lead to higher domestic natural gas prices, increased domestic natural gas production, reduced domestic natural gas consumption, and higher levels of economic output (as measured by real gross domestic product or GDP). The impacts of exports, according to EIA, are as follows:

Increased natural gas prices. EIA stated that larger export levels would lead to larger domestic price increases. Percentage changes in delivered natural gas prices would be lower than percentage changes in producer prices, particularly for residential and commercial customers.

Increased natural gas production and supply. Increased exports would result in increased natural gas production that would satisfy 61 to 84 percent of the increase in natural gas exports, with a minor additional contribution from increased imports from Canada. Across most cases, EIA states that about three-quarters of this increased production would come from shale sources.

Decreased natural gas consumption. Due to higher prices, EIA projects a decrease in the volume of natural gas consumed domestically. EIA states that the electric power generation mix would shift toward other generation sources, including coal and renewable fuels. EIA indicates that there also would be a small reduction in natural gas use in all sectors from efficiency improvements and conservation.

<u>Increased levels of GDP.</u> EIA states that increased energy production would spur investment, which would more than offset the adverse impact of somewhat higher energy prices. GDP increases would range from 0.05 to 0.17 percent and generally increase with the amount of added LNG exports.

4. Increased Natural Gas Prices

EIA found that natural gas prices would increase generally across all of the export scenarios, with the greatest impact during the first 10 years when LNG exports are ramping up. The smallest price change over the baseline occurs in the High Oil and Gas Resource case. The Low Oil and Gas Resource case yields the largest price response.

EIA notes that the percentage changes in producer natural gas prices and delivered prices to customers compared to the AEO 2014 Reference case baseline would vary, but would be relatively modest. Prices paid to producers would increase from 4 to 11 percent under the 12 and 20 Bcf/d scenario, respectively, while prices paid by residential customers would rise even less—from 2 to 5 percent under the 12 and 20 Bcf/d scenarios.

5. Increased Natural Gas Production and Supply

EIA projected that most of the additional natural gas needed for export would be provided by increased domestic production with a minor contribution from increased pipeline imports from Canada. The remaining portion of the increased export volumes would be offset by decreases in consumption resulting from higher prices associated with the increased exports.

6. Decreased Domestic Natural Gas Consumption

EIA projected that greater export levels would lead to decreases in domestic natural gas consumption. This decrease would occur largely within the electric power sector. EIA projected that over the 2015-40 period, the decline in natural gas consumption from electric power generators, on average, contributes from 10 to 18 percent to the levels of natural gas needed for the increased LNG export demands, across all cases and scenarios. The Study noted that the trade-off in natural gas-fired generation and generation from competing fuels varies depending on the case, and generally depends on the generation fuel mix in the base scenarios.

7. Energy-Related Carbon Dioxide Emissions

EIA projected that the use of natural gas to provide energy for added liquefaction, combined with the displacement of natural gas by more carbon-intensive fuels in end-use sectors, causes an increase in U.S. CO_2 emissions over the analysis period in most pairings of export scenarios and baselines. The Study noted that the increased use of coal in the electric power sector and the increased use of liquids in the industrial sector generally result in a net increase in CO_2 emissions. The Study also noted that, despite the CO_2 emission increases projected in the LNG export scenarios, energy-related CO_2 emissions remain below the 2005 level in each year of the projection period across all pairings of scenarios and baselines.

EIA's analysis did not include the U.S. Environmental Protection Agency's (EPA) Transport Rule,[93] as it had been vacated at the time, or other proposed EPA rulemakings.[94] EIA also did not analyze global CO_2 emissions or life cycle emissions. DOE looked at these latter issues in a separate analysis—the LCA GHG Report, discussed below in Section IX.

8. Increased End-User Natural Gas and Electricity Delivered Prices

EIA projected increased total end-use energy expenditures across the range of LNG export scenarios and baselines. Implementation of the 12 Bcf/d scenario under Reference case conditions is projected to increase total end-use energy expenditures by $9 billion per year, or

[93] U.S. Envtl. Prot. Agency, Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals; Final Rule, 76 Fed. Reg. 48,208 (Aug. 8, 2011).
[94] Legislation and regulations assumed for the 2014 Annual Energy Outlook and 2014 EIA Study are available at http://www.eia.gov/forecasts/archive/aeo14/section_legs_regs.cfm.

0.6 percent on average, from 2015-2040. For the 20 Bcf/d scenario, total end-use energy expenditures are projected to rise by $18 billion per year, or 1.3 percent on average, from 2015 to 2040. EIA projected that increased end-use expenditures on natural gas account for one-third of additional expenditures.

9. Increased Gross Domestic Product

EIA projected that increased LNG exports leads to higher economic output, as measured by real GDP, as increased energy production spurs investment. This higher economic output is enough to overcome the negative impact of higher domestic energy prices over the projection period. EIA projected that implementing the export scenarios specified for this Study increased GDP by 0.05 to 0.2 percent over the 2015-2040 period depending on the export scenario. The GDP gains from increasing LNG exports are positive across all cases, although relatively modest.

C. 2015 LNG Export Study, *The Macroeconomic Impact of Increasing U.S. LNG Exports*

The Center for Energy Studies at Rice University's Baker Institute and Oxford Economics (hereinafter, Rice-Oxford) were commissioned by Leonardo Technologies, Inc. (LTI) on behalf of DOE/FE to undertake a scenario-based assessment of the macroeconomic impact of alternative levels of U.S. LNG exports under a range of assumptions concerning U.S. resource endowment, U.S. natural gas demand, and the international market environment—referred to herein as the 2015 Study.

1. Overview of Rice-Oxford's Findings in the 2015 Study

The key findings of the 2015 Study include the following:

<u>Rising LNG exports are associated with a net increase in domestic natural gas production.</u> The 2015 Study finds that the majority of the increase in LNG exports is accommodated by expanded domestic production rather than reductions in domestic demand.

<u>As exports increase, the spread between U.S. domestic prices and international benchmarks narrows.</u> In every case, greater LNG exports raise domestic prices and lower prices internationally. The majority of the price movement (in absolute terms) occurs in Asia.

<u>The overall macroeconomic impacts of higher LNG exports are marginally positive, a result that is robust to alternative assumptions for the U.S. natural gas market.</u> With external demand for U.S. LNG exports at 20 Bcf/d, the impact of increasing exports from 12 Bcf/d is between 0.03 and 0.07 percent of GDP over the period of 2026–2040, or $7 to $20 billion annually in today's prices.

<u>An increase in LNG exports from the United States will generate small declines in output at the margin for some energy-intensive, trade-exposed industries.</u> The sectors that appear most exposed are cement, concrete, and glass, but the estimated impact on sector output is very small compared to expected sector growth to 2040.

<u>Negative impacts in energy-intensive sectors are offset by positive impacts elsewhere.</u> Other industries benefit from increasing U.S. LNG exports, especially those that supply the natural gas sector or benefit from the capital expenditures needed to increase production. This includes some energy-intensive sectors and helps offset some of the impact of higher energy prices.

2. Methodology

Rice-Oxford's analysis in the 2015 Study used a highly specialized, multi-stage modeling approach. First, the Rice World Gas Trade Model (RWGTM) was used to simulate various alternative futures for the global natural gas market.[95] These output data were input into the Oxford Economics Global Economic Model (GEM) and Global Industry Model (GIM) to simulate broad macroeconomic and sectors impacts of the various alternative paths for the global natural gas market.

According to Rice-Oxford, the 2015 Study analyzed a wide range of scenarios in order to establish conclusions that are not dependent on any particular set of starting conditions for the U.S. or international natural gas markets. The scenario assumptions fall along two core dimensions. In one dimension, Rice-Oxford considered different U.S. domestic market conditions regarding resources and domestic demand. In the other dimension, Rice-Oxford considered specific circumstances that result in different international demand pull for U.S.-sourced LNG for each domestic scenario. The domestic scenarios were:

- Reference domestic case;
- High Resource Recovery (HRR) case, which reflects a higher level of recoverable resource in the United States;
- Low Resource Recovery (LRR) case, which reflects a lower level of recoverable resource in the United States; and
- High Natural Gas Demand (Hi-D) case, which reflects a higher level of demand in the United States.

The international demand scenarios were:

- Reference international case;
- Global demand for U.S. LNG supports 12 Bcf/d of exports;
- Global demand for U.S. LNG supports 20 Bcf/d of exports but U.S. exports do not exceed 12 Bcf/d;

[95] The Rice World Gas Trade Model is an equilibrium global natural gas model, as described in Annex B of the 2015 LNG Study. The model has 290 regional demand areas that cover countries having 90 percent of the global energy demand, and 140 natural gas resource and production regions modeled on recent authoritative resource estimates.

- Global demand for U.S. LNG supports 20 Bcf/d of exports but U.S. exports do not exceed 20 Bcf/d; and

- Global demand for U.S. LNG supports 20 Bcf/d of exports and U.S. exports are endogenously determined by the RWGTM.

The table below outlines the approach.

Table 3: Rice-Oxford Study Scenarios

		Domestic Scenarios			
International Demand Scenarios		Reference	High Resource Recovery	Low Resource Recovery	High Natural Gas Demand
Reference		Ref_Ref	Ref_HRR	Ref_LRR	Ref_Hi-D
Global Demand for U.S. LNG Supports 12 Bcf/d		LNG12_Ref	LNG12_HRR	LNG12_LRR	LNG12_Hi-D
Global Demand for U.S. LNG Supports 20 Bcf/d	U.S. LNG Exports 12 Bcf/d	LNG20_Ref12	LNG20_HRR12	LNG20_LRR12	LNG20_Hi-D12
	U.S. LNG Exports 20 Bcf/d	LNG20_Ref20	LNG20_HRR20	LNG20_LRR20	LNG20_Hi-D20
	U.S. LNG Exports Endogenous	LNG20_Ref	LNG20_HRR	LNG20_LRR	LNG20_Hi-D

In general, when reading the case nomenclature in the table above, Rice-Oxford notes for a case "N1_N2X," N1 denotes the name of the international demand scenario, N2 denotes the domestic scenario, and X (either 12 or 20 Bcf/d) denotes the level of LNG exports that can occur from the United States based on the scenario. If X is not present, this means that the amount of LNG exports from the United States is fully endogenous to (*i.e.*, internally generated within) the scenario being considered.

3. Natural Gas Market Assumptions across International Demand Scenarios

Rice-Oxford constructed the scenarios of the 2015 Study to show sufficient international market opportunity to support commercially viable LNG exports from the United States in accordance with the volumes indicated in each case. Various assumptions are made about the international natural gas market so as to stimulate investment in the U.S. upstream sector and the commensurate development of LNG export infrastructure. These scenario assumptions primarily constrain alternative sources of global supply, such as foreign shale production or LNG capacity, to leave more global natural gas demand to be met by U.S. LNG. The Reference, Global Demand for U.S. LNG at 12 Bcf/d (LNG12), and Global Demand for U.S. LNG at 20 Bcf/d (LNG20) international demand scenarios adjust shale resource availability, pipeline, and LNG infrastructure expansion opportunities outside the United States, and natural gas demand in different countries. Table 4 below presents key assumptions used in the 2015 Study.

For U.S. LNG exports to reach 12 to 20 Bcf/d of natural gas, several unlikely developments in the global natural gas market were included in the 2015 Study. For example, accessible global shale resources were limited to 3,542 Tcf in the LNG20 Scenario compared to 8,407 Tcf in the Reference case. Other assumptions in Table 4 are equally drastic, such as assuming no foreign LNG export capacity comes online after 2020. Without significant assumptions of this magnitude, U.S. LNG exports in the Rice World Gas Trade Model would not reach the 12 or 20 Bcf/d export levels.

Table 4: Select Natural Gas Market Assumptions Across International Demand Scenarios

		Reference	LNG12	LNG20
Accessible Shale Resource (trillion cubic feet)	**World**	8,407	6,500	3,542
	Africa	1,918	1,918	0
	Asia and Pacific	2,107	1,075	90
	China	1,285	390	0
	Australia	529	529	90
	Europe	444	0	0
	South America	1,786	1,786	1,260
	North America	1,839	1,839	1,839
	US	829	829	829
	Canada	498	498	498
	Mexico	513	513	513
	Rest of World	314	86	0
LNG New Build Capability		No limits	Limited expansion capabilities in selected locations	Only U.S. has expansion capability beyond 2020
Pipeline New Build Capability		No limits	No future expansions of Central Asian pipelines to China	LNG12 plus existing Russia-China pipeline supply agreements dissolve
Demand		In all scenarios, a CO_2 trading platform is in place in Europe and the United States is assumed to retire 61 GWs of coal by 2030	Chinese gas demand rises in response to policies to limit coal use; Japanese nukes remain offline	LNG12 case plus CO_2 reduction protocols targeting coal use in India, Indonesia, South Korea, and a handful of other smaller coal consuming nations

4. The Rice World Gas Trade Model

The Rice World Gas Trade Model (or RWGTM) is used in the 2015 Study to investigate how various assumptions about international and domestic demand and resource availability could impact the U.S. natural gas market over the coming decades. The Rice World Gas Trade Model proves and develops resources, constructs and utilizes transportation infrastructure, and calculates prices to equate demands and supplies while maximizing the present value of producer profits within a competitive framework. New capital investments in production and delivery infrastructure thus must earn a minimum return for development to occur. The debt-equity ratio is allowed to differ across different categories of investment, such as proving resources, developing wellhead delivery capability, constructing pipelines, and developing LNG infrastructure. By developing supplies, pipelines, and LNG delivery infrastructure, the Rice World Gas Trade Model provides a framework for examining the effects of different economic and political influences on the global natural gas market within a framework grounded in geologic data and economic theory.

5. The Oxford Global Economic Model and Global Industry Model

Rice-Oxford stated that the Global Economic Model is the world's leading globally integrated macro model, used by over 100 clients around the world, including finance ministries, leading banks, and blue-chip companies. The Global Economic Model covers 46 countries, including the United States, Canada, the EU, and major emerging markets including China and India. The model provides a rigorous, consistent structure for analysis and forecasting, and allows the implications of alternative global scenarios and policy developments to be analyzed at both the macro and sector level.

The Global Economic Model is an error correction model, a form of a multiple time series model that estimates the speed at which a dependent variable returns to its equilibrium after a shock to one or more independent variables. Rice-Oxford noted that this form of model is useful as estimating both the short and long run effects of variables on the given variable in question. The Global Economic Model exhibits "Keynesian" features in the short run. Factor prices are sticky and output is determined by aggregate demand. In the long-run, its properties are Neoclassical, such that prices adjust fully, the equilibrium is determined by supply factors (productivity, labor and capital), and attempts to raise growth by boosting demand only lead to higher prices.

Linked to the Global Economic Model is the Global Industry Model. This model, based upon standard industrial classifications and updated quarterly, has a detailed breakdown of output by sector across 100 sectors and 67 countries. The model includes a particularly detailed breakdown in the manufacturing sector, covering eight key sectors: metals, chemicals, motor vehicles, engineering and metal goods, electronics and computers, textiles and clothing, aerospace, and other intermediate goods. The Global Industry Model generates forecasts for both gross output and gross value added (output excluding intermediate consumption).

6. Results of the 2015 LNG Export Study

In the 2015 Study, Rice-Oxford generally found that LNG exports will lead to: (i) increased domestic natural gas production, (ii) a narrowing of the spread between domestic prices and marginally positive international benchmarks, (iii) macroeconomic impacts, and (iv) small declines in output at the margin for some energy-intensive industries that are offset by positive impacts elsewhere.

Table 5 below indicates the level of U.S. LNG exports in the year 2040 for every case considered. The Rice World Gas Trade Model Reference International and Domestic Scenario (Ref_Ref case) has 6.38 Bcf/d of U.S. LNG exports in 2040. With the Reference International Demand Scenario and different Domestic Scenarios, U.S. LNG exports range from 5.20 Bcf/d to 6.74 Bcf/d.[96]

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[96] Additional explanation of the Ref_Ref case is provided in the 2015 LNG Export Study. The Study explains that, although U.S. LNG exports increase in the Ref_Ref case, the impact of U.S. LNG exports and other global supply developments on international domestic prices ultimately places a check on the total volume of U.S. LNG exports.

Table 5: U.S. LNG Exports in 2040 Across Cases (Bcf/d)

International Demand Scenarios		Domestic Scenarios: Reference	High Resource Recovery	Low Resource Recovery	High Natural Gas Demand
Reference		6.38	6.74	5.20	6.36
Global Demand for U.S. LNG Supports 12 Bcf/d		11.18	16.30	6.73	9.02
Global Demand for U.S. LNG Supports 20 Bcf/d	U.S. LNG Exports 12 Bcf/d	11.81	11.82	11.80	11.81
	U.S. LNG Exports 20 Bcf/d	18.82	19.74	*	*
	U.S. LNG Exports Endogenous	22.34	28.05	18.02	20.37

* The level of exports in these cases is the same as in the "U.S. LNG Exports Endogenous" cases.

The impacts of exports, according to Rice-Oxford, included:

Increase in domestic natural gas production. The 2015 Study found that the majority of the increase in LNG exports is accommodated by expanded domestic production rather than reductions in domestic demand. Domestic production continues to increase through the time horizon when LNG export volumes can expand to 20 Bcf/d of natural gas, rising 4 percent on average from 2026-2040.

As exports increase, the spread between U.S. domestic prices and international benchmarks narrows. In every case, greater LNG exports raise domestic prices and lower prices internationally. The majority of the price movement (in absolute terms) occurs in Asia.

Specifically, the price spreads in the international marketplace weaken to the point that full cost recovery of U.S. LNG export facilities currently under construction is compromised for about a decade. Although those facilities operate during that time period, further investment in LNG export capacity is stymied until global demand expands to stimulate new capital flows into the U.S. LNG export value chain. *See* 2015 LNG Export Study at 41.

The Japan Korea Marker (JKM) price declines in dollar terms by an amount that is roughly six times greater than the price increase at Henry Hub in the United States. Rice-Oxford states that this is the result of the international market conditions that are simulated in the LNG20 cases. Additionally, the LNG demand stimulus is primarily the result of highly constrained supply potentials plus higher demand in Asia. Although shale potential is also constrained in Europe in the LNG20 cases, the change relative to the Reference international case is small compared to the change in Asia.

Marginally positive overall macroeconomic impacts. This result is robust to alternative assumptions for the U.S. natural gas market. With external demand for domestically produced LNG exports at 20 Bcf/d of natural gas, the impact of increasing exports in excess of 12 Bcf/d is between 0.03 and 0.07 percent of GDP from 2026-2040, or $7 to $20 billion annually in today's prices. The 2015 Study detailed several key drivers of the macroeconomic impacts:

- ***U.S. LNG Production and Investment:*** When U.S. LNG exports rise to 20 Bcf/d from 12 Bcf/d, natural gas production is 4.0 percent higher in the domestic Reference case. This is associated with a rise in net fuel exports of just 0.02 percent of GDP over the period 2026–2040 and additional investment of 0.06 percent of GDP. There are positive multipliers from the extra production and investment, as activity is stimulated in the rest of the economy, and as a result total output is 0.1 percent higher from 2026–2040.

- ***U.S. Natural Gas Prices:*** The Henry Hub price is, on average, 4.3 percent higher in the 20 Bcf/d export case than the 12 Bcf/d case over the period 2026–2040. As noted above, higher gas prices dampen domestic consumption and erode U.S. export competitiveness. In total, higher prices reduce GDP by 0.1 percent from 2026–2040.

- ***U.S. Profits:*** Profits in the 20 Bcf/d export case are higher given the rise in prices, production and export volumes, but the scale of the impact is small relative to the size of GDP. Profits are 0.03 percent of GDP higher in the 20 Bcf/d case compared with the 12 Bcf/d case. The rise in profit is also modest because it is assumed U.S. producers receive the Henry Hub price on LNG exports rather than the price in the destination market. It assumed that 95 percent of profits are distributed to households and this results in a marginal increase in consumption and GDP from 2026–2040.

- ***Rest of World Natural Gas Production and Investment:*** Production in the rest of the world is little changed when U.S. LNG exports increase to 20 Bcf/d from 12 Bcf/d. Due to the Study's scenario assumptions, international demand conditions remain unchanged, and the addition of incremental U.S. LNG exports displaces very little supply from the rest of the world. As a result, capital expenditures by the natural gas sector in the rest of the world remain broadly unchanged when the United States increases LNG exports.

- ***Rest of World Natural Gas Prices:*** The increase in the availability of cheaper U.S. natural gas exports on the world market dampens natural gas price increases in Asia, though prices in Europe are little affected. The marginal decline in natural gas prices both boosts real income in the rest of the world—which boosts demand and is positive for U.S. exports—and boosts the competitiveness of Asian firms relative to U.S. companies, which is negative for U.S. exports. However, the small impact on gas prices and the relative unimportance of natural gas to total energy supply in Asia means that the impact on consumption in Asia is limited as is the competitiveness boost enjoyed by Asian firms from lower natural gas prices. As a result, the overall impact on U.S. GDP is limited.

Small declines in output at the margin for some energy-intensive, trade-exposed industries. The sectors that appear most exposed are cement, concrete, and glass, but the estimated impact on sector output is very small compared to expected sector growth to 2040.

Negative impacts in energy-intensive sectors are offset by positive impacts elsewhere. Other industries benefit from increasing U.S. LNG exports, especially those that supply the natural gas sector and/or benefit from the capital expenditures needed to increase production. This includes some energy-intensive sectors and helps offset some of the impact of higher energy prices.

VII. COMMENTS ON THE 2014 AND 2015 LNG EXPORT STUDIES AND DOE/FE ANALYSIS

DOE/FE published the Notice of Availability of the 2014 and 2015 LNG Export Studies in the *Federal Register* on December 29, 2015, seeking public comment on both studies. DOE/FE specifically invited comment on:

> [T]he potential impact of LNG exports on domestic energy consumption, production, and prices; the macroeconomic factors identified in the two studies, including Gross Domestic Product, consumption, U.S. economic sector analysis, and U.S. LNG export feasibility analysis; and any other factors included in the analyses.[97]

DOE noted that, "[w]hile this invitation to comment covers a broad range of issues, the Department may disregard comments that are not germane to the present inquiry."[98]

DOE/FE has reviewed the 38 comments submitted in response to the NOA. Of those, 14 comments opposed the two Studies and/or exports of LNG, 21 supported the Studies, and three took no position. Below, DOE/FE summarizes: (i) the pertinent arguments by topic, with reference to representative comments, and (ii) DOE/FE's basis for the conclusions that it drew in reviewing those comments. In so doing, DOE/FE has responded to the relevant, significant issues raised by the commenters.[99]

A. Data Inputs and Estimates of Natural Gas Demand

1. Comments

Several commenters, including Sierra Club, the Industrial Energy Consumers of America (IECA), Cascadia Wildlands, Wim de Vriend, and Hair on Fire Oregon, challenge the data used as inputs to the LNG Export Studies.[100] Specifically, these commenters assert that the 2015 LNG Export Study relies on inaccurate assumptions that fail to reflect "current conditions" adversely affecting the viability of exporting domestically produced LNG from the United States. Citing various articles and natural gas industry reports, these commenters point to the following conditions—some of which they acknowledge arose after the 2015 LNG Export Study

[97] 80 Fed. Reg. at 81,302.
[98] *Id.*
[99] *See, e.g.*, *Public Citizen v. F.A.A.*, 988 F.2d 186, 197 (D.C. Cir. 1993).
[100] Unless specifically noted, the comments address the 2015 LNG Export Study.

was published:

- An oversupplied global energy market due to the rapid expansion worldwide of LNG terminals ("supply glut"), which commenters allege will be the status quo for years to come;
- The drop in international oil prices, which allegedly has reduced or eliminated the price advantage for U.S. LNG exports;
- The difference in costs between greenfield and brownfield LNG projects and the associated risks to capital, given the alleged uncertainties associated with LNG exports;
- The declining costs of and advances in renewable energy sources, which allegedly will compete directly with U.S. LNG in end markets;
- Japan's re-starting of some of its nuclear power plants;
- The increasing prevalence of carbon trading regimes internationally (*e.g.*, China), making natural gas less of a viable energy source; and
- China's slowing economy.

According to Sierra Club and other commenters, these conditions undermine the assumptions and constraints of the 2015 LNG Export Study, calling into question the Study's conclusions that LNG exports will provide a slight benefit to GDP. Sierra Club further contends that, in light of these changing conditions, DOE should have revisited the 2012 LNG Export Study, rather than conducting new studies to analyze the marginal effects of higher LNG export volumes.

2. DOE/FE Analysis

We note that the 2015 LNG Export Study modeled a wide range of possible future supply and demand conditions, including alternative assumptions for domestic resource availability, domestic natural gas demand, and a range of international supply and demand conditions that generate different potential market pull for U.S. LNG exports. The 2015 Study scenarios were constructed so there was sufficient international demand to support commercially viable LNG export flows from the United States in accordance with the volumes indicated in each case. This approach allowed Rice-Oxford to assess the macroeconomic impacts of increased levels of U.S.

LNG exports under global market conditions where that trade would occur. The 2015 LNG Export Study found that "the overall macroeconomic impacts of higher LNG exports are marginally positive, a result that is robust to alternative assumptions for the U.S. natural gas market."[101] That is, the macroeconomic results are similar across the different scenarios examined. The energy market conditions noted by the commenters would, all else being equal, reduce international demand for U.S. LNG exports. The 2014 LNG Export Study included cases with levels of U.S. LNG exports below 20 Bcf/d, specifically 12 and 16 Bcf/d. The 2014 LNG Export Study found that "GDP gains from increasing LNG exports are positive across all cases, although relatively modest."[102]

We also take note of EIA's projections in AEO 2016 for natural gas supply, demand, and prices. The AEO 2016 Reference case incorporates the Clean Power Plan (CPP) final rule[103] and assumes that all states choose to meet a mass-based standard to cover both existing and new sources of carbon dioxide emissions. Although Reference case natural gas consumption for the year 2040 (the end of the forecast period in these Outlooks) was projected to increase by 7.6 Bcf/d between AEO 2014 and AEO 2016 (from 86.7 Bcf/d to 94.3 Bcf/d), total 2040 lower-48 domestic dry gas production was projected to increase by nearly twice that amount, increasing by 14.9 Bcf/d (from 99.7 Bcf/d to 114.6 Bcf/d). In addition, the projected 2040 Henry Hub price declined from $8.03 per million British thermal units (MMBtu) to $4.86/MMBtu (both prices in constant 2015 dollars), despite projected Reference case 2040 net exports (including both pipeline and LNG exports) rising from 15.9 Bcf/d in AEO 2014 to 20.7 Bcf/d in AEO 2016. As

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[101] 2015 Study at 8.
[102] 2014 Study at 25.
[103] U.S. Envtl. Protection Agency, Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule, 80 Fed. Reg. 64,662 (Oct. 23, 2015) (effective Dec. 22, 2015). On February 9, 2016, the U.S. Supreme Court issued a stay of the effectiveness of this rule pending review. *See Chamber of Commerce, et al. v. EPA, et al.*, Order in Pending Case, 577 U.S. ___ (2016).

described here, the AEO 2016 Reference case, even more so than the AEO 2014, projects robust domestic supply conditions that are more than adequate to meet domestic needs and supply exports.

B. Distributional Impacts

1. Gross Domestic Product (GDP)

a. Comments

Several commenters, including IECA, allege that any macroeconomic benefits from the 2015 LNG Export Study are likely overstated. Cascadia Wildlands, Sierra Club, and Hair on Fire Oregon, among others, allege that, in concluding that LNG exports would create a net benefit to the economy, the 2015 Study relied too heavily on the fact that exports will increase GDP while failing to give adequate weight to projected domestic natural gas price increases, foreign natural gas price decreases, and deleterious socio-economic, sectoral, and regional impacts on consumers, households, and the middle class, including wage-earners. Additionally, Cascadia Wildlands notes that the 2015 Study concludes that economic benefits associated with LNG exports are only “marginally positive,” and asserts that this margin is so small as to be within the margin of error for the Study’s calculations. IECA argues that the 2015 Study fails to account for the lost capital investment opportunity that would have occurred in the absence of LNG exports, as well as for the significant jobs that would have been created in the United States had it not been for higher natural gas prices, thus eliminating any “marginally positive” benefits associated with LNG exports.

Conversely, a number of other commenters, including API, Exxon Mobil Corporation, African American Environmentalist Association, William Shughart, Western Energy Alliance, and the City of Tulsa’s Office of the Mayor, assert that LNG exports will create jobs and boost the economy. For example, the African American Environmentalist Association states that a report by ICF International shows that LNG exports will result in a net gain in employment in the United States, and that the job impacts of LNG exports will grow larger as export volumes rise.

b. DOE/FE Analysis

The 2015 LNG Export Study analyzed the macroeconomic impacts of LNG exports in five areas. These are U.S. natural gas production and investment, U.S. natural gas prices, recycling of extra profits from the U.S. natural gas sector, changes to natural gas production and investment in the rest of the world, and international natural gas prices.[104] Although some commenters assert that the 2015 Study failed to give adequate weight to changes in natural gas prices, Rice-Oxford noted that the first two areas of impact—U.S. natural gas production and investment and U.S. natural gas prices—are the most significant for the United States and broadly offset each other.

The Studies found that increasing LNG exports from 12 Bcf/d to 20 Bcf/d could increase GDP by up to $20 billion. The 2015 Rice-Oxford Study found in its Reference domestic case (the 20 Bcf/d export case) that, in the long run, U.S. GDP was 0.03 percent higher on average ($7.7 billion annually in today's prices) over 2026-2040 than in the 12 Bcf/d export case.[105] The 2015 Study's result of GDP gains is consistent with the results of the EIA 2014 LNG Export Study. The 2014 EIA Study found that GDP increases across all cases "range from 0.05% to 0.17% and generally increase with the amount of added LNG exports required to fulfill an export scenario for the applicable baseline."[106] This equals an annual net increase to GDP of $12

[104] 2015 Study at 14.
[105] *See id*.
[106] 2014 Study at 12.

billion to $20 billion across the scenarios from the 2014 LNG Export Study.[107] These increases are significant, and the Studies project higher levels of employment with increased LNG exports.

2. Sectoral Impacts

a. Comments

Some commenters debate whether LNG exports will impact the domestic energy-intensive, trade-exposed (EITE) sectors disproportionately, at too high a cost to the U.S. economy to justify exporting LNG. Specifically, IECA and Citizens Against LNG assert that increasing LNG exports reduces the cost of natural gas to our global competitors and simultaneously increases the domestic cost of natural gas and electricity—negatively impacting EITE industries. According to these commenters, exporting LNG will drive up the price of natural gas for American consumers and manufacturers, eliminate jobs, and create a financial burden in an already stressed American economy. IECA further contends that the 2015 Study fails to include the "relative cost impact" to EITE industries, *i.e.*, "the combined impact of lower prices to our global competitors and higher prices domestically," and thus overstates the macroeconomic results associated with LNG exports. Stating that the 2015 Study fails to cite any studies on the price sensitivity of EITE industries, IECA also questions whether any research on EITE industries was conducted as part of the Study.

Other commenters, including API and ExxonMobil, dispute these arguments. They challenge the notion that an LNG export industry cannot co-exist with a growing domestic manufacturing base. API, ExxonMobil, and Golden Pass Products, LLC emphasize the size and productivity of the U.S. natural gas resource base, contending that there is an abundance of natural gas to support both LNG export demand and continued growth in the EITE industries.

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[107] *See id*. at 32 ("Gross Domestic Product" in 2005 U.S. dollars).

These commenters note that the vast supply of natural gas in the United States will continue to support current gains in domestic manufacturing, even as LNG exports take place. They also state that LNG exports will both sustain and increase domestic production of natural gas, which, in turn, will provide EITE industries with a greater supply of natural gas at more stable prices, allowing them to stay globally competitive.

Other commenters, such as John L. Rafuse, LNG Allies, and American Council for Capital Formation, maintain that there would be serious consequences to hindering the export of LNG. They state that, if exports are prohibited or constrained, the United States will lose economic benefits that other countries will capture as those countries begin extracting their shale gas resources and competing in the global LNG export market. Many commenters, including Institute for 21st Century Energy, Western Energy Alliance, API, and Golden Pass Products, LLC, similarly assert that it would not be in the public interest for DOE to limit LNG exports in contravention of U.S. free trade principles.

b. DOE/FE Analysis

With respect to the argument that natural gas confers greater value on the U.S. economy when used in manufacturing than when produced for export, we begin with the observation that more natural gas is likely to be produced domestically if LNG exports are authorized than if they are prohibited. There is no one-for-one trade-off between natural gas used in manufacturing and gas diverted for export. The competition between the demand for natural gas for domestic consumption and the demand for natural gas for export is captured in the modelling for the 2014 and 2015 Studies. In scenarios with increased levels of U.S. LNG exports, both Studies found that greater economic benefits, in terms of GDP, accrued to the U.S. economy due to those exports.

The 2015 Study used the Oxford Economics Global Industry Model (GIM) to model the impact of increased LNG exports on activity at the sector level. The Global Industry Model covers 100 sectors in 67 countries. In that model, forecasts for individual industries are driven by the macroeconomic forecast—consumption, investment, and exports—combined with detailed modeling of industry interactions, such as supply-chain linkages.[108] The 2015 Study presented sector-level impacts for energy-intensive sectors, including chemicals, basic metals and metal products, and non-metallic minerals (which, in turn, includes cement and glass).[109] The 2015 Study projected that the overall impact across sectors is small compared with the expected growth in sector output through 2040.

The 2015 Study noted that higher natural gas prices have a negative impact for energy-intensive manufacturing sectors, and some sectors (glass, cement, and chemicals) will see small declines in output with increased levels of LNG exports. Rice-Oxford found that these declines are "outweighed by gains in manufacturing industries that benefit from increased investment in the natural gas sector and increased construction activity, such as metals, as well as industry gains attributable to the increase in overall demand (*i.e.*, consumer products, food, etc.)."[110] As a result, "the manufacturing sector in aggregate is little impacted."[111] The 2014 Study found that natural gas price increases would initially challenge EITE industries, "but adverse impacts [would be] ameliorated as energy prices return to base levels and GDP begins to increase."[112]

With respect to the argument that some industries derive greater economic value from natural gas than others, we continue to be guided by the long-standing principle established in

[108] 2015 Study at 22.
[109] *Id*. at 68.
[110] *Id*. at 67.
[111] *Id*.
[112] 2014 Study at 26.

our Policy Guidelines that resource allocation decisions of this nature are better left to the market, rather than to DOE, to resolve.

3. Household and Distributional Impacts

a. Comments

Several commenters, including Sierra Club, IECA, Hair on Fire Oregon, Torrey Byles, Cascadia Wildlands, and Citizens Against LNG, maintain that, for most citizens, the macroeconomic benefits of LNG exports, if any, will be minimal. These commenters contend that the main beneficiaries of LNG exports will be a narrow band of the population, chiefly wealthy individuals in the natural gas industry, foreign investors, and those holding stock or having retirement plans invested in natural gas companies. They assert that, by contrast, a majority of Americans will experience negative economic impacts, such as higher gas and electric bills, without sharing in the benefits of the exports.

b. DOE/FE Analysis

The 2015 LNG Export Study analyzed the macroeconomic impacts of LNG exports in five areas. The 2015 Study projected that, for the economy as a whole, "the positive impacts of higher U.S. gas production, greater investment in the U.S. natural gas sector, and increased profitability of U.S. gas producers typically exceeds the negative impacts of higher domestic natural gas prices associated with increased LNG exports."[113]

As noted previously, DOE believes that the public interest generally favors authorizing proposals to export natural gas that have been shown to lead to net benefits to the U.S. economy. While there may be circumstances in which the distributional consequences of an authorizing decision could be shown to be so negative as to outweigh net positive benefits to the U.S.

[113] 2015 Study at 16.

economy as a whole, we do not see sufficiently compelling evidence that those circumstances are present here. None of the commenters advancing this argument has performed a quantitative analysis of the distributional consequences of authorizing LNG exports at the household level. Given the findings in the 2014 and 2015 Studies that exports will benefit the U.S. economy as a whole in terms of increased GDP, and absent stronger record evidence on the distributional consequences of authorizing the proposed exports, we cannot say that those exports are inconsistent with the public interest on these grounds.

4. Regional Impacts

a. Comments

Many commenters, including Oregon Wild and Harriett Heywood, address the issue of negative and positive regional impacts potentially associated with LNG exports. For example, Ninette Jones and Paula Jones assert that shale gas development and production will have a negative impact on local industries that is incompatible with extraction-related activities, such as agriculture and tourism. These commenters, along with Oregon Wild, identify specific ways in which they allege local communities near shale gas production areas, pipelines, and/or LNG export terminals could be adversely affected by increases in natural gas production and LNG exports. They cite property devaluation, degradation of infrastructure, environmental and public health issues, harm to local economies, and safety risks, among other issues.

Other commenters seek to rebut these concerns by identifying the positive regional benefits associated with LNG exports, both in regions where shale development and production occur, and the regions in which LNG export terminals may be located. The African American Environmentalist Association, the Small Business & Entrepreneurship Council, Women Impacting Public Policy, Our Energy Movement, Center for Liquefied Natural Gas, Sempra LNG, and Western Energy Alliance cite regional economic benefits associated with each LNG project, including the potential for new jobs, substantial direct and indirect business income, and millions of dollars in new tax revenue. Jordan Cove Energy Project, L.P., affirms the positive regional befits associated with LNG exports, but contends that the 2014 and 2015 LNG Export Studies fail to consider these positive regional impacts to the disadvantage of pending LNG projects subject to review by DOE/FE.

b. DOE/FE Analysis

We agree with the commenters who contend that a general consideration of regional impacts is outside of the scope of the 2014 and 2015 LNG Export Studies, and that regional impacts are appropriately considered by DOE/FE on a case-by-case basis during the review of each LNG export application. We note, however, that the Application in this proceeding is unopposed.

C. Estimates of Domestic Natural Gas Supplies

1. Comments

Clarence Adams and other commenters assert that, in addition to underestimating the demand for domestically produced natural gas, the 2015 Study overestimates future domestic supplies of natural gas. Mr. Adams contends that several factors may limit domestic supplies of natural gas, including: (i) new sources of LNG coming online internationally, (ii) increasing resistance to hydraulic fracturing in the United States, and (iii) the shorter-than-expected productivity of shale gas wells. According to these commenters, lower than estimated supplies of natural gas will exacerbate the likely price increases due to exports.

Contrary to these arguments, many commenters, such as API, the City of Tulsa’s Office of the Mayor, Tara Shumata Lee, and Triana Energy, LLC, argue that the United States has abundant domestic natural gas reserves.

Other commenters, such as Oregon Wild, Torrey Byles, and Sierra Club, contend that, to become energy independent, the United States must preserve its supplies of finite domestic energy resources, not export them. They argue that authorizing LNG exports will hasten the depletion of this country's natural gas resource base. In their view, investment in LNG exports will take away from potential investment in renewable energy supplies, compounding this country's dependency on fossil fuels.

2. DOE/FE Analysis

a. Measures of Supply

Before turning to a consideration of the specific comments, it is important to note the various measures of natural gas supply. DOE/FE notes that, by three measures of supply, there are adequate natural gas resources to meet demand associated with the requested authorization. Because these supply estimates have changed over time, however, DOE/FE will continue to monitor them to inform future decisions. These estimates include:

i) AEO natural gas estimates of production, price, and other domestic industry fundamentals. The AEO 2016 Reference case projection of dry natural gas production in 2035 increased significantly (by 37.3 Bcf/d) as compared with AEO 2011, while projections of domestic natural gas consumption in 2035 also increased in AEO 2016 compared with AEO 2011 (by 16.6 Bcf/d). Even with higher production and consumption, the 2035 projected natural gas market price in the Reference case declined from $7.72/MM Btu (2015$) in AEO 2011 to $4.91/MM Btu (2015$) in AEO 2016. The implication of the latest EIA projections in AEO 2016 is that a greater quantity of natural gas is projected to be available at a lower cost than estimated five years ago.

ii) Proved reserves of natural gas. Proved reserves of natural gas have been increasing. Proved reserves are those volumes of oil and natural gas that geologic and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. The R/P ratio measures the number of years of production (P) that proved reserves (R) represent at current production rates. Typically industry maintains proved reserves at about 10 years of production, but as Table 6 below demonstrates, reserves have increased from 9.2 years of production in 2000 to 13.9 years of production in 2014, the latest year statistics are available. Of particular note is that, since 2000, proved reserves have increased 108 percent to 368,704 Bcf, while production has increased only 38 percent, demonstrating the growing supply of natural gas available under existing economic and operating conditions.

Table 6: U.S. Dry Natural Gas Proved Reserves[114]

	Proved Reserves (R)		**U.S. Dry Natural Gas Estimated Production (P)**		
Year	**(Bcf)**	**Percent change versus year 2000**	**(Bcf)**	**Percent change versus year 2000**	**R/P Ratio - Years**
2000	177,427	--	19,219	--	9.2
2005	204,385	15	18,458	-4	11.1
2010	304,625	72	22,239	16	13.7
2014	368,704	108	26,611	38	13.9

iii) Technically recoverable resources (TRR). Technically recoverable resources have also increased significantly. Technically recoverable resources are resources in accumulations producible using current recovery technology but without reference to economic profitability. They include both proved reserves and unproved resources.[115]

[114] EIA, *U.S. Dry Natural Gas Proved Reserves* (May 18, 2016), *available at* http://www.eia.gov/dnav/ng/ng_enr_dry_dcu_nus_a.htm (additional calculations conducted to produce percentage change and R/P ratios).

[115] Unproved resources are generally less well known and therefore less precisely quantifiable than proved reserves, and their eventual recovery is less assured.

DOE/FE notes that EIA's estimates of lower-48 natural gas TRR have increased from 1,816 Tcf in AEO 2010 to 1,996 Tcf in AEO 2015.[116] EIA notes that these levels represent the starting values for the model, and that assumed future technological improvements in the model add to the TRR while production subtracts from the TRR.

b. Supply Impacts

The 2014 and 2015 Studies each conclude that, for the period of the analysis, the United States is projected to have ample supplies of natural gas resources that can meet domestic needs for natural gas and the LNG export market. Additionally, most projections of domestic natural gas resources extend beyond 20 to 40 years. While not all TRR is currently economical to produce, it is instructive to note that EIA's recent estimate of TRR equates to nearly 83 years of natural gas supply at the 2015 domestic consumption level of 27.47 Tcf. Moreover, given the supply projections under each of the above measures, we find that granting the requested authorization is unlikely to affect adversely the availability of natural gas supplies to domestic consumers such as would negate the net economic benefits to the United States.

We further find that, given these estimates of supply, the projected price increases and increased price volatility that could develop in response to a grant of the requested LNG export authorization are not likely to negate the net economic benefits of the exports. This issue is discussed below. With regard to the adequacy of supply, however, it bears noting that while certain commenters contend that U.S. natural gas production would not be able to meet unlimited LNG exports and domestic demand, the 2015 Study supports a different conclusion. The 2015

[116] *See* U.S. Energy Information Administration, *Assumptions to the Annual Energy Outlook 2015* (Sept. 2015), Table 9.2. Technically recoverable U.S. dry natural gas resources as of January 1, 2013, at 130, *available at*: http://www.eia.gov/forecasts/aeo/assumptions/pdf/0554(2015).pdf and U.S. Energy Information Administration, *Assumptions to the Annual Energy Outlook 2010* (Apr. 2010), Table 9.2. Technically recoverable U.S. natural gas resources as of January 1, 2008, at 111, *available at*: http://www.eia.gov/oiaf/aeo/assumption/pdf/0554(2010).pdf. The latest reserve assumptions for the 2016 AEO have not been published as of the issuance of this Order.

Study included scenarios in which LNG exports were unconstrained. Should the U.S. resource base be less robust and more expensive than anticipated, U.S. LNG exports would be less competitive in the world market, thereby resulting in lower export levels from the United States. By way of example, the 2015 Study modeled a number of low resource recovery scenarios, which had U.S. resources that were less robust and more expensive than other cases. In these low resource recovery scenarios, U.S. wellhead natural gas prices were driven up by higher production costs, and prices increased to a level that lowered demand for exports compared to the Reference case. In other unconstrained cases evaluated with the high resource recovery scenarios, domestic natural gas production was able to keep up with the increased demand for U.S. LNG exports compared to the Reference case. In all of these cases, the supply and price response to LNG exports did not negate the net economic benefit to the economy from the exports.

c. Supply Impacts Related to Renewable Energy Sources

To the degree that natural gas prices may increase, alternative sources of energy will become more attractive to consumers and investors. Accordingly, the 2014 Study forecasts increases in electricity from renewable energy resources across the LNG export cases over the 2015-2040 timeframe. Therefore, we do not agree with the suggestion that LNG exports would diminish investment in renewable energy.

Further, the 2014 and 2015 Studies did not evaluate the steps to become energy independent, as that was not part of the criteria evaluated. However, both Studies concluded that the United States has ample supplies of natural gas resources that can both meet domestic needs for natural gas *and* allow for participation in the LNG export market, without a significant impact on supplies or prices for the period of the analysis under the assumptions made.

D. Modeling the LNG Export Business

1. Comments

Several commenters, including Hair on Fire Oregon, Torrey Byles, Sierra Club, and Citizens Against LNG, contend that the 2015 LNG Export Study incorrectly assumed that the financing of investments in natural gas supplies for export and in the LNG export projects that will be used for export operations would originate from U.S. sources. These commenters assert that, in fact, a substantial portion of the investment is being made by foreign entities, and these foreign entities—not domestic corporations—will reap the benefits of export activity in the form of royalties, tolling fees, income, and tax proceeds from the resale of LNG overseas.

In addition, Clarence Adams contends that the 2015 Study misrepresents the amount of natural gas used by LNG terminals in the liquefaction process, which understates the demand associated with exports. He contends that any volumes used in the liquefaction process (approximately 10 percent of the export volume) should be considered domestic consumption.

2. DOE/FE Analysis

The 2014 and 2015 Studies did not discuss the impact of foreign investment. The 2015 Study concluded that the main path for positive impacts to GDP from increased U.S. LNG exports is through higher production and greater investment in the natural gas sector in the United States. These positive impacts are "due to the fact that most of any U.S. LNG exports would be made possible by increased extraction rather than the diversion of natural gas supplies."[117] The 2015 Study also noted that the model assumes U.S. producers receive the U.S. benchmark Henry Hub price on LNG exports rather than the price in the international destination

[117] 2015 Study at 83.

market.[118] The 2014 Study stated that "increased energy production spurs investment, which more than offsets the adverse impact of somewhat higher energy prices when export scenarios are applied."[119]

As for consideration of the natural gas consumed in the liquefaction process, both the 2014 and 2015 Studies assumed a consumption level equal to 10 percent of the natural gas feedstock, which is included in the models.

E. Cost of Environmental Externalities

1. Comments

Sierra Club, along with Citizens Against LNG, Hair on Fire Oregon, Cascadia Wildlands, Oregon Wild, Torrey Byles, MA Rohrer, and Harriet Heywood, maintain that LNG exports will increase demand for natural gas, thereby increasing negative environmental and economic consequences associated with natural gas production. These and other commenters assert that the 2015 Study failed to consider the cost of environmental externalities that would follow such exports. The externalities identified by these commenters include:

- Environmental costs associated with producing more natural gas to support LNG exports, including the costs, risks, and impacts associated with hydraulic fracturing and drilling to produce natural gas; and costs associated with increased water scarcity to support hydraulic fracturing, especially in the drought-stricken regions of the West Coast;

- Environmental costs associated with the life cycle of U.S. LNG (hydraulic fracturing of shale gas, liquefaction, and export) in the form of increased emissions of GHGs and other air pollutants, climate change, and local impacts such as ocean acidification;

- Local and regional costs associated with LNG exports, including impacts on local communities and industries;

[118] *Id.* at 64.
[119] 2014 Study at 12.

- The costs associated with eminent domain, which may be necessary to build new pipelines to transport natural gas;

- The costs of hazards associated with LNG developments, such as costs for police, fire, and security personnel overseeing LNG tanker deliveries; risks associated with LNG-related explosions; and threats related to natural disasters, terrorism, and disruption of LNG facilities, storage tanks, and related systems;

- The potential regulatory costs and impacts of environmental regulations governing hydraulic fracturing and natural gas drilling; and

- The social costs of carbon and methane associated with natural gas emissions.

2. DOE/FE Analysis

All environmental issues are discussed below. *See infra* §§ VIII, IX, X, XII.

F. Prices and Volatility

1. Natural Gas Price Volatility

a. Comments

Several commenters, such as IECA, Sierra Club, MA Rohrer, and Citizens Against LNG, address potential natural gas price volatility associated with LNG exports. They contend that there is little evidence that domestic natural gas price volatility will be reduced by LNG exports. Rather, they argue that increases in LNG exports will increase demand for natural gas, driving up prices in the United States and adversely affecting electric and natural gas utility consumers, EITE industries, and residential consumers.

Sierra Club, Citizens Against LNG, and Torrey Byles also assert that, as domestic natural gas prices rise due to LNG exports, some electric power companies will want to switch from gas-based to coal-based electric generation. However, because there is less coal-fired capacity to switch to, coal-fired options could be limited, which will drive natural gas prices higher than expected. In this regard, they state that the 2014 EIA Study indicates that increasing exports of

LNG will cause increased domestic coal use in all export scenarios, but fails to address or quantify the environmental impacts of this switch.

b. DOE/FE Analysis

Natural gas price volatility can be measured in terms of short term changes—daily or monthly volatility—or over longer periods. Short term volatility is largely determined by weather patterns, localized service outages, and other factors that appear unlikely to be affected substantially by DOE export authorization decisions. Moreover, the 2014 and 2015 Studies were long-term analyses covering a 25-year period, and thus were not intended to focus on short term shocks or volatility.

To the extent commenters are concerned about the risk of large upward price spikes sustained over longer periods, such as those that occurred in 2005 and 2008, we do not agree that LNG exports will necessarily exacerbate this risk. First, as noted above, when domestic wholesale gas prices rise above the LNG netback price, LNG export demand is likely to diminish, if not disappear altogether. Therefore, under some international market conditions, LNG export facilities are likely to make natural gas demand in the United States more price-elastic and less conducive to sustained upward spikes. Second, in light of our findings regarding domestic natural gas reserves explained above, we see no reason why LNG exports would interfere with the market's supply response to increased prices. In any capital intensive industry, investments are made based on observed and anticipated market signals. In natural gas markets, if prices or expected prices rise above the level required to provide an attractive return on investment for new reserves and production, industry will make that investment to capture the anticipated profit. These investments spur development of reserves and production and increase availability of natural gas, exerting downward pressure on prices. This is part of the normal business cycle that was captured in the 2014 and 2015 Studies. On balance, we are not persuaded that LNG exports are likely to increase substantially the volatility of domestic natural gas prices.

2. Linking the Domestic Price of Natural Gas to World Prices

a. Comments

Commenters, including IECA and Citizens Against LNG, argue that LNG exports could link domestic natural gas prices to the price of natural gas in the world market, and that this could exacerbate the potential increase in domestic natural gas prices as well as increase price volatility.

By contrast, API argues that natural gas prices will not rise to global prices because the market will limit the amount of U.S. natural gas that will be exported, since liquefaction, transportation, and regasification costs act as a cushion. API argues that, if this cushion disappears and the U.S. export price rises to the global LNG price, market forces will bring U.S. exports to a halt.

b. DOE/FE Analysis

The 2015 Study examined changes in three benchmark prices across the export scenarios: the Henry Hub price in the United States, the National Balancing Point (NBP) price in the United Kingdom, and the Japan Korea Marker (JKM) price. In general, the Henry Hub price rises as LNG exports increase, while the other benchmark prices decline. The 2015 Study stated that this is the result of allowing increased trade from the United States, thereby serving to relax the highly constrained supply situation internationally in the scenarios.[120] The 2015 Study presented the price spreads among JKM and Henry Hub and NBP and Henry Hub for all of the cases considered from 2015-2040. The JKM-Henry Hub price spread in 2040 ranges from $5 to over

[120] 2015 Study at 58.

$15 across the scenarios; the spread for NBP-Henry Hub in 2040 is roughly $3 to nearly $8.[121] The 2015 Study noted that the impact of LNG exports on the Henry Hub price depends on both domestic and international market considerations. For example, Henry Hub prices would rise with increased domestic demand for natural gas.

Additionally, prices for U.S. LNG would include the cost of inland transportation, liquefaction, shipping, and regasification. The 2015 Study's model assumed competition among different suppliers, such that buyers would have no incentive to buy natural gas from the United States if the delivered price after liquefaction and transportation is higher than the alternative delivered LNG price from other sources. DOE/FE agrees that a competitive market would behave in this manner and U.S. natural gas prices would be lower than international LNG prices in such a market by at least the costs previously described. Further, the introduction of LNG exported from the United States into the international market would tend to exert downward pressure on the prevailing higher delivered price for LNG in those foreign markets and could weaken the "oil-indexed" pricing terms.

For these reasons, we agree with those commenters who maintain that LNG exports from the United States will have difficulty competing with LNG exports from other countries unless domestic U.S. natural gas can be produced much cheaper. There is no evidence before us demonstrating that the prices of natural gas or LNG in the international market are more volatile than the prices in the U.S. domestic market.

VIII. DOE/FE ADDENDUM TO ENVIRONMENTAL REVIEW DOCUMENTS CONCERNING EXPORTS OF NATURAL GAS FROM THE UNITED STATES

On June 4, 2014, DOE/FE published the Draft Addendum for public comment. The purpose of the Addendum, DOE/FE explained, was to provide information to the public regarding

[121] *Id*. at 52.

the potential environmental impacts of unconventional natural gas production. Although not required by NEPA, DOE/FE prepared the Addendum in an effort to be responsive to the public and to provide the best information available on a subject that had been raised by commenters in this and other LNG export proceedings. The 45-day comment period on the Draft Addendum closed on July 21, 2014. DOE/FE received 40,745 comments in 18 separate submissions, and considered those comments in issuing the Addendum on August 15, 2014.[122] DOE provided a summary of the comments received and responses to substantive comments in Appendix B of the Addendum.[123] DOE/FE has incorporated the Draft Addendum, comments, and final Addendum into the record in this proceeding.

The Addendum focuses on the environmental impacts of unconventional natural gas production, which primarily includes production from shale formations, but also includes tight gas and coalbed methane production. DOE/FE elected to focus the Addendum on unconventional production because such production is considered more likely than other forms of production to increase in response to LNG export demand. EIA's 2012 Study, published as part of the LNG Export Study, projected that more than 90 percent of the incremental natural gas produced to supply LNG exports would come from these unconventional sources.[124]

Although the 2012 EIA Study made broad projections about the types of resources from which additional production may come, the Addendum stated that DOE cannot meaningfully estimate where, when, or by what particular method additional natural gas would be produced in response to non-FTA export demand. Therefore, the Addendum focuses broadly on

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[122] Addendum at 3.
[123] *Id*. at 79-151.
[124] *See* LNG Export Study – Related Documents, *available at* http://energy.gov/fe/services/natural-gas-regulation/lng-export-study (EIA 2012 Study) at 11 (total from shale gas, tight gas, and coalbed sources).

unconventional production in the United States as a whole, making observations about regional differences where appropriate.

The Addendum discusses several categories of environmental considerations—Water Resources, Air Quality, Greenhouse Gas, Induced Seismicity, and Land Use Impacts—each of which is summarized briefly below.

A. Water Resources

1. Water Quantity

Natural gas production from shale resources requires water at various stages of development, approximately 89 percent of which is consumed through the process of hydraulic fracturing.[125] The Addendum presents information regarding water usage for shale gas production both in comparison to other energy sources and other regional uses. Although production of natural gas from shale resources is more water-intensive than conventional natural gas production, it is substantially less water-intensive than many other energy sources over the long term after the well has been put into production. As shown in the Addendum, Table 7 below captures differences in water intensity across energy sources.

[125] Addendum at 10.

Table 7: Water Intensity[126]

Energy Source	Range in Water Intensity (gallons/mmBtu)
Conventional Natural Gas	~0
Shale Gas	0.6 – 1.8
Coal (no slurry transport)	2 – 8
Nuclear (uranium at plant)	8 – 14
Conventional oil	1.4 – 62
Oil Shale Petroleum (mining)	7.2 – 38
Oil Sands Petroleum (*in situ*)	9.4 – 16
Synfuel (coal gasification)	11 – 26
Coal (slurry transport)	13 – 32
Oil Sands Petroleum (mining)	14 – 33
Syn Fuel (coal Fischer-Tropsch)	41 – 60
Enhanced Oil Recovery	21 – 2,500
Fuel ethanol (irrigated corn)	2,500 – 29,000
Biodiesel (irrigated soy)	13,800 – 60,000

The Addendum also explains that, despite its relatively low long-term water intensity, shale gas production could impact water supply in specific areas, particularly arid regions such as the Eagle Ford Shale play in Texas. The Addendum notes that the relationship between shale gas production and water quantity is principally a local issue, and that the degree of impact depends on "the local climate, recent weather patterns, existing water use rates, seasonal fluctuations, and other factors."[127] The following Table 8 shows the variation in the proportion of water usage by activity in shale gas regions:

[126] *Id.* at 11 (Table 2).
[127] *Id.* at 12.

Table 8: Water Usage in Shale Gas Regions[128]

Play	Public Supply (%)	Industry & Mining (%)	Power Generation (%)	Irrigation (%)	Livestock (%)	Shale Gas (%)	Total Water Use (Bgals/yr)*
Barnett 1	82.7	4.5	3.7	6.3	2.3	0.4	133.8
Eagle Ford[2]	17	4	5	66	4	3 – 6	64.8
Fayetteville[1]	2.3	1.1	33.3	62.9	0.3	0.1	378
Haynesville[1]	45.9	27.2	13.5	8.5	4.0	0.8	90.3
Marcellus[1]	12.0	16.1	71.7	0.1	0.01	0.06	3,570
Niobrara[3]	8	4	6	82		0.01	1,280

[*Bgal/yr = billion gallons per year]

2. Water Quality

Observing that water quality concerns may have received more attention than any other aspect of unconventional natural gas production, the Addendum addresses water quality issues arising from four aspects of unconventional natural gas production: construction, drilling, use of hydraulic fracturing fluids, and handling of flowback and produced waters.

Runoff from the construction of access roads and other earth-disturbing activities can lead to temporary increases in turbidity and sedimentation in surface waters when well sites are being developed. However, the Addendum states that "when standard industry practices and preventative measures are deployed, only minor impacts are likely to result."[129]

Drilling in unconventional natural gas production requires penetrating shallower fresh water aquifers. Referring to NETL's *Modern Shale Gas Development in the United States: A Primer*, the Addendum briefly explains the manner in which such drilling can be undertaken to protect fresh water aquifers.[130] The Addendum acknowledges, however, that while unconventional natural gas formations are thousands of feet below aquifers associated with public

[128] *Id.* at 12 (Table 3) (citations omitted).
[129] *Id.* at 13.
[130] Addendum at 13-14 (citing GWPC and ALL Consulting. 2009. *Modern Shale Gas Develop. In the United States: A Primer.* Nat'l Energy Tech. Lab.; *available at*: http://www.netl.doe.gov/File%20Library/Research/Oil-Gas/Shale_Gas_Primer_2009.pdf).

water supply or surface hydrological connection, poor construction practices may cause failure of a casing or cement bond. This failure, in turn, could lead to potential contamination of an aquifer. The Addendum also observes that drilling may create connections with existing fractures or faults, or improperly plugged or abandoned wells, allowing contaminants to migrate through the subsurface.[131]

The fluid used for hydraulic fracturing consists of over 98 percent water, but also may include several different chemical compounds.[132] These compounds can vary from well to well based on site specific geological information. The Addendum describes federal and state efforts to gather information and require disclosure of the types of chemical additives being used in hydraulic fracturing. The risks posed by the use of these fluids may come from spills and leakages during transport to the well, storage on the well pad, or during the chemical mixing process.[133] Further, chemical additives may contaminate groundwater should the integrity of the casing or cement seal of the well be compromised.[134]

The Addendum considers the potential environmental impacts associated with produced water recovered during flowback operations. Produced water may contain elevated levels of total dissolved solids, salts, metals, organics, and natural occurring radioactive materials, as well as the chemicals included in the fracturing fluid noted above. The Addendum discusses the three principal ways of mitigating the impacts associated with produced water: minimization of the quantity of water used, recycling and re-use of produced water, and disposal.

Concluding its discussion of water resources, the Addendum observes that "[u]nconventional natural gas production, when conforming to regulatory requirements,

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[131] *Id.* at 14.
[132] *Id.* at 14-15.
[133] *Id.* at 18.
[134] *Id.*

implementing best management practices, and administering pollution prevention concepts, may have temporary, minor impacts to water resources."[135] Further, risks may arise when best practices are not employed: "[I]mproper techniques, irresponsible management, inadequately trained staff, or site-specific events outside of an operator's control could lead to significant impacts on local water resources."[136]

B. Air Quality

The Addendum discusses air pollutants emitted at different stages of the natural gas production process. These emissions and their sources are captured in Table 9 below:

Table 9: Source Categories of Airborne Emissions from Upstream Natural Gas Activities (EPA, 2013)[137]

	Type of Emissions	Sources of Emissions
Combustion Emissions	NO_x and carbon monoxide (CO) resulting from the burning of hydrocarbon (fossil) fuels. Air toxics, PM, un-combusted VOCs, and CH_4 are also emitted.	Engines, heaters, flares, incinerators, and turbines.
Vented Emissions	VOCs, air toxics, and CH_4 resulting from direct releases to the atmosphere.	Pneumatic devices, dehydration processes, gas sweetening processes, chemical injection pumps, compressors, tanks, well testing, completions, and workovers.
Fugitive Emissions	VOCs, air toxics, and CH_4 resulting from uncontrolled and under-controlled emissions.	Equipment leaks through valves, connectors, flanges, compressor seals, and related equipment and evaporative sources including wastewater treatment, pits, and impoundments.

[135] Addendum at 19.
[136] *Id.*
[137] *Id*. at 23 (Table 6).

The Addendum describes the existing regulatory framework relating to such emissions, as well as the U.S. Environmental Protection Agency's (EPA) 2012 New Sources Performances Standards for hydraulically fractured natural gas wells[138] and EPA's 2013 update to those standards covering storage tanks.[139] The Addendum also summarizes the existing literature on each significant category of air pollutant and describes the potential contribution of oil and gas production activities to ground-level ozone pollution and reduced visibility in sensitive areas.

The Addendum concludes its discussion of air quality by stating that natural gas development leads to both short- and long-term increases in local and regional air emissions, especially methane, VOCs, and hazardous air pollutants. According to the Addendum, the intermittent nature of air emissions from sources such as wells makes it difficult to analyze impacts at the regional level. As more data become available, a better understanding of trends in local and regional air quality and potential impacts may emerge.[140]

C. GHG Emissions

Separate from the LCA GHG Report described below, the Addendum includes a discussion of GHG emissions associated with unconventional natural gas production— principally methane and carbon dioxide. The Addendum describes the nature of GHG emissions from each phase of the production process, including: well drilling and completion; gas production; well re-completions, workovers, and maintenance; gas processing; and gas transmission and storage.

The Addendum also summarizes regulations affecting GHG emissions from upstream natural gas activity. As in the air quality section, the Addendum discusses EPA's 2012 New

[138] *Id*. at 20-22.
[139] *Id.* at 22.
[140] *Id*. at 32.

Source Performance Standards regulations. The Addendum also describes EPA's publication in April 2014 of five technical white papers on potentially significant sources of emissions in the oil and gas sector, including completions and ongoing production of hydraulically fractured oil wells, compressors, pneumatic valves, liquids unloading, and leaks.[141] EPA stated that it will use these white papers, along with input from peer reviewers and the public to determine how best to pursue emissions reductions from these sources, possibly including the development of additional regulations.[142]

Finally, the Addendum summarizes the existing literature estimating GHG emissions and methane leakage rates from the upstream natural gas industry, noting that most studies suggest that "emissions of GHGs from the upstream industry are of similar magnitude for both conventional and unconventional sources."[143]

D. Induced Seismicity

The Addendum provides information on induced seismicity across various types of energy resource activities, namely the production of natural gas, gas condensates, and oil from currently targeted unconventional plays. More specifically, it provides greater detail about the potential for induced seismicity from hydraulic fracturing and wastewater disposal via injection, which is one method of disposing of produced water. Because the duration of injection of hydraulic fracturing fluids is generally minutes or hours and the quantity of injected fluid is relatively low, the Addendum states that "the probability of injecting enough fluid into a natural fault to trigger a felt earthquake is low."[144] By contrast, the Addendum states that the "incidence of felt earthquakes is

[141] Addendum at 22 (*citing* U.S. Envtl. Prot. Agency, Office of Air Quality Planning & Standards, *White Papers on Methane and VOC Emissions, available at*: http://www.epa.gov/airquality/oilandgas/whitepapers.html) (released April 15, 2014).
[142] *Id.* at 44.
[143] *Id.* at 40.
[144] *Id.* at 51.

higher for wastewater disposal via wastewater injection wells because a large volume of water is injected over a longer period of time without any withdrawal of fluids, with the result that fluid pressures can be increased within a large area surrounding the injection well."[145] The Addendum identifies seismic events thought to have been triggered by wastewater disposal into injection wells in Oklahoma, Colorado, Arkansas, and Ohio.

Addressing the severity of seismic events induced by natural gas activities, the Addendum cites a 2013 National Research Council report characterizing the risk of induced seismicity as principally one of alarm to the public and minor property damage, as opposed to significant disruption.[146]

E. Land Use

The Addendum addresses potential land use impacts resulting from unconventional natural gas production. Land use impacts arise from the construction and development of new access roads, heavy truck traffic on existing local roadways, well pads, pipeline rights of way, and other structures such as compressor stations. The Addendum includes discussions of increased vehicle traffic, habitat fragmentation, reflective light pollution, noise, and other impacts associated with these land use changes. According to the Addendum, "[t]he real issue with land use impacts is not the minor impacts related to each well pad, access road, or pipeline."[147] Rather, "[w]hen the impacts from these individual components of shale gas development are considered in aggregate, or cumulatively, the impacts become magnified on an ecosystem or regional scale."[148] The Addendum identifies siting and design considerations that may minimize land use impacts, as well

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[145] *Id*. at 52.
[146] *Id* at 55-56 (citing *Induced Seismicity Potential in Energy Technologies*. National Research Council. The National Academies Press, Washington, D.C. (2013) at 5).
[147] Addendum at 62.
[148] *Id*.

as traffic and road way impacts associated with large vehicles and concerns for vehicular safety for the motoring public.

IX. DOE/FE LIFE CYCLE GREENHOUSE GAS PERSPECTIVE ON EXPORTING LIQUEFIED NATURAL GAS FROM THE UNITED STATES

A. Description of LCA GHG Report

In January 2014, DOE/FE commissioned NETL to undertake a study analyzing the life cycle emissions of greenhouse gases (GHG), including carbon dioxide (CO_2) and methane (CH_4), associated with natural gas produced in the United States and exported as LNG to other countries for use in electric power generation. The study was intended to inform DOE/FE's decision-making under NGA section 3(a) and to provide additional information to the public. The study—entitled *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States* (LCA GHG Report)—estimated the life cycle GHG emissions of domestically produced LNG (also referred to as U.S. LNG) exports to Europe and Asia, compared with alternative fuel supplies (such as regional coal and other imported natural gas), for electric power generation in the destination countries.

NETL published the LCA GHG Report on May 29, 2014, as well as a 200-page supporting document entitled, *Life Cycle Analysis of Natural Gas Extraction and Power Generation.*[149] On June 4, 2014, DOE/FE provided notice of the documents in the *Federal Register* and invited public comment.[150] The 45-day public comment period closed July 21, 2014. In this section, we

[149] *See* Dep't of Energy, Nat'l Energy Tech. Lab., *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States* (May 29, 2014), *available at:* http://energy.gov/fe/life-cycle-greenhouse-gas-perspective-exporting-liquefied-natural-gas-united-states; *see also* Dep't of Energy, Nat'l Energy Tech. Lab., *Life Cycle Analysis of Natural Gas Extraction and Power Generation* (May 29, 2014), *available at:* http://www.netl.doe.gov/energy-analyses/temp/NaturalGasandPowerLCAModelDocumentationNG%20Report_052914.pdf [hereinafter NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation*].

[150] Dep't of Energy, Notice of Availability of Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States and Request for Comment, 79 Fed. Reg. 32,260 (June 4, 2014). The NETL

summarize the scope of the LCA GHG Report, as well as its methods, limitations, and conclusions. Below, we summarize the public comments on the Report and respond to those comments. *See infra* § IX.B.

1. Purpose of the LCA GHG Report

The LCA GHG Report was designed to answer two principal questions:

- How does LNG exported from the United States compare with regional coal (or other LNG sources) used for electric power generation in Europe and Asia, from a life cycle GHG perspective?
- How do those results compare with natural gas sourced from Russia and delivered to the same European and Asian markets via pipeline?

In establishing this framework, NETL considered the following:

- In what countries will the natural gas produced in the United States and exported as LNG be used?
- How will the U.S. LNG be used in those countries, *i.e.*, for what purpose?
- What are the alternatives to using U.S. LNG for electric power generation in those countries?

Because the exact destination country (or countries) of U.S. LNG cannot be predicted for this study, NETL considered one medium-distance destination (a location in Europe) and one long-distance destination (a location in Asia). NETL chose Rotterdam, Netherlands, as the European destination and power plant location, and Shanghai, China, as the Asian location. NETL used other locations for the alternative sources of natural gas and coal, as specified in the Report. NETL also determined that one of the most likely uses of U.S. LNG is to generate electric power in the destination countries. In considering sources of fuel other than U.S. LNG, NETL assumed that producers in Europe and Asia could generate electricity in the following ways: (1) by

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documents and all comments received were placed in the administrative record for each of the 25 non-FTA export application dockets then before DOE/FE, including this docket. *See id*.

obtaining natural gas from a local or regional pipeline, (2) by obtaining LNG from a LNG producer located closer geographically than the United States, or (3) by using regional coal supplies, foregoing natural gas altogether.

Using this framework, NETL developed four study scenarios, identified below. To compare scenarios, NETL used a common denominator as the end result for each scenario: one megawatt-hour (MWh) of electricity delivered to the consumer, representing the final consumption of electricity. Additionally, NETL considered GHG emissions from all processes in the LNG supply chains—from the "cradle" when natural gas or coal is extracted from the ground, to the "grave" when electricity is used by the consumer. This method of accounting for cradle-to-grave emissions over a single common denominator is known as a life cycle analysis, or LCA.[151]

Using this LCA approach, NETL's objective was to model realistic LNG export scenarios, encompassing locations at both a medium and long distance from the United States, while also considering local fuel alternatives. The purpose of the medium and long distance scenarios was to establish likely results for both extremes (*i.e.*, both low and high bounds).

2. Study Scenarios

NETL identified four modeling scenarios to capture the cradle-to-grave process for both the European and Asian cases. The scenarios vary based on where the fuel (natural gas or coal) comes from and how it is transported to the power plant. For this reason, the beginning "cradle" of each scenario varies, whereas the end, or "grave," of each scenario is the same because the uniform goal is to produce 1 MWh of electricity. The first three scenarios explore different ways

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[151] The data used in the LCA GHG Report were originally developed to represent U.S. energy systems. To apply the data to this study, NETL adapted its natural gas and coal LCA models. The five life cycle stages used by NETL, ranging from Raw Material Acquisition to End Use, are identified in the LCA GHG Report at 1-2.

to transport natural gas; the fourth provides an example of how regional coal may be used to generate electricity, as summarized in Table 10 below:

Table 10: LCA GHG Scenarios Analyzed by NETL[152]

Scenario	Description	Key Assumptions
1	• Natural gas is extracted in the United States from the Marcellus Shale. • It is transported by pipeline to an LNG facility, where it is cooled to liquid form, loaded onto an LNG tanker, and transported to an LNG port in the receiving country (Rotterdam, Netherlands, for the European case and Shanghai, China, for the Asian case). • Upon reaching its destination, the LNG is re-gasified, then transported to a natural gas power plant.	The power plant is located near the LNG import site.
2	• Same as Scenario 1, except that the natural gas comes from a regional source closer to the destination. • In the European case, the regional source is Oran, Algeria, with a destination of Rotterdam. • In the Asian case, the regional source is Darwin, Australia, with a destination of Osaka, Japan.	Unlike Scenario 1, the regional gas is produced using conventional extraction methods, such as vertical wells that do not use hydraulic fracturing. The LNG tanker transport distance is adjusted accordingly.
3	• Natural gas is produced in the Yamal region of Siberia, Russia, using conventional extraction methods.[153] • It is transported by pipeline directly to a natural gas power plant in either Europe or Asia.	The pipeline distance was calculated based on a "great circle distance" (the shortest possible distance between two points on a sphere) between the Yamal district in Siberia and a power plant located in either Rotterdam or Shanghai.
4	• Coal is extracted in either Europe or Asia. It is transported by rail to a domestic coal-	This scenario models two types of coal widely used to generate

[152] The four scenarios are set forth in the LCA GHG Report at 2.
[153] Yamal, Siberia, was chosen as the extraction site because that region accounted for 82.6% of natural gas production in Russia in 2012.

	fired power plant.	steam-electric power: surface mined sub-bituminous coal and underground mined bituminous coal. Additionally, U.S. mining data and U.S. plant operations were used as a proxy for foreign data.

In all four scenarios, the 1 MWh of electricity delivered to the end consumer is assumed to be distributed using existing transmission infrastructure.

3. GHGs Reported as Carbon Dioxide Equivalents

Recognizing that there are several types of GHGs, each having a different potential impact on the climate, NETL normalized GHGs for the study. NETL chose carbon dioxide equivalents (CO_2e), which convert GHG gases to the same basis: an equivalent mass of CO_2. CO_2e is a metric commonly used to estimate the amount of global warming that GHGs may cause, relative to the same mass of CO_2 released to the atmosphere. NETL chose CO_2e using the global warming potential (GWP) of each gas from the 2013 Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) (IPCC, 2013). The LCA GHG Report applied the respective GWPs to a 100-year and a 20-year time frame.

4. Natural Gas Modeling Approach

NETL states that its natural gas model is flexible, allowing for the modeling of different methods of producing natural gas. For Scenario 1, all natural gas was modeled as unconventional gas from the Marcellus Shale, since that shale play reasonably represents new marginal gas production in the United States. For Scenarios 2 and 3, the extraction process was modeled after conventional onshore natural gas production in the United States. This includes both the regional LNG supply options that were chosen for this study (Algeria for Europe and

Australia for Asia) and extraction in Yamal, Siberia, for pipeline transport to the power plants in Europe and Asia.

In the above three natural gas scenarios, the natural gas is transported through a pipeline, either to an area that processes LNG (Scenarios 1 and 2) or directly to a power plant (Scenario 3). NETL's model also includes an option for all LNG steps—from extraction to consumption—known as an LNG supply chain. After extraction and processing, natural gas is transported through a pipeline to a liquefaction facility. The LNG is loaded onto an ocean tanker, transported to an LNG terminal, re-gasified, and fed to a pipeline that transports it to a power plant. NETL assumed that the natural gas power plant in each of the import destinations already exists and is located close to the LNG port.

The amount of natural gas ultimately used to make electricity is affected by power plant efficiency. Therefore, the efficiency of the destination power plant is an important parameter required for determining the life cycle emissions for natural gas power. The less efficient a power plant, the more gas it consumes and the more GHG emissions it produces per unit of electricity generated. For this study, NETL used a range of efficiencies that is consistent with NETL's modeling of natural gas power in the United States.[154] NETL also assumed that the efficiencies used at the destination power plants (in Rotterdam and Shanghai) were the same as those used in the U.S. model.

5. Coal Modeling Approach

NETL modeled Scenario 4, the regional coal scenario, based on two types of coal: bituminous and sub-bituminous. Bituminous coal is a soft coal known for its bright bands. Sub-bituminous coal is a form of bituminous coal with a lower heating value. Both types are widely

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[154] *See* LCA GHG Report at 4 (*citing* NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation*).

used as fuel to generate steam-electric power. NETL used its existing LCA model for the extraction and transport of sub-bituminous and bituminous coal in the United States as a proxy for foreign extraction in Germany and China. Likewise, NETL modeled foreign coal production as having emissions characteristics equivalent to average U.S. coal production. No ocean transport of coal was included to represent the most conservative coal profile (whether regionally sourced or imported).

The heating value of coal is the amount of energy released when coal is combusted, whereas the heat rate is the rate at which coal is converted to electricity by a power plant. Both factors were used in the model to determine the feed rate of coal to the destination power plant (or the speed at which the coal would be used). For consistency, this study used the range of efficiencies that NETL modeled for coal power in the United States. The study also assumed the same range of power plant efficiencies for Europe and Asia as the U.S. model.

6. Key Modeling Parameters

NETL modeled variability among each scenario by adjusting numerous parameters, giving rise to hundreds of variables. Key modeling parameters described in the LCA GHG Report include: (1) the method of extraction for natural gas in the United States, (2) methane leakage for natural gas production,[155] (3) coal type (sub-bituminous or bituminous),[156] (4) the flaring rate for natural gas,[157] (5) transport distance (ocean tanker for LNG transport, and rail for

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[155] The key modeling parameters for the natural gas scenarios are provided in Table 5-1 (LNG) and Table 5-2 (Russian natural gas). *See* LCA GHG Report at 6. The key parameters for natural gas extraction, natural gas processing, and natural gas transmission by pipeline are set forth in Tables 5-4, 5-5, and 5-6, respectively. *See id*. at 7-8.

[156] The modeling parameters and values for the coal scenarios are provided in Table 5-3. *See* LCA GHG Report at 6.

[157] Flaring rate is a modeling parameter because the global warming potential of vented natural gas, composed mostly of methane, can be reduced if it is flared, or burned, to create CO_2. *See id*. at 7.

coal transport),[158] and (6) the efficiency of the destination power plant.

For example, as shown in Table 5-1 of the LCA GHG Report, NETL used two different ranges for methane leakage rates for Scenarios 1 and 2: from 1.2 to 1.6% for natural gas extracted from the Marcellus Shale, and from 1.1 to 1.6% from gas extracted using conventional extraction methods. For Scenario 3 (the Russian cases), however, NETL used a higher range for methane leakage rates for both the European and Asian locations, in light of the greater pipeline distance from Russia.[159] As the pipeline distance increases, the total methane leakage from pipeline transmission also increases, as does the amount of natural gas that is extracted to meet the same demand for delivered natural gas. Notably, as part of the study, NETL conducted a methane leakage breakeven analysis to determine the "breakeven leakage" at which the life cycle GHG emissions for natural gas generated power would equal those for the coal Reference case (Scenario 3).[160]

In sum, NETL noted that the LCA study results are sensitive to these key modeling parameters, particularly changes to natural gas and coal extraction characteristics, transport distances, and power plant performance.[161] NETL also identified several study limitations based on the modeling parameters, including: (1) NETL's LCA models are U.S.-based models adapted for foreign natural gas and coal production and power generation, and (2) the specific LNG export and import locations used in the study represent an estimate for an entire region (*e.g.*, New Orleans representing the U.S. Gulf Coast).[162]

[158] The distances used for pipeline transport of Russian gas are provided in Table 5-2. *See id*. at 6.
[159] *See* LCA GHG Report at 5.
[160] The methane leakage breakeven analysis is described in the LCA GHG Report at 14 and 15.
[161] *See* LCA GHG Report at 5. To ensure that the study results were robust, NETL conducted several side analyses and sensitivity calculations, as discussed in the LCA GHG Report.
[162] The study limitations are described in the LCA GHG Report at 18.

7. Results of the LCA GHG Report

NETL states that two primary conclusions may be drawn from the LCA GHG Report.[163] First, use of U.S. LNG exports to produce electricity in European and Asian markets will *not* increase GHG emissions on a life cycle perspective, when compared to regional coal extraction and consumption for power production. As shown below in Figures 1 and 2, NETL's analysis indicates that, for most scenarios in both the European and Asian regions, the generation of power from imported natural gas has lower life cycle GHG emissions than power generation from regional coal.[164] (The use of imported coal in these countries will only increase coal's GHG profile.) Given the uncertainty in the underlying model data, however, NETL states that it is not clear if there are significant differences between the corresponding European and Asian cases other than the LNG transport distance from the United States and the pipeline distance from Russia.

[163] NETL's detailed study results, with corresponding figures, are set forth on pages 8 through 18 of the LCA GHG Report.

[164] Although these figures present an expected value for each of the four scenarios, NETL states that the figures should not be interpreted as the most likely values due to scenario variability and data uncertainty. Rather, the values allow an evaluation of trends only—specifically, how each of the major processes (*e.g.*, extraction, transport, combustion) contribute to the total life cycle GHG emissions. *See* LCA GHG Report at 8-9.

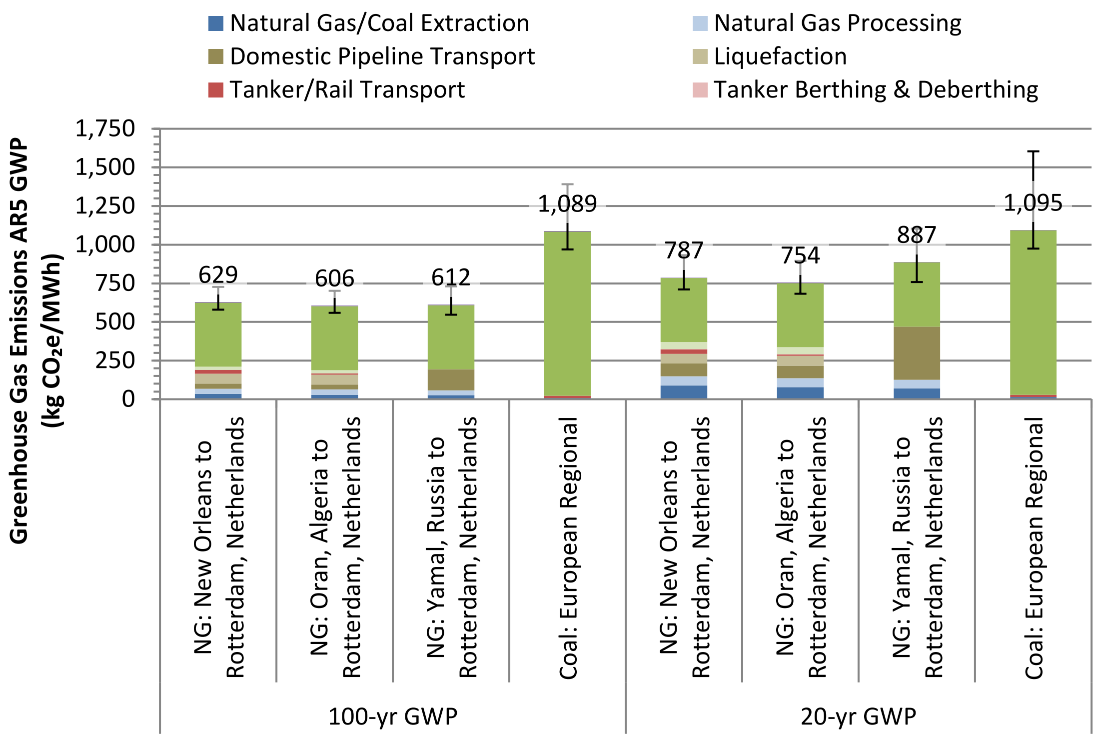

Figure 1: Life Cycle GHG Emissions for Natural Gas and Coal Power in Europe[165]

[165] LCA GHG Report at 9 (Figure 6-1).

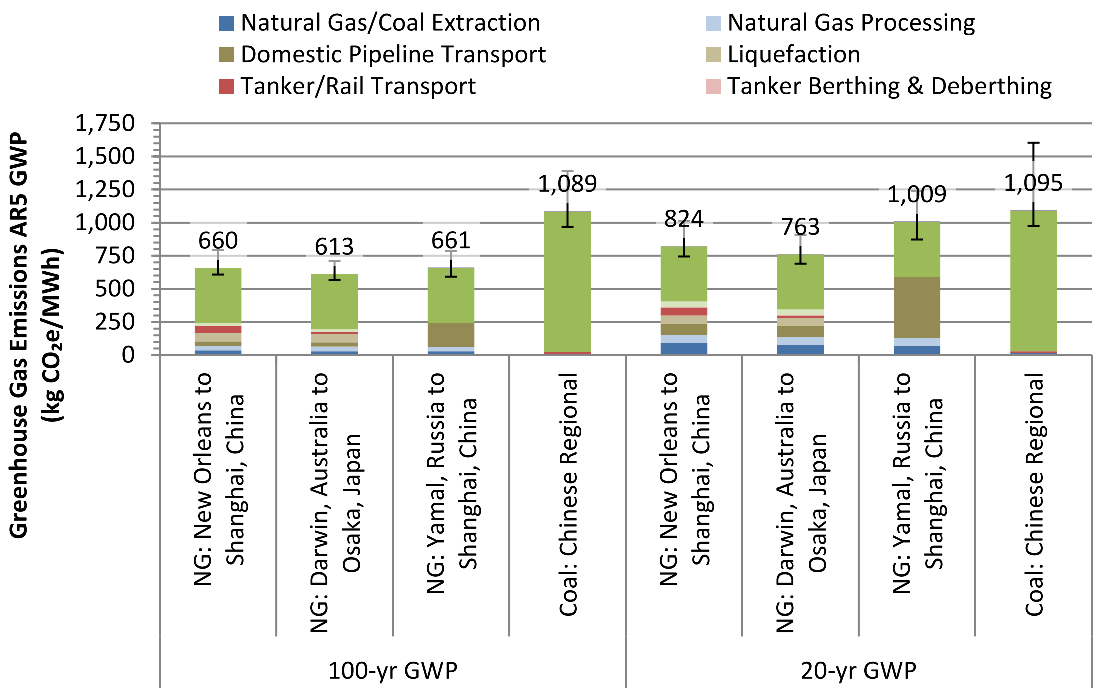

Figure 2: Life Cycle GHG Emissions for Natural Gas and Coal Power in Asia[166]

Second, there is an overlap between the ranges in the life cycle GHG emissions of U.S. LNG, regional alternative sources of LNG, and natural gas from Russia delivered to the European or Asian markets. Any differences are considered indeterminate due to the underlying uncertainty in the modeling data. Therefore, the life cycle GHG emissions among these sources of natural gas are considered similar, and no significant increase or decrease in net climate impact is anticipated from any of these three scenarios.

[166] LCA GHG Report at 10 (Figure 6-2).

B. Comments on the LCA GHG Report and DOE/FE Analysis

As discussed above, the LCA GHG Report compares life cycle GHG emissions from U.S. LNG exports to regional coal and other imported natural gas for electric power generation in Europe and Asia. Following the close of the public comment period on the LCA GHG Report, DOE/FE identified 18 unique submissions received from the general public, interest groups, industry, and academia/research institutions, which DOE/FE categorized into seven distinct comments.[167]

DOE/FE identifies below: (i) the pertinent arguments by topic, with reference to representative comments, and (ii) DOE/FE's basis for the conclusions that it drew in reviewing those comments. In so doing, DOE/FE will respond to the relevant, significant issues raised by the commenters.

1. Study Conclusions

a. Comments

Several commenters, including Citizens Against LNG and Oregon Wild, claim that the life cycle GHG emissions from natural gas are higher than those from coal.

b. DOE/FE Analysis

These comments assert that natural gas has higher GHGs than coal, but they do not cite data sources applicable to the comparison of U.S.-exported LNG to regional coal, nor do they acknowledge that the different end uses of coal and natural gas (i.e., heating, power, or transportation) affect their relative life cycle GHG performance. If the characteristics of each fuel (most critically, the carbon content per unit of the fuel's energy) and power plant

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[167] In some instances, single letters were sent on behalf of a group of people. In one case, multiple copies of a form letter were received from 149 individuals, hereinafter referred to as "Concerned Citizens." Most of the individuals in the Concerned Citizens group live in New York, but other states and countries are also represented.

efficiencies are considered, the lower per-MWh CO_2 emissions from natural gas power plants in comparison to coal power plants make natural gas lower than coal in the context of power plant operations by 61% (see Table 11 below, [(415 – 1,063)/1,063 x 100]). The life cycle of baseload electricity generation is a reasonable basis for comparing natural gas and coal because both types of fuels are currently used on a large scale by baseload power plants.

Table 11 shows the life cycle GHG emissions CO_2, methane (CH_4), nitrous oxide (N_2O), and sulfur hexafluoride (SF_6) from natural gas and coal systems and demonstrates the importance of power plant operations to total life cycle GHG emissions over 100- and 20-year GWP timeframes. This table is representative of European end-use scenarios, which consume natural gas exported from the United States and coal extracted in Europe. (This table is based on the same data as used by Figure 6-1 of the LCA GHG Report.)

Table 11: Life Cycle GHG Emissions from Natural Gas and Coal Systems (kg CO_2e/MWh)

Life Cycle Process	100-yr GWP		20-yr GWP	
	Natural Gas: New Orleans to Rotterdam, Netherlands	Coal: European Regional	Natural Gas: New Orleans to Rotterdam, Netherland	Coal: European Regional
Natural Gas/Coal Extraction	33.9	7.8	88.7	13.6
Natural Gas Processing	34.5	-	60.4	-
Domestic Pipeline Transport	32.3	-	81.4	-
Liquefaction	63.6	-	63.6	-
Tanker/Rail Transport	25.0	14.4	28.4	15.3
Tanker Berthing & Deberthing	1.5	-	1.6	-
LNG Regasification	20.0	-	45.3	-
Power Plant Operations	415	1,063	415	1,064
Electricity T&D	3.4	3.4	2.5	2.5
Total	**629**	**1,089**	**787**	**1,095**

2. Boundaries of the LCA GHG Report

a. Comments

Sierra Club,[168] Food & Water Watch,[169] Americans Against Fracking *et al*., Susan Sakmar, and Concerned Citizens, among others, contend that the LCA GHG Report has flawed boundaries and scenarios. In particular, these commenters contend that the LCA GHG Report assumes that LNG will displace coal power without also accounting for the displacement of renewable energy.

b. DOE/FE Analysis

The boundaries of the LCA were developed with respect to questions about two fossil fuels, coal and natural gas, and where they come from. The scenarios in the LCA do not model displacement of any kind. These two scenarios are purely attributional, meaning that they focus on independent supply chains for each scenario and do not account for supply or demand shifts caused by the use of one fuel instead of another fuel.

3. Natural Gas Transport between Regasification and Power Plants

a. Comments

Sierra Club and Concerned Citizens, among others, assert that the LCA GHG Report does not account for natural gas transport between LNG regasification facilities and power plants in the importing countries.

b. DOE/FE Analysis

The choice to exclude transportation between regasification and the power plant was a modeling simplification. The sensitivity analysis of GHG emissions with changes to pipeline

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[168] Sierra Club submitted comments on behalf of its members and supporters as well as Cascadia Wildlands, Otsego 2000, Inc., Columbia Riverkeeper, Stewards of the Lower Susquehanna, Inc., Friends of the Earth, Chesapeake Climate Action Network, Food and Water Watch, and EarthJustice.

[169] Food & Water Watch submitted comments in the form of a letter signed by 85 individuals representing various national, state, and local public interest groups.

transport distance, as illustrated by Figures 4-7 and 4-8 of NETL's *Life Cycle Analysis of Natural Gas Extraction and Power Generation*, shows that the *doubling* (i.e., a 100% increase) of natural gas pipeline transport distance increases the *upstream* GHG emissions from natural gas by 30%. When this upstream sensitivity is applied to the life cycle boundary of the LCA GHG Report, an additional 100 miles beyond the LNG import terminal increases the life cycle GHG emissions for the LNG export scenarios by 0.8%, and an additional 500 miles beyond the LNG import terminal increases the life cycle GHG emissions for the LNG export scenarios by 4% (using 100-year GWPs as specified by the IPCC Fifth Assessment Report). Although this parameter modification changes the results of the LCA slightly, it does not change the conclusions of the LCA GHG Report.

4. Data Quality for LNG Infrastructure, Natural Gas Extraction, and Coal Mining

a. Comments

Several commenters, including API, Concerned Citizens, and Sierra Club, commented on whether the data used in the LCA GHG Report is current and fully representative of the natural gas industry. In particular, API asserts that NETL's model is representative of inefficient liquefaction technologies that overstate the GHG emissions from the LNG supply chain, coal data that understates the methane emissions from coal mines, and natural gas extraction data that mischaracterizes "liquids unloading" practices.[170] API proposes the use of newer data for both

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[170] For purposes of this term, we refer to EPA's description of "liquids unloading" as follows: "In new gas wells, there is generally sufficient reservoir pressure to facilitate the flow of water and hydrocarbon liquids to the surface along with produced gas. In mature gas wells, the accumulation of liquids in the well can occur when the bottom well pressure approaches reservoir shut-in pressure. This accumulation of liquids can impede and sometimes halt gas production. When the accumulation of liquid results in the slowing or cessation of gas production (i.e., liquids loading), removal of fluids (i.e., liquids unloading) is required in order to maintain production. Emissions to the atmosphere during liquids unloading events are a potentially significant source of VOC and methane emissions." U.S. Envtl. Prot. Agency, Office of Air Quality Planning & Standards, *Oil & Natural Gas Sector Liquids Unloading Processes*, Report for Oil & Gas Sector Liquids Unloading Processes Review Panel, at 2 (April 2014), *available at*: http://www.epa.gov/airquality/oilandgas/pdfs/20140415liquids.pdf.

liquefaction terminals in the United States and methane emission factors from unconventional natural gas extraction and coal mining. Concerned Citizens argue that the LCA GHG Report does not clearly identify its source of data for estimates of loss related to LNG production, shipping, and regasification, as well as the basis for estimates of pipeline losses from Russia. Sierra Club points to inaccurate referencing of EPA's Subpart W report, which was the basis for many of NETL's emission factors for natural gas extraction.

b. DOE/FE Analysis

(1) Liquefaction Data

API points to newer data for liquefaction facilities that have higher efficiencies than the liquefaction process in the LCA GHG Report. API points to the GHG intensities of the liquefaction facilities proposed by Sabine Pass, Cameron LNG, and FLEX, each of which has been granted one or more non-FTA LNG export orders by DOE/FE (*see infra* § XII.D). According to API, these proposed facilities will produce 0.26, 0.29, and 0.12 tonnes of CO_2e per tonne of LNG, respectively. The majority of a liquefaction facility's energy is generated by combusting incoming natural gas, so the GHG intensity of a liquefaction facility is directly related to its efficiency. As API correctly points out, the LCA model assumes a GHG intensity of 0.44 tonnes of CO_2e per tonne of LNG; this GHG intensity is representative of a facility that consumes 12% of incoming natural gas as plant fuel.[171]

The above GHG intensities and liquefaction efficiencies are not life cycle numbers, but represent only the gate-to-gate operations of liquefaction facilities, beginning with the receipt of processed natural gas from a transmission pipeline and ending with liquefied natural gas ready

[171] NETL (2010). NETL Life Cycle Inventory Data – Unit Process: LNG Liquefaction, Operation. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: May 2010 (version 01); *available at*: http://www.netl.doe.gov/File Library/Research/Energy Analysis/Life Cycle Analysis/UP_Library/DS_Stage1_O_LNG_Liquefaction_2010-01.xls.

for ocean transport. As illustrated by Figures 6-1 and 6-2 in the LCA GHG Report (reproduced as tables herein), liquefaction accounts for approximately 10% of the life cycle GHG emissions of U.S. LNG used for electric power generation in Europe and Asia. A doubling of liquefaction efficiency (thus achieving a GHG intensity comparable to the average of the Sabine Pass, Cameron, and Freeport facilities) would lead to a 6% reduction in the feed rate of natural gas to the liquefaction plant.[172] This feed rate reduction would also reduce natural gas extraction, processing, and transmission emissions by 6%, but would not affect the processes downstream from liquefaction (ocean tankers, power plants, and electricity transmission networks). Applying the increased liquefaction efficiency and the 6% reduction in feed rate to the results of the LCA GHG Report would reduce the life cycle GHG emissions for LNG export scenarios by only 1.5% (using 100-year GWPs as stated in the IPCC Fifth Assessment Report). Increasing liquefaction efficiency may significantly reduce the emissions from one point in the supply chain, but it does not change the conclusions of the LCA.

(2) Natural Gas Methane Data

API and Concerned Citizens criticize the quality of data that DOE/NETL uses for natural gas extraction. API's concern is that NETL overstates the GHG emissions from unconventional well completion. API compares NETL's emission factor for unconventional well completions (9,000 Mcf of natural gas/episode) to the emission factor that EPA states in its 2014 GHG inventory (approximately 2,500 Mcf of natural gas/episode). EPA revised its unconventional completion emission factor between its 2013 and 2014 inventory reports,[173] after NETL's model had been finalized and during the time that NETL was completing the LCA GHG Report. These

[172] *See id*.
[173] U.S. Envtl. Prot. Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012, *available at*: http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Main-Text.pdf.

factors are referred to as "potential emission factors" because they do not represent natural gas that is directly released to the atmosphere, but they represent the volume of natural gas that can be sent to flares and other environmental control equipment. NETL uses a potential emission factor of 9,000 Mcf of natural gas per each episode of shale gas hydraulic fracturing, and a potential emission factor of 3.6 Mcf of natural gas per each episode of liquids unloading (with 31 liquids unloading episodes per well-year). NETL's model augments potential emission factors with flaring, thereby reducing the amount of methane that is released to the atmosphere. These emission factors are consistent with the findings of a survey jointly conducted by API and America's Natural Gas Alliance and released in September 2012.[174] They also match the factors used by EPA's 2013 GHG inventory.[175]

NETL's current model accounts for liquids unloading emissions from conventional wells, but does not account for liquids unloading from unconventional wells. Applying liquids unloading to the unconventional wells in this analysis increases the life cycle GHGs by 0.6% for LNG export scenarios (using 100-year GWPs as stated in the IPCC Fifth Assessment Report). This 0.6% was estimated by assigning the liquid unloading emissions from onshore conventional natural gas to the upstream results for Marcellus Shale natural gas, followed by an expansion of the boundaries to a life cycle context. Simply put, liquids unloading accounts for 11% of the upstream GHG emissions from conventional onshore natural gas.[176] When liquids unloading is added to unconventional natural gas in the LCA model, it is scaled according to the unique production rates and flaring practices of unconventional wells in addition to the subsequent flows of natural gas processing, liquefaction, ocean transport, regasification, power plant operations,

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[174] *Characterizing Pivotal Sources of Methane Emissions from Natural Gas Production: Summary and Analysis of API and ANGA Survey Responses*. Final Report (Sept. 21, 2012).
[175] U.S. Envtl. Prot. Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011 (Apr. 12, 2013).
[176] *See* NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation*.

and electricity transmission. Thus, while liquids unloading may account for a significant share of *upstream* GHG emissions, none of the LCA GHG Report's conclusions would change with the addition of liquids unloading to unconventional natural gas extraction.

The potential emissions from unconventional well completions are modeled as 9,000 Mcf of natural gas per episode. It is important to remember that this factor does not represent methane emissions directly released to the atmosphere, but the flow of natural gas prior to environmental controls. For unconventional natural gas, NETL's model flares 15% of these potential emissions (flaring converts methane to CO_2, thus reducing the GWP of the gas) and apportions all completion emissions to a unit of natural gas by dividing them by lifetime well production (completion emissions occur as one-time episode that must be converted to a life cycle basis by amortizing them over total lifetime production of a well). Further, the life cycle GHG contributions from well completions are diluted when scaled to the subsequent flows of natural gas processing, liquefaction, ocean transport, regasification, power plant operations, and electricity transmission. However, in NETL's model, life cycle completion emissions are directly affected by the estimated ultimate recovery (EUR) of a well because the total amount of natural gas produced by a well is used as a basis for apportioning completion and other one-time emissions to a unit of natural gas produced. From an engineering perspective, wells with high EURs are more likely to have a high initial reservoir pressure that increases the potential completion emissions. A reasonable uncertainty range around the potential emissions from unconventional completion emissions (9,000 Mcf/episode) is -30% to +50% (6,100 to 13,600 Mcf/episode). This uncertainty range matches the scale of uncertainty around the Marcellus Shale EUR used in the LCA GHG Report (see Table 5-4 of the LCA GHG Report). This -30%

to +50% uncertainty around potential emissions from unconventional completions causes a -2% to 3% uncertainty around life cycle GHG emissions for the export scenarios of this analysis.

The recently revised New Source Performance Standards (NSPS) rules for the oil and natural gas sector, which EPA amended in a final rule published on June 3, 2016,[177] will achieve significant methane emission reductions primarily by requiring all new or modified wells to capture and control potential emissions of VOCs during natural gas well completion. In addition to well completion emissions, the NSPS rules target other point sources of VOC emissions from new and modified sources at natural gas extraction and processing sites, but they do not address liquids unloading.[178] The LCA GHG Report does not account for the potential effects of the NSPS rules on natural gas emissions because the scope of the LCA accounts for GHG emissions from natural gas being produced today. EPA's Regulatory Impact Analysis estimated that the final NSPS rule would reduce annual methane emissions in 2015 by 18 million metric tons, meaning that this rule will have the effect of reducing life cycle emissions from natural gas systems as new wells are developed and existing wells are modified. The likely effects of the NSPS rule therefore suggest that the conclusions of the LCA GHG Report are conservative with respect to the life cycle GHG emissions of natural gas produced in the United States.

Sierra Club contends that NETL's documentation, including the 200-page supporting LCA document, does not clearly cite EPA's Subpart W document. NETL's Report has three references to Subpart W, cited as EPA 2011a, 2011b, and 2011c. These three references should

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[177] U.S. Envtl. Prot. Agency, Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources; Final Rule (40 C.F.R. Part 60), 81 Fed. Reg. 35,824 (June 3, 2016); *available at:* https://www.gpo.gov/fdsys/pkg/FR-2016-06-03/pdf/2016-11971.pdf.

[178] U.S. Envtl. Prot. Agency, Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews (40 C.F.R. Part 63) (Apr. 17, 2012); *available at:* http://www.epa.gov/airquality/oilandgas/pdfs/20120417finalrule.pdf.

refer to the same document.[179] Future versions of the Report will correct these duplicate citations. Sierra Club also calls out the citation for EPA, 2012c, although this is a correct reference that points to EPA's documentation of New Source Performance Standards.

(3) Coal Methane Data

API and Concerned Citizens criticize the quality of data that DOE/NETL uses for coal extraction. In particular, API claims that coal mine methane emissions may be higher than the factors used by NETL. Concerned Citizens simply claim that NETL used a limited set of references to characterize coal mine emissions.

Methane emissions from coal mines are based on data collected by EPA's Coalbed Methane Outreach Program and have been organized by coal type and geography. Due to data limitations, the LCA GHG Report used this data as a proxy for emissions from foreign coal. This limitation is noted in the LCA GHG Report and is accounted for by uncertainty.[180] The bounds on coal methane uncertainty were informed by the variability in coal mine methane emissions between surface mines (subbituminous coal) and underground mines (bituminous coal) in the United States. The default parameters in NETL's model represent subbituminous coal, which has lower coal mine methane emissions than bituminous coal (these parameters are specified in Table 5-3 of the LCA GHG Report). If coal mines in Europe and Asia emit methane at rates similar to the underground, bituminous coal mines in the United States, then the life cycle GHG emissions from coal power would increase. This increase in coal mine methane emissions would increase the life cycle GHG emissions of coal power by 8 percent (from 1,089 to 1,180 kg CO_2e/MWh, using 100-year GWPs as stated in the IPCC Fifth Assessment Report).

[179] U.S. Envtl. Prot. Agency, Greenhouse Gas Emissions Reporting from the Petroleum and Natural Gas Industry: Background Technical Support Document (2011), *available at:* https://www.epa.gov/sites/production/files/2015-05/documents/subpart-w_tsd.pdf.
[180] *See, e.g.*, NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation*.

This uncertainty is illustrated by Figure 6-16 in the LCA GHG Report. Again, even though changes to coal mine methane emissions change the GHG results of the LCA, they do not change the conclusions of the LCA.

5. Methane Leakage Rate Used in the LCA GHG Report

a. Comments

A number of commenters, including Sierra Club, Food & Water Watch, Americans Against Fracking et al., and Zimmerman and Associates, claim that the methane leakage rate used by NETL is too low. They assert that it does not match top-down (or aerial) measurements recently conducted in regions with natural gas activity, nor does it match the leakage rate in a recent analysis of wellhead casings in Pennsylvania.

b. DOE/FE Analysis

Recent studies lack consensus concerning the extent and rates of leakage from the upstream natural gas supply chain, with the leakage rates reported by these studies ranging from less than 1% to as high as 10%.[181] One reason for this broad range of leakage rates is the fact that different analysts use different boundaries (*e.g.*, extraction only, extraction through processing, extraction through transmission, and extraction through distribution). Further, top-down measurements are taken over narrow time frames and limited geographic scopes that represent only a snapshot of operations. They do not necessarily represent long-term operations over a broad area.

Another reason for this range of leakage rates is confusion between leaks and losses. Natural gas leaks include emissions from pneumatically controlled devices, valves, compressor seals, acid gas removal units, dehydrators, and flanges. These leaks are a mix of methane and

[181] *See* NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation* (Section 6.2.1) (identifying reports that include various leakage rates).

other hydrocarbons, and are a subset of total natural gas losses. Another type of loss includes flaring, which converts methane to CO_2 and thus reduces methane venting to the atmosphere. Similarly, the combustion of natural gas by reboilers in a natural gas processing plant or by compressors on a pipeline represents the loss of natural gas that is used to improve the purity of the gas itself and move it along the transmission network.

NETL's expected cradle-through-transmission leakage rate is 1.2%. In other words, the extraction, processing, and transmission of 1 kg of natural gas releases 0.012 kg of CH_4 to the atmosphere. In contrast, NETL's expected loss rate from the same boundary is approximately 8%: for the delivery of 1 kg of natural gas via a transmission pipeline, 0.012 kg of CH_4 is released to the atmosphere, and 0.068 kg is flared by environmental controls or combusted for processing and transmission energy.

Sierra Club compares NETL's leakage rate to a 1.54% leakage rate derived from EPA's 2013 GHG inventory. The two types of leakage rates (the 1.2% calculated by NETL's life cycle model and the 1.54% implied by EPA's 2013 inventory) are not directly comparable. LCAs and national inventories have different temporal boundaries. NETL's leakage rate is a life cycle number based on a 30-year time frame; it levelizes the emissions from one-time well completion activities over a 30-year time frame of steady-state production. The leakage rate implied by EPA's inventory represents 2011 industry activity; it captures the spike in completion emissions due to the atypically high number of wells that were completed that year. In other words, national inventories calculate all emissions that occur in a given year, while LCAs apportion all emissions that occur during a study period (*e.g.*, 30 years) to a unit of production (*e.g.*, 1 MWh of electricity generated). Both approaches are legitimate with respect to the unique goals of each type of analysis.

Sierra Club also compares NETL's 1.2% leakage rate to the 2.01% leakage rate calculated by Burnham et al.[182] Again, a boundary difference explains why the two leakage rates are not directly comparable. Burnham et al.'s leakage rate includes natural gas distribution, which is an additional transport step beyond transmission. Natural gas distribution moves natural gas from the "city gate" to small scale end users (commercial and residential consumers). NETL's leakage rate ends after natural gas transmission, the point at which natural gas is available for large scale end users such as power plants. The natural gas distribution system is a highly-branched network that uses vent-controlled devices to regulate pressure. This boundary difference explains why Burnham et al.'s leakage rate is higher than NETL's rate. Sierra Club also compares NETL's leakage rate to a shale gas analysis conducted by Weber et al.[183] We have reviewed Weber et al.'s work and do not see any mention of leakage rate.

It is also important to note that leakage rate is not an input to NETL's life cycle model. Rather, it is calculated from the outputs of NETL's life cycle model. NETL uses an approach that assembles all activities in the natural gas supply chain into a network of interconnected processes. The emissions from each process in this model are based on engineering relationships and emission factors from the EPA and other sources. This method is known as a "bottom-up" approach. Researchers are trying to discern why "top-down" studies such as Pétron's measurements in northeast Colorado[184] do not match the bottom-up calculations by NETL and other analysts. We believe that inconsistent boundaries (*i.e.*, bottom-up models that account for long term emissions at the equipment level in comparison to top-down measurements that

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[182] Burnham, Andrew, et al. Life-cycle greenhouse gas emissions of shale gas, natural gas, coal, and petroleum. *Environmental Science & Technology* 46.2 (2011): 619-627.
[183] Weber, Christopher L., and Christopher Clavin. Life cycle carbon footprint of shale gas: Review of evidence and implications. *Environmental science & technology* 46.11 (2012): 5688-5695.
[184] Pétron, G., Frost, *et al*. (2012). Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study. *Journal of Geophysical Research: Atmospheres (1984–2012)*, *117*(D4).

encompass an entire region with more than one type of industrial activity over a narrow time frame) partly explain the differences between bottom-up and top-down results. As research continues, however, we expect to learn more about the differences between bottom-up and top-down methods.

Zimmerman and Associates references a recent study by Ingraffea et al. that assessed failure rates of well casings for oil and gas wells in Pennsylvania.[185] However, Ingraffea et al. do not calculate a methane leakage rate in their analysis; rather, they calculate the rate at which wells develop leaks. The rate at which leaks develop in well casings is a different phenomenon than the rate at which methane leaks from the natural gas supply chain. The former is a measurement of failure rates (the number of wells in a group that have leaks) and the latter is a measurement of the magnitude of total leakage (the amount of methane in extracted natural gas that is released to the atmosphere).

The breakeven analysis shown in Section 6 of the LCA GHG Report models hypothetical scenarios that increase the natural gas leakage rate to the point where the life cycle emissions from natural gas power are the same as those from coal power. The breakeven points between natural gas and coal systems are illustrated in Figures 6-8 and 6-9 of the Report. These results are based on the most conservative breakeven point, which occurs between the high natural gas cases (*i.e.*, lowest power plant efficiency, longest transport distance, and highest methane leakage) with the low coal case (*i.e.*, highest power plant efficiency and shortest transport distance). These graphs show that on a 100-year GWP basis, methane leakage would have to increase by a factor of 1.7 to 3.6, depending on the scenario, before the breakeven occurs. The

[185] Ingraffea, A. R., Wells, M. T., Santoro, R. L., & Shonkoff, S. B. (2014). Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000–2012. *Proceedings of the National Academy of Sciences*, *111*(30), 10955-10960.

breakeven methane leakage is lower for the 20-year GWP basis and, for some scenarios, is lower than the modeled leakage rate.

6. The Uncertainty Bounds of the LCA GHG Report

a. Comments

Concerned Citizens claim that the LCA GHG Report has significant uncertainty, and contend that "poor modeling is not a reason to dismiss impacts."

b. DOE/FE Analysis

The results of the LCA GHG Report are based on a flexible model with parameters for natural gas extraction, processing, and transport. Uncertainty bounds are assigned to three key parameters: well production rates, flaring rates, and transport distances. These uncertainty bars are not an indication of poor modeling. To the contrary, they are used to account for variability in natural gas systems. If the analysis did *not* account for uncertainty, the results would imply that the GHG emissions from natural gas systems are consistently a single, point value, which would be inaccurate. We therefore believe the chosen uncertainty bounds strengthen the LCA model, as opposed to indicating any weakness in modeling.

7. The LCA GHG Report and the NEPA Approval Process

a. Comments

Several commenters, including Citizens Against LNG, Dominion Cove Point LNG, Susan Sakmar, and Americans Against Fracking et al., note that the LCA GHG Report does not fulfill the requirements of an EIS as defined by NEPA. These commenters maintain that the LCA GHG Report should not be used as a basis for approving proposed LNG export terminals.

b. DOE/FE Analysis

We agree that the LCA GHG Report does not fulfill any NEPA requirements in this proceeding, nor has DOE/FE made any suggestion to that effect. The LCA GHG Report addresses foreign GHG emissions and thus goes beyond the scope of what must be reviewed under NEPA.

X. FERC PROCEEDING AND GRANT OF AUTHORIZATION

A. FERC's Pre-Filing Procedures

Authorizations issued by FERC permitting the siting, construction, and operation of LNG export terminals are reviewed under NGA section 3(a) and (e), 15 U.S.C. § 717b(a), (e). FERC's approval process for such an application consists of a mandatory pre-filing process during which the environmental review required by NEPA commences,[186] and a formal application process that starts no sooner than 180 days after issuance of a notice that the pre-filing process has commenced.[187]

Cameron LNG filed a request with FERC for use of the pre-filing procedures on February 24, 2015. On March 2, 2015, in Docket No. PF15-13-000, the Director of the Office of Energy Projects at FERC granted Cameron LNG's request to commence the pre-filing review process. On June 24, 2015, FERC issued a Notice of Intent to Prepare an Environmental Assessment (NOI) of the proposed Liquefaction Project.[188]

DOE agreed to participate as a cooperating agency in FERC's environmental review,[189] as set forth in the NOI.[190] Consistent with its practice, FERC published the NOI in the *Federal Register* and mailed it to federal, state, and local government representatives and agencies, elected officials, environmental and public interest groups, Native American Tribes, property

[186] 18 C.F.R. § 157.21.
[187] 18 C.F.R. § 157.21(a)(2)(i-ii).
[188] Cameron LNG, LLC, Notice of Intent to Prepare an Environmental Assessment for the Planned Cameron LNG Expansion Project, and Request for Comments on Environmental Issues, 80 Fed. Reg. 36,332 (June 24, 2015) [hereinafter FERC NOI].
[189] 40 C.F.R. §1501.6 ("In addition, any other Federal agency which has special expertise with respect to any environmental issue, which should be addressed in the statement may be a cooperating agency upon request of the lead agency."); *see also id.* § 1501.6(b) (responsibilities of a cooperating agency).
[190] *See* FERC NOI, 80 Fed. Reg. 36,332.

owners in the vicinity of the proposed facilities, other interested parties, and local libraries and newspapers.[191] As part of FERC's public scoping process under NEPA, FERC held open houses and received comments from a variety of stakeholders, which served to identify issues for FERC staff to address in the EA.

B. FERC's Environmental Review

On September 28, 2015, Cameron LNG began the second part of FERC's approval process by filing its formal application in FERC Docket No. CP15-560-000 for authorization to site, construct, and operate the Expansion Project.[192] FERC issued the EA for the Expansion Project on February 12, 2016, and placed the EA into the public record.[193] FERC provided a 30-day public comment period on the EA. No comments on the EA were submitted.[194]

The EA addresses numerous environmental issues, including potential impacts on geology, groundwater, surface water and aquatic resources, wildlife, threatened and endangered species, land use, recreation, visual resources, cultural resources, air quality, noise, safety, socioeconomics, cumulative impacts, and alternatives.[195] Based on its environmental analysis, FERC staff concluded that, "approval of the Expansion Project would not constitute a major federal action significantly affecting the quality of the human environment," subject to recommended mitigation measures.[196] FERC staff recommended 70 mitigating environmental conditions for the Expansion Project.[197]

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[191] FERC Order at P 12.
[192] Cameron LNG, LLC, Application of Cameron LNG, LLC for Authorization Under Section 3 of the Natural Gas Act, FERC Docket No. CP15-560-000 (Sept. 28, 2015) [hereinafter Cameron LNG FERC App.]; *see also* 80 Fed. Reg. 63,551.
[193] FERC Order at P 14.
[194] *See id*.
[195] *See id*.
[196] EA at 118.
[197] *See id*. at 118-29.

C. FERC's Order Granting Authorization

On May 5, 2016, FERC issued its order granting Cameron LNG's requested authorization to site, construct, and operate the proposed Expansion Project, pursuant to NGA section 3(a). In granting this authorization, FERC observed that the proposed Expansion Project is located entirely within the footprint of the existing Cameron LNG terminal, and the affected and adjacent lands are used solely for industrial purposes.[198] FERC thus determined that "the environmental impacts of the Expansion Project are expected to be few and well-defined."[199]

Based on the analysis in the EA, FERC determined that, "with the conditions required herein, Cameron's Expansion Project results in minimal environmental impacts and can be construed and operated safely," and thus "Cameron's proposals are not inconsistent with the public interest."[200] FERC further concluded that, if the Expansion Project is constructed and operated in accordance with Cameron LNG's application, and in compliance with the environmental conditions set forth in the Order, "[FERC's] approval of this proposal would not constitute a major federal action significantly affecting the quality of the human environment."[201] Accordingly, FERC adopted all 70 mitigation measures in the EA as environmental conditions of its Order, set forth in the Appendix.

In addition, FERC adopted two of its own additional environmental conditions—Environmental Conditions 10 and 63—bringing the total number of environmental conditions adopted by FERC to 72. These two conditions clarify that "authorization from the Director of the Office of Energy Projects will be required prior to the introduction of hazardous fluids into the Expansion Project facilities and loading of the initial cargoes of LNG during commissioning

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198 *See* FERC Order at P 10.
199 *Id*. at P 11.
200 *Id*.
201 *Id*. at P 15.

activities, as well as to require Cameron to file weekly reports to document the commissioning process."[202]

XI. CURRENT PROCEEDING BEFORE DOE/FE

A. Overview

Cameron LNG's Application in this proceeding is uncontested. In response to the Notice of Application published in the *Federal Register* on August 6, 2015, DOE/FE received nine comments in support of the Application, including a resolution adopted by the Cameron Parish Police Jury. Comments in support were submitted by Bob Hensgens, Representative for the State of Louisiana; Larry DeRoussel, Executive Director of Lake Area Industry Alliance; S. Mark McMurry, President of McMurry Leadership & Management, LLC; Dan Morrish, Senator for the State of Louisiana; David Vitter, United States Senator for Louisiana; Bill Cassidy, M.D., United States Senator for Louisiana; Steven Grissom, Secretary of Louisiana Economic Development, writing on behalf of Governor Bobby Jindal; Charles W. Boustany Jr., United States Representative for the State of Louisiana; and (as indicated above) the Cameron Parish Police Jury.[203] No comments were received opposing the Application.

DOE/FE also received one timely-filed motion to intervene in this proceeding filed by API, taking no position on the Application.[204] Cameron LNG did not oppose API's motion to intervene.

B. Non-Intervenor Comments in Support of the Application

The non-intervener comments submitted in support of the Application generally address the existing construction activities at the Cameron Terminal, and the additional benefits that will

[202] *Id*. at P 14.
[203] Four of the nine comments were filed shortly after the October 5, 2015 deadline established in the *Federal Register*. Because no party opposed the late filings, DOE/FE nonetheless accepts them into the record to inform the public interest review.
[204] Motion to Intervene of the American Petroleum Institute, FE Docket No. 15-90-LNG (Oct. 5, 2015).

result from the proposed Expansion Project. For example, Louisiana State Representative Hensgens states that Cameron LNG's on-going construction of Trains 1-3 has created over 140 permanent jobs and has been beneficial to Louisiana's economy. He and U.S. Senator Cassidy assert that the Expansion Project will expand upon these benefits over a longer duration, including the creation of 50 more permanent jobs.

Many of the commenters—including Mr. DeRoussel, Mr. McMurry, Louisiana State Representative Hensgens, Louisiana State Senator Morrish, and U.S. Representative Boustany—state that Cameron LNG has been a longstanding member of the business community in Louisiana and has regularly invested in the Southwest Louisiana community. They further state that Cameron LNG has provided support to the Southwest Louisiana community by investing in education, non-profits, health, and the environment. In their view, Cameron LNG has been a good corporate citizen to the state of Louisiana.

U.S. Representative Boustany adds that the Cameron Terminal has resulted in a $10 billion investment in the community. Representative Boustany and U.S. Senator Cassidy assert that the Expansion Project will build upon this investment, while also improving the U.S. balance of trade by $114 billion. Similarly, Mr. McMurray states that the Expansion Project will sustain economic investment in the region while increasing the market for domestically produced natural gas.

Mr. Grissom, Secretary of Louisiana Economic Development and writing on behalf of Governor Bobby Jindal, maintains that allowing exports from the Expansion Project will aid the state of Louisiana, and will benefit the nation's energy security in an ever-changing global energy market. U.S. Senator Vitter states that, in addition to generating positive benefits for the U.S. economy, the Expansion Project will provide natural gas to U.S. allies overseas.

Finally, Resolution No. 1025, adopted and approved on September 29, 2015, by the Cameron Parish Police Jury, asserts the Jury's support for the Expansion Project. The Resolution cites the longstanding presence of Cameron LNG within Louisiana, and the company's continued improvements to the state and local economy. The Resolution also highlights the number of jobs projected to be created through the Expansion Project, as well as associated non-financial contributions to the local community.

C. API's Motion to Intervene

API is a national trade association representing more than 625 member companies involved in all aspects of the oil and gas industry in the United States. API states that its members include owners and operators of LNG import and export facilities in the United States and around the world, as well as owners and operators of LNG vessels, global LNG traders, and manufacturers of essential technology and equipment used all along the LNG value chain. API claims a direct and immediate interest in this proceeding that cannot be adequately protected by any other party. API seeks to intervene as a party to this proceeding, but does not state its support or opposition to the Application.

XII. DISCUSSION AND CONCLUSIONS

In reviewing Cameron LNG's Application to export LNG, DOE/FE has considered both its obligations under NEPA and its obligation under NGA section 3(a) to ensure that the proposed LNG exports are not inconsistent with the public interest. To accomplish these purposes, DOE/FE has examined a wide range of information addressing environmental and non-environmental factors, including:

- Cameron LNG's uncontested Application, the comments filed in support of the Application, and API's motion;
- FERC's EA and May 5, 2016 Order, including the 72 environmental conditions adopted in that Order;

- The Draft Addendum, comments received in response to the Draft Addendum, and the final Addendum;
- The LCA GHG Report (and the supporting NETL document), including comments submitted in response to those documents; and
- The 2014 and 2015 LNG Export Studies, including comments received in response to those Studies.

To avoid repetition, the following discussion focuses on arguments and evidence presented by Cameron LNG and the commenters, to the extent that DOE/FE has not already addressed the same or substantially similar arguments in its responses to comments on the Addendum, the LCA GHG Report, and/or the 2014 and 2015 Studies.

A. Procedural Issues

API timely filed a motion to intervene in this proceeding. Cameron LNG did not oppose API's motion and, therefore, API's motion to intervene is deemed granted. 10 C.F.R. § 590.303(g).

B. Non-Environmental Issues

In considering non-environmental issues in this proceeding, we have reviewed the uncontested Application and the filings in this proceeding, as well as the 2014 and 2015 LNG Export Studies and comments thereto. We also take administrative notice of EIA's more recent authoritative supply data and projections, set forth in AEO 2015 and AEO 2016 as discussed below.

1. Cameron LNG's Application

Upon review, we find that several factors identified in the Application, including our prior analyses performed in FE Docket Nos. 11-162-LNG and 15-67-LNG (which have been incorporated by reference in this record) support a grant of the authorization to export LNG in an amount equivalent to 515 Bcf/yr of natural gas.

First, the record supports a finding that there are ample supplies of natural gas available to support the exports contemplated in the Application without affecting the availability of natural gas to meet domestic demand.

Second, as discussed below, the record demonstrates that domestic natural gas can be liquefied and exported to foreign markets in the volumes proposed in the Application with only a nominal effect on U.S. prices due to the proposed exports.

Third, we agree with Cameron LNG and the commenters in this proceeding that substantial economic and public benefits, including reductions to the U.S. trade deficit and the generation of significant tax revenues for federal, state, and local governmental entities, will follow from a grant of the Application.

2. Price Impacts

As discussed above, the 2014 and 2015 LNG Export Studies projected the economic impacts of LNG exports in a range of scenarios, including scenarios that exceeded the current amount of LNG exports authorized in the final non-FTA export authorizations to date (equivalent to a total of 13.22 Bcf/d of natural gas with the issuance of this Order).[205] The 2015 Study concluded that LNG exports at these levels (12 to 20 Bcf/d of natural gas) would result in higher U.S. natural gas prices, but that these price changes would remain in a relatively narrow range across the scenarios studied. However, even with these estimated price increases, the 2015 Study found that the United States would experience net economic benefits from increased LNG exports in all cases studied.[206]

We have also reviewed EIA's AEO 2016, published in June 2016. The Reference case of this projection includes the effects of the Clean Power Plan (CPP), discussed *supra*, which is

[205] *See infra* § XII.D.
[206] *See* 2015 Study at 8, 82.

intended to reduce carbon emissions from the power sector. DOE/FE assessed the AEO 2016 to evaluate any differences from AEO 2014, which formed the basis for the 2014 Study.

Comparing key results from 2040 (the end of the projection period in Reference case projections from AEO 2014 and AEO 2016) shows that the latest Outlook foresees market conditions that would be even more supportive of LNG exports, including higher production and demand coupled with lower prices. Results from EIA's AEO 2016 no-CPP case, which is the same as the Reference case but does not include the CPP, are also more supportive of LNG exports on the same basis of higher production and demand with lower prices relative to AEO 2014.

For the year 2040, the AEO 2016 Reference case anticipates 15 percent more natural gas production in the lower-48 than AEO 2014. It also projects an average Henry Hub natural gas price that is lower than AEO 2014 by nearly 40 percent. With regard to exports, the 2016 projection's 2040 net pipeline exports of 2.4 Bcf/d and total LNG exports of 18.4 Bcf/d (over 90 percent higher than total LNG exports in AEO 2014) illustrate the Outlook's view of a market environment supportive of exports.

In the AEO 2016 no-CPP case, for the year 2040, lower-48 production is almost 14 percent higher than in AEO 2014, with the Henry Hub price over 42 percent lower. Net pipeline exports of 2.8 Bcf/d and total LNG exports of 18.6 Bcf/d again indicate a market supportive of exports. These differences are depicted in the table below:

Table 12: Year 2040 Reference Case Comparisons in AEO 2014 and AEO 2016

	AEO 2014 Reference Case	**AEO 2016 Reference Case** **Includes Clean Power Plan**	**AEO 2016 Reference Case** **Without Clean Power Plan**
Lower-48 Dry Natural Gas Production (Bcf/d)	99.7	114.6	113.5
Total Natural Gas Consumption (Bcf/d)	86.7	94.3	92.6
Electric Power Sector Consumption (Bcf/d)	30.8	32.8	30.6
Net Exports by Pipeline (Bcf/d)	6.7	2.4	2.8
Net LNG Exports (Bcf/d)	9.2	18.2	18.4
LNG Exports – Total (Bcf/d)	9.6	18.4	18.6
Lower-48	7.4	18.4	18.6
Alaska	2.2	0.0	0.0
Henry Hub Spot Price ($/MMBtu)(Note 1)	**$8.03 (2015$)** $7.65 (2012$)	**$4.86 (2015$)**	**$4.65 (2015$)**

Note 1: Prices adjusted to 2015$ with the GDP implicit deflator for AEO 2014.

3. Significance of the 2014 and 2015 LNG Export Studies

For the reasons discussed above, DOE/FE commissioned the 2014 EIA LNG Export Study and the 2015 LNG Export Study, and invited the submission of responsive comments on both Studies. DOE/FE has analyzed this material and determined that these two Studies provide substantial support for granting Cameron LNG's Application. Specifically, the conclusion of the

2015 Study is that the United States will experience net economic benefits from issuance of authorizations to export domestically produced LNG.

We have evaluated the public comments submitted in response to the 2014 and 2015 LNG Export Studies. Certain commenters have criticized aspects of the models, assumptions, and design of the Studies. As discussed above, however, EIA's projections in AEO 2016 continue to show market conditions that will accommodate increased exports of natural gas. When compared to the AEO 2014 Reference case, the AEO 2016 Reference case projects increases in domestic natural gas production—well in excess of what is required to meet projected increases in domestic consumption. Accordingly, we find that the 2014 and 2015 LNG Export Studies are fundamentally sound and support the proposition that the proposed authorization will not be inconsistent with the public interest.

4. Benefits of International Trade

We have not limited our review to the contents of the 2014 and 2015 LNG Export Studies and the data from AEO 2015 and AEO 2016, but have considered a wide range of other information. For example, the National Export Initiative, established by Executive Order, sets an Administration goal to "improve conditions that directly affect the private sector's ability to export" and to "enhance and coordinate Federal efforts to facilitate the creation of jobs in the United States through the promotion of exports."[207]

We have also considered the international consequences of our decision. We review applications to export LNG to non-FTA nations under section 3(a) of the NGA. The United States' commitment to free trade is one factor bearing on that review. An efficient, transparent international market for natural gas with diverse sources of supply provides both economic and

[207] National Export Initiative, 75 Fed. Reg. 12,433 (Mar. 16, 2010).

strategic benefits to the United States and our allies. Indeed, increased production of domestic natural gas has significantly reduced the need for the United States to import LNG. In global trade, LNG shipments that would have been destined to U.S. markets have been redirected to Europe and Asia, improving energy security for many of our key trading partners. To the extent U.S. exports can diversify global LNG supplies, and increase the volumes of LNG available globally, it will improve energy security for many U.S. allies and trading partners. As such, authorizing U.S. exports may advance the public interest for reasons that are distinct from and additional to the economic benefits identified in the 2014 and 2015 Studies.

C. Environmental Issues

In reviewing the potential environmental impacts of Cameron LNG's proposal to export LNG, DOE/FE has considered both its obligations under NEPA and its obligation under NGA section 3(a) to ensure that the proposal is not inconsistent with the public interest.

1. Adoption of FERC's EA

As a cooperating agency in FERC's environmental review, DOE/FE is responsible for conducting an independent review of the results of FERC's efforts and determining whether the record needs to be supplemented in order for DOE/FE to meet its statutory responsibilities under section 3 of the NGA and under NEPA. DOE/FE has reviewed the administrative record compiled at FERC, including the EA and the FERC Order. Based on that review, DOE/FE has concluded that supplementation of the record is not warranted or necessary in order for DOE/FE to take final agency action herein. Accordingly, DOE/FE adopts the EA in the FONSI (*see supra* § I), and the findings contained in the FERC Order, and hereby incorporates FERC's reasoning and findings in this Order.

2. Environmental Impacts Associated with Induced Production of Natural Gas

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.[208] Nevertheless, a decision by DOE/FE to authorize exports to non-FTA nations could accelerate that development by some increment. For this reason, DOE/FE prepared and received public comment on the Addendum and made the Addendum and the comments part of the record in this proceeding. As discussed above, the Addendum reviewed the academic and technical literature covering the most significant issues associated with unconventional gas production, including impacts to water resources, air quality, greenhouse gas 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 VOCs and methane, and the potential for groundwater contamination. These environmental concerns do not lead us to conclude, however, that exports of natural gas to non-FTA nations should be prohibited. Rather, we believe the public interest is better served by addressing these environmental concerns directly—through federal, state, or local regulation, or through self-imposed industry guidelines where appropriate—rather than by prohibiting exports of natural gas. Unlike DOE, environmental regulators have the legal authority to impose requirements on natural gas production that appropriately balance benefits and burdens, and to update these regulations from time to time as technological practices and scientific understanding evolve. For example, in 2012, using its authority under the Clean Air Act, EPA promulgated regulations for hydraulically fractured wells that are expected to yield significant emissions

[208] Addendum at 2.

reductions.[209] In 2013, EPA updated those regulations to include storage tanks,[210] and in 2014 EPA issued a series of technical white papers exploring the potential need for additional measures to address methane emissions from the oil and gas sector.[211] In January 2015, EPA announced a strategy for "address[ing] methane and smog-forming VOC emissions from the oil and gas industry in order to ensure continued, safe and responsible growth in U.S. oil and natural gas production."[212] Specifically, as part of the Administration's efforts to address climate change, EPA has initiated a rulemaking to set standards for methane and VOC emissions from new and modified oil and gas production sources, and natural gas processing and transmission sources.[213] EPA issued the proposed rule in September 2015,[214] and the final rule on June 3, 2016.[215]

Section 3(a) of the NGA is too blunt an instrument to address these environmental concerns efficiently. A decision to prohibit exports of natural gas would cause the United States to forego entirely the economic and international benefits discussed herein, but would have little more than a modest, incremental impact on the environmental issues identified by intervenors.

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[209] U.S. Envtl. Prot. Agency, Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews; Final Rule, 77 Fed. Reg. 49,490 (Aug. 16, 2012).

[210] U.S. Envtl. Prot. Agency, Oil and Natural Gas Sector: Reconsideration of Certain Provisions of New Source Performance Standards; Final Rule, 78 Fed. Reg. 58,416 (Sept. 23, 2013).

[211] U.S. Envtl. Prot. Agency, Office of Air Quality Planning & Standards, *White Papers on Methane and VOC Emissions*, *available at* http://www3.epa.gov/airquality/oilandgas/methane.html (released April 15, 2014).

[212] U.S. Envtl. Prot. Agency, Fact Sheet: EPA's Strategy for Reducing Methane and Ozone-Forming Pollution From the Oil and Natural Gas Industry (Jan. 14, 2015), *available at* http://www.epa.gov/airquality/oilandgas/pdfs/20150114fs.pdf.

[213] The White House, Office of the Press Secretary, Fact Sheet: Administration Takes Steps Forward on Climate Action Plan by Announcing Actions to Cut Methane Emissions (Jan. 14, 2015), *available at* https://www.whitehouse.gov/the-press-office/2015/01/14/fact-sheet-administration-takes-steps-forward-climate-action-plan-anno-1 (stating that, in developing the proposed and final standards, EPA "will focus on in-use technologies, current industry practices, [and] emerging innovations … to ensure that emissions reductions can be achieved as oil and gas production and operations continue to grow.").

[214] *See* U.S. Environmental Protection Agency, Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, Proposed Rule, 80 Fed. Reg. 56,593 (Sept. 18, 2015). EPA subsequently extended the public comment period on this proposed rule and two related proposed rules until December 4, 2015. *See* 80 Fed. Reg. 70,719 (Nov. 13, 2015).

[215] *See supra* note 177.

For these reasons, we conclude that the environmental concerns associated with natural gas production do not establish that exports of natural gas to non-FTA nations are inconsistent with the public interest.

3. Greenhouse Gas Impacts Associated with U.S. LNG Exports

Certain commenters on the LCA GHG Report, the Addendum, and the 2014 and 2015 LNG Export Studies have expressed concern that exports of domestic natural gas to non-FTA nations may impact the balance of global GHG emissions through their impact domestically on the price and availability of natural gas for electric generation and other uses. They also have objected that exports of natural gas could have a negative effect on the GHG intensity and total amount of energy consumed in foreign nations.

a. Domestic Environmental Impacts Associated with Increased Natural Gas Prices

To the extent exports of natural gas to non-FTA nations increase domestic natural gas prices, those higher prices would be expected, all else equal, to reduce the use of natural gas in the United States as compared to a future case in which exports to non-FTA exports were prohibited. Within the U.S. electric generation sector, reduced demand for natural gas caused by higher prices would be balanced by some combination of reduced electric generation overall (aided by conservation and efficiency measures), increased generation from other resources (such as coal, renewables, and nuclear), and more efficient use of natural gas (*i.e*., shifting of generation to natural gas-fired generators with superior heat rates).

Although EIA's 2012 Study found that additional natural gas production would supply most of the natural gas needed to support added LNG exports, EIA modeled the effects of higher natural gas prices on energy consumption in the United States in the years 2015 through 2035, and found several additional results. In particular, EIA found that "under Reference case conditions, decreased natural gas consumption as a result of added exports are countered proportionately by increased coal consumption (72 percent), increased liquid fuel consumption (8 percent), other increased consumption, such as from renewable generation sources (9 percent), and decreases in total consumption (11 percent)."[216] Further, EIA determined that, in the earlier years of the 2015 to 2035 period, "the amount of natural gas to coal switching is greater," with "coal play[ing] a more dominant role in replacing the decreased levels of natural gas consumption, which also tend to be greater in the earlier years."[217] Likewise, "[s]witching from natural gas to coal is less significant in later years, partially as a result of a greater proportion of switching into renewable generation."[218] EIA ultimately projected that, for LNG export levels from 6 to 12 Bcf/d of natural gas and under Reference case conditions, aggregate carbon dioxide emissions would increase above a base case with no exports by between 643 and 1,227 million metric tons (0.5 to 1.0 percent) over the period from 2015 to 2035.[219] It is worth noting, however, that a substantial portion of these projected emissions came from consumption of natural gas in the liquefaction process, rather than from increased use of coal. The liquefaction of natural gas is captured in the LCA GHG Report's estimate of the life cycle GHG emissions of U.S.-exported LNG, discussed above.

We further note that EIA's 2014 Study assumed the regulations in effect at the time the AEO 2014 was prepared.[220] Therefore, EIA's analysis included the impacts that EPA's Mercury and Air Toxics Standard[221] but not EPA's Transport Rule[222] as it had been vacated at the time.

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[216] 2012 EIA Study at 18.
[217] *Id.*
[218] *Id.*
[219] *Id.* at 19.
[220] *See supra* § VI.B.
[221] U.S. Envtl. Prot. Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial- Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final

EIA's analysis in 2014 also captured the Clean Air Interstate Rule, which sets limits on regional sulphur dioxide and mono-nitrogen oxides (SO_2 and NO_x). There are, however, other rules that were not final at the time of AEO 2014, including two then-proposed rules from EPA to reduce the extent to which the increased use of coal would compensate for reduced use of natural gas. These rules, finalized in the fall of 2015, impose limits on GHG emissions from both new and existing coal-fired power plants.[223] In particular, these rules have the potential to mitigate significantly any increased emissions from the U.S. electric power sector that would otherwise result from increased use of coal, and perhaps to negate those increased emissions entirely.

The AEO 2016 incorporated the Clean Power Plan final rule in the Reference case and assumes that all states choose to meet a mass-based standard to cover both existing and new sources of carbon dioxide emissions. In the Reference case—which includes 18.4 Bcf/d of LNG exports from the United States in 2040—electric power sector carbon dioxide emissions are projected to be 35 percent below 2005 levels in 2030 due to the implementation of the CPP. Natural gas generation increases by 44 percent in the Reference case from 2015 to 2040, and coal generation declines by 32 percent from 2015 to 2040.

Therefore, on the record before us, we cannot conclude that exports of natural gas would be likely to cause a significant increase in U.S. GHG emissions through their effect on natural gas prices and the use of coal for electric generation.

Rule, 77 Fed. Reg. 9,304 (Feb. 16, 2012).

[222] U.S. Envtl. Prot. Agency, Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals; Final Rule, 76 Fed. Reg. 48,208 (Aug. 8, 2011).

[223] U.S. Envtl. Protection Agency, Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units; Final Rule, 80 Fed. Reg. 64,510 (Oct. 23, 2015); U.S. Envtl. Protection Agency, Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule, 80 Fed. Reg. 64,662 (Oct. 23, 2015) (effective Dec. 22, 2015). As noted above, *supra* note 103, the U.S. Supreme Court has issued a stay of the effectiveness of this rule pending review.

b. International Impacts Associated with Energy Consumption in Foreign Nations

The LCA GHG Report estimated the life cycle GHG emissions of U.S. LNG exports to Europe and Asia, compared with certain other fuels used to produce electric power in those importing countries. The key findings for U.S. LNG exports to Europe and Asia are summarized in Figures 3 and 4 below, which are also presented above in Section IX.A (Figures 1 and 2):

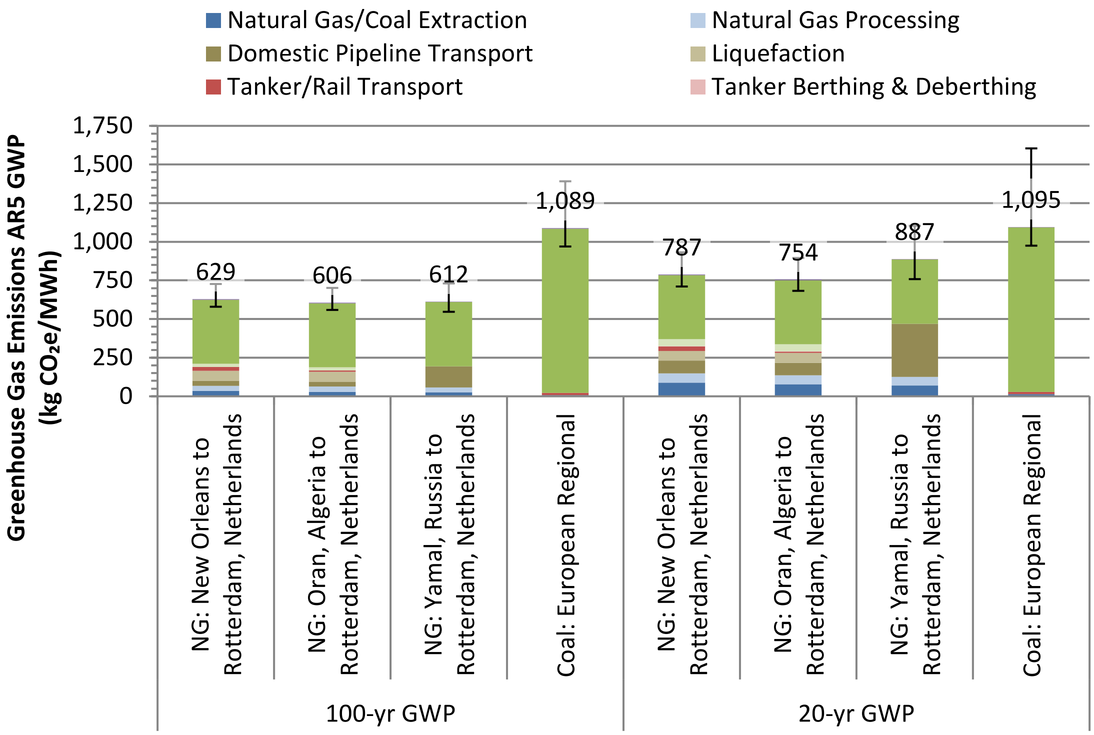

Figure 3: Life Cycle GHG Emissions for Natural Gas and Coal Power in Europe[224]

[224] LCA GHG Report at 9 (Figure 6-1).

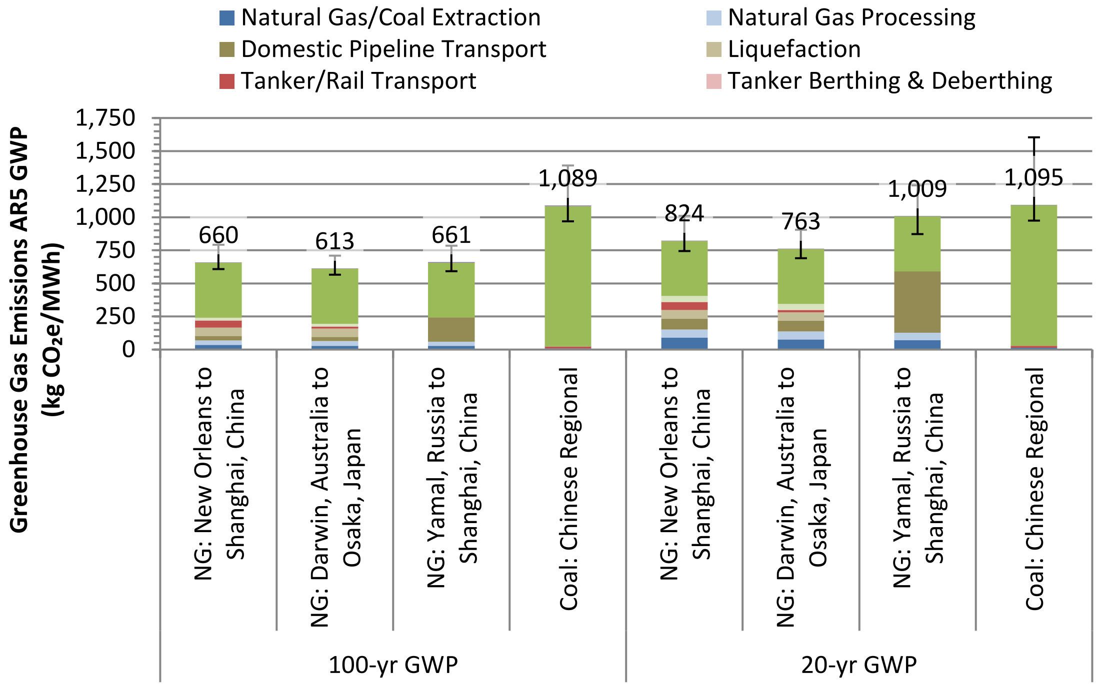

Figure 4: Life Cycle GHG Emissions for Natural Gas and Coal Power in Asia[225]

While acknowledging substantial uncertainty, the LCA GHG Report shows that 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. Further, 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.[226]

The LCA GHG Report does not answer the ultimate question whether authorizing exports of natural gas to non-FTA nations will increase or decrease global GHG emissions, because regional coal and imported natural gas are not the *only* fuels with which U.S.-exported LNG would compete. U.S. LNG exports may also compete with renewable energy, nuclear energy, petroleum-based liquid fuels, coal imported from outside East Asia or Western Europe, indigenous natural gas, synthetic natural gas derived from coal, and other resources, as well as

[225] LCA GHG Report at 10 (Figure 6-2).
[226] *Id*. at 9, 18.

efficiency and conservation measures. To model the effect that U.S. LNG exports would have on net global GHG emissions would require projections of how each of these fuel sources would be affected in each LNG-importing nation. Such an analysis would not only have to consider market dynamics in each of these countries over the coming decades, but also the interventions of numerous foreign governments in those markets.

For example, Sierra Club and other commenters have observed that renewable energy has experienced significant growth in key LNG-importing countries such as India and China. These commenters do not, however, place the growth of renewable energy in the context of the aggregate use of fossil energy projects in those countries. Nor do they explain the extent to which growth in renewable energy has been driven by public policies in those countries and how the availability of U.S. LNG exports would or would not impact the continuation of those policies.

The uncertainty associated with estimating each of these factors would likely render such an analysis too speculative to inform the public interest determination in this or other non-FTA LNG export proceedings. Accordingly, DOE/FE elected to focus on the discrete question of how U.S. LNG compares on a life cycle basis to regional coal and other sources of imported natural gas in key LNG-importing countries. This is a useful comparison because coal and imported natural gas are prevalent fuel sources for electric generation in non-FTA LNG-importing nations. For example, EIA notes that installed electric generation capacity in China was 63 percent coal and 4 percent natural gas in 2013.[227] For India, installed electric generation capacity in 2014 is 62 percent coal and 8 percent natural gas.[228] In both China and India, electric generation

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[227] U.S. Energy Information Administration, China Analysis Brief (last updated May 14, 2015), *available at:* http://www.eia.gov/beta/international/analysis.cfm?iso=CHN.

[228] U.S. Energy Information Administration, India Analysis Brief (last updated June 14, 2016), *available at*

capacity is expected to increase substantially in coming years. For Japan, the largest importer of LNG in the world, electric generation from fossil fuels was 74 percent of total generation in 2011 and 86 percent in 2013 after the Fukushima disaster.[229] In Europe, use of fossil fuels is slightly less than in the Asian nations noted above but still significant, comprising 62 percent of electric generation in the United Kingdom and around half for Spain for 2014, respectively.[230]

The conclusions of the LCA GHG Report, combined with the observation that many LNG-importing nations rely heavily on fossil fuels for electric generation, suggests that exports of U.S. LNG may decrease global GHG emissions, although there is substantial uncertainty on this point as indicated above. In any event, the record does not support the conclusion that U.S. LNG exports will increase global GHG emissions in a material or predictable way. Therefore, while we share the commenters' strong concern about GHG emissions as a general matter, based on the current record evidence, we do not see a reason to conclude that U.S. LNG exports will significantly exacerbate global GHG emissions.

4. Other Considerations

Our decision is not premised on an uncritical acceptance of the general conclusion of the 2014 and 2015 LNG Export Studies of net economic benefits from LNG exports. Both of those Studies and many public comments identify significant uncertainties and even potential negative impacts from LNG exports. The economic impacts of higher natural gas prices and potential increases in natural gas price volatility are two of the factors that we view most seriously. Yet

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http://www.eia.gov/beta/international/analysis.cfm?iso=IND

[229] U.S. Energy Information Administration, Japan Analysis Brief (last updated Jan. 30, 2015), *available at:* http://www.eia.gov/beta/international/analysis.cfm?iso=JPN.

[230] EIA, International Energy Statistics, *available at:* http://www.eia.gov/beta/international/. To evaluate the effect that U.S. LNG exports may have on the mix of fuels used for electric generation in Western Europe also requires consideration of the role of the European Trading System (ETS). The ETS places a cap on GHG emissions. Therefore, where the cap is a binding constraint, the ETS ultimately may ensure that the availability of U.S.-exported LNG will not affect aggregate emissions.

we also have taken into account factors that could mitigate such impacts, such as the current oversupply situation and data indicating that the natural gas industry would increase natural gas supply in response to increasing exports. Further, we note that it is far from certain that all or even most of the proposed LNG export projects will ever be realized because of the time, difficulty, and expense of commercializing, financing, and constructing LNG export terminals, as well as the uncertainties inherent in the global market demand for LNG. On balance, we find that the potential negative impacts of Cameron LNG's proposed exports are outweighed by the likely net economic benefits and by other non-economic or indirect benefits.

More generally, DOE/FE continues to subscribe to the principle set forth in our 1984 Policy Guidelines[231] that, under most circumstances, the market is the most efficient means of allocating natural gas supplies. However, agency intervention may be necessary to protect the public in the event there is insufficient domestic natural gas for domestic use. There may be other circumstances as well that cannot be foreseen that would require agency action.[232] Given these possibilities, DOE/FE recognizes the need to monitor market developments closely as the impact of successive authorizations of LNG exports unfolds.

D. Conclusion

We have reviewed the evidence in the record and relevant precedent in earlier non-FTA export decisions and have not found an adequate basis to conclude that Cameron LNG's

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[231] 49 Fed. Reg. at 6684 (Feb. 22, 1984).

[232] Some commenters previously asked DOE to clarify the circumstances under which the agency would exercise its authority to revoke (in whole or in part) previously issued LNG export authorizations. We cannot precisely identify all the circumstances under which such action would be taken. We reiterate our observation in *Sabine Pass* that: "In the event of any unforeseen developments of such significant consequence as to put the public interest at risk, DOE/FE is fully authorized to take action as necessary to protect the public interest. Specifically, DOE/FE is authorized by section 3(a) of the Natural Gas Act … to make a supplemental order as necessary or appropriate to protect the public interest. Additionally, DOE is authorized by section 16 of the Natural Gas Act 'to perform any and all acts and to prescribe, issue, make, amend, and rescind such orders, rules, and regulations as it may find necessary or appropriate' to carry out its responsibilities." *Sabine Pass*, DOE/FE Order No. 2961, at 33 n.45 (quoting 15 U.S.C. § 717o).

proposed exports of LNG to non-FTA countries will be inconsistent with the public interest. For that reason, we are authorizing Cameron LNG's proposed exports to non-FTA countries subject to the limitations and conditions described in this Order.

In deciding whether to grant a final non-FTA export authorization, we consider in our decision-making the cumulative impacts of the total volume of all final non-FTA export authorizations. With the issuance of this Order, DOE/FE has now issued final non-FTA authorizations in a cumulative volume of exports totaling 13.22 Bcf/d of natural gas, or 4.83 Tcf/yr, for the 18 final authorizations issued to date—Sabine Pass Liquefaction, LLC (2.2 Bcf/d),[233] Carib Energy (USA) LLC (0.04 Bcf/d),[234] Cameron LNG, LLC (1.7 Bcf/d),[235] FLEX I (1.4 Bcf/d),[236] FLEX II (0.4 Bcf/d),[237] Dominion Cove Point LNG, LP (0.77 Bcf/d),[238] Cheniere Marketing, LLC and Corpus Christi Liquefaction, LLC (2.1 Bcf/d),[239] Sabine Pass Liquefaction,

[233] *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 2961-A, FE Docket No. 10-111-LNG, Final Opinion and Order Granting Long-Term Authorization to Export Liquefied Natural Gas From Sabine Pass LNG Terminal to Non-Free Trade Agreement Nations (Aug. 7, 2012).

[234] *Carib Energy (USA) LLC*, DOE/FE Order No. 3487, FE Docket No. 11-141-LNG, Final Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas in ISO Containers by Vessel to Non-Free Trade Agreement Nations in Central America, South America, or the Caribbean (Sept. 10, 2014).

[235] *Cameron LNG, LLC*, DOE/FE Order No. 3391-A, FE Docket No. 11-162-LNG, Final Opinion and Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Cameron LNG Terminal in Cameron Parish, Louisiana, to Non-Free Trade Agreement Nations (Sept. 10, 2014).

[236] *Freeport LNG Expansion, L.P.*, *et al.*, DOE/FE Order No. 3282-C, FE Docket No. 10-161-LNG, Final Opinion and Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal on Quintana Island, Texas, to Non-Free Trade Agreement Nations (Nov. 14, 2014) (FLEX I Final Order).

[237] *Freeport LNG Expansion, L.P.*, *et al.*, DOE/FE Order No. 3357-B, FE Docket No. 11-161-LNG, Final Opinion and Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Freeport LNG Terminal on Quintana Island, Texas, to Non-Free Trade Agreement Nations (Nov. 14, 2014) (FLEX II Final Order).

[238] *Dominion Cove Point LNG, LP*, DOE/FE Order No. 3331-A, FE Docket No. 11-128-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas from the Cove Point LNG Terminal in Calvert County, Maryland, to Non-Free Trade Agreement Nations (May 7, 2015).

[239] *Cheniere Marketing, LLC and Corpus Christi Liquefaction, LLC*, DOE/FE Order No. 3638, FE Docket No. 12-97-LNG, Final Order and Opinion Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Proposed Corpus Christi Liquefaction Project to Be Located in Corpus Christi, Texas, to Non-Free Trade Agreement Nations (May 12, 2015).

LLC Expansion Project (1.38 Bcf/d),[240] American Marketing LLC (0.008 Bcf/d),[241] Emera CNG, LLC (0.008 Bcf/d),[242] Floridian Natural Gas Storage Company, LLC,[243] Air Flow North American Corp. (0.002 Bcf/d),[244] Bear Head LNG Corporation and Bear Head LNG (USA), LLC (0.81 Bcf/d),[245] Pieridae Energy (USA) Ltd.,[246] Sabine Pass Liquefaction, LLC Design Increase (0.56 Bcf/d),[247] Cameron LNG, LLC Design Increase (0.42 Bcf/d),[248] Flint Hills Resources, LP (0.01 Bcf/d),[249] and this Order (1.41 Bcf/d).

We note that the volumes authorized for export in the *Carib* and *Floridian* orders are both 14.6 Bcf/yr of natural gas (0.04 Bcf/d), yet are not additive to one another because the

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[240] *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 3669, FE Docket Nos. 13-30-LNG, 13-42-LNG, & 13-121-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Sabine Pass LNG Terminal Located in Cameron Parish, Louisiana, to Non-Free Trade Agreement Nations (June 26, 2015).

[241] *American LNG Marketing LLC*, DOE/FE Order No. 3690, FE Docket No. 14-209-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas in ISO Containers Loaded at the Proposed Hialeah Facility Near Medley, Florida, and Exported by Vessel to Non-Free Trade Agreement Nations (Aug. 7, 2015).

[242] *Emera CNG, LLC*, DOE/FE Order No. 3727, FE Docket No. 13-157-CNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Compressed Natural Gas by Vessel From a Proposed CNG Compression and Loading Facility at the Port of Palm Beach, Florida, to Non-Free Trade Agreement Nations (Oct. 19, 2015).

[243] *Floridian Natural Gas Storage Co., LLC*, DOE/FE Order No. 3744, FE Docket No. 15-38-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas in ISO Containers Loaded at the Proposed Floridian Facility in Martin County, Florida, and Exported by Vessel to Non-Free Trade Agreement Nations (Nov. 25, 2015).

[244] *Air Flow North American Corp*., DOE/FE Order No. 3753, FE Docket No. 15-206-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas in ISO Containers Loaded at the Clean Energy Fuels Corp. LNG Production Facility in Willis, Texas, and Exported by Vessel to Non-Free Trade Agreement Nations in Central America, South America, the Caribbean, or Africa (Dec. 4, 2015).

[245] *Bear Head LNG Corporation and Bear Head LNG (USA)*, DOE/FE Order No. 3770, FE Docket No. 15-33-LNG, Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export U.S.-Sourced Natural Gas by Pipeline to Canada for Liquefaction and Re-Export in the Form of Liquefied Natural Gas to Non-Free Trade Agreement Countries (Feb. 5, 2016).

[246] *Pieridae Energy (USA) Ltd*., DOE/FE Order No. 3768, FE Docket No. 14-179-LNG, Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export U.S.-Sourced Natural Gas Natural Gas by Pipeline to Canada for Liquefaction and Re-Export in the Form of Liquefied Natural Gas to Non-Free Trade Agreement Countries (Feb. 5, 2016).

[247] *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 3792, FE Docket No. 15-63-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel From the Sabine Pass LNG Terminal Located in Cameron Parish, Louisiana, to Non-Free Trade Agreement Nations (Mar. 11, 2016).

[248] *Cameron LNG, LLC*, DOE/FE Order No. 3797, FE Docket No. 15-167-LNG, Final Opinion and Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Cameron Terminal Located in Cameron and Calcasieu Parishes, Louisiana, to Non-Free Trade Agreement Nations (Mar. 18, 2016).

[249] *Flint Hills Resources, LP*, DOE/FE Order No. 3829, *supra* note 16.

source of LNG approved under both orders is from the Floridian Facility.[250] Likewise, the volumes authorized for export in the Bear Head and Pieridae US orders are not additive; together, they are limited to a maximum of 0.81 Bcf/d to reflect the current capacity of the Maritimes Northeast Pipeline at the U.S.-Canadian border.[251] In sum, the total export volume is within the range of scenarios analyzed in the 2014 and 2015 LNG Export Studies. The 2015 Study found that in all such scenarios—assuming LNG export volumes totaling 12 Bcf/d up to 20 Bcf/d of natural gas—the United States would experience net economic benefits.

DOE/FE will continue taking a measured approach in reviewing the other pending applications to export domestically produced LNG. Specifically, DOE/FE will continue to assess the cumulative impacts of each succeeding request for export authorization on the public interest with due regard to the effect on domestic natural gas supply and demand fundamentals. In keeping with the performance of its statutory responsibilities, DOE/FE will attach appropriate and necessary terms and conditions to authorizations to ensure that the authorizations are utilized in a timely manner and that authorizations are not issued except where the applicant can show that there are or will be facilities capable of handling the proposed export volumes and existing and forecast supplies that support that action. Other conditions will be applied as necessary.

The reasons in support of proceeding cautiously are several: (1) the 2014 and 2015 LNG Export Studies, like any studies based on assumptions and economic projections, are inherently limited in their predictive accuracy; (2) applications to export significant quantities of

[250] *See Floridian Natural Gas Storage Co., LLC*, DOE/FE Order No. 3744, at 22 (stating that the quantity of LNG authorized for export by Floridian in DOE/FE Order No. 3744 "will be reduced by the portion of the total approved volume of 14.6 Bcf/yr that is under firm contract directly or indirectly to Carib Energy (USA), LLC"); *see also id*. at 21 (Floridian "may not treat the volumes authorized for export in the [*Carib* and *Floridian*] proceedings as additive to one another").

[251] *See Bear Head LNG Corporation and Bear Head LNG (USA)*, DOE/FE Order No. 3770, at 178-79 (stating that the quantity of LNG authorized for export by Bear Head LNG and Pieridae US "are not additive; together, they are limited to a maximum of 0.81 Bcf/d to reflect the current capacity of the M&N US Pipeline").

domestically produced LNG are a new phenomena with uncertain impacts; and (3) the market for natural gas has experienced rapid reversals in the past and is again changing rapidly due to economic, technological, and regulatory developments. The market of the future very likely will not resemble the market of today. In recognition of these factors, DOE/FE intends to monitor developments that could tend to undermine the public interest in grants of successive applications for exports of domestically produced LNG and, as previously stated, to attach terms and conditions to the authorization in this proceeding and to succeeding LNG export authorizations as are necessary for protection of the public interest.

XIII. TERMS AND CONDITIONS

To ensure that the authorization issued by this Order is not inconsistent with the public interest, DOE/FE has attached the following Terms and Conditions to the authorization. The reasons for each term or condition are explained below. Cameron LNG must abide by each Term and Condition or may face rescission of the authorization or other appropriate sanction.

A. Term of the Authorization

Cameron LNG requests a 20-year term for the authorization commencing from the date export operations begin. This term is consistent with our practice in the non-FTA export authorizations issued to date, including Cameron LNG's non-FTA authorizations in DOE/FE Order Nos. 3391-A and 3797. In imposing this condition, we are mindful that LNG export facilities are capital intensive and that, to obtain financing for such projects, there must be a reasonable expectation that the authorization will continue for a term sufficient to support repayment. We find that a 20-year term is likely sufficient to achieve this result. Accordingly, the 20-year term will begin on the data when Cameron LNG commences commercial export of domestically sourced LNG from the Expansion Project (Trains 4 and 5), but not before.

B. Commencement of Operations Within Seven Years

Cameron LNG requested this authorization to commence on the earlier of the date of first export or seven years from the date of the issuance of this Order. Consistent with Cameron LNG's non-FTA authorizations in DOE/FE Order Nos. 3391-A and 3797 and other non-FTA authorizations issued to date, DOE/FE will add as a condition of the authorization that Cameron LNG must commence commercial LNG export operations from the Expansion Project no later than seven years from the date of issuance of this Order. The purpose of this condition is to ensure that other entities that may seek similar authorizations are not frustrated in their efforts to obtain those authorizations by authorization holders that are not engaged in actual export operations.

C. Commissioning Volumes

Cameron LNG will be permitted to apply for short-term export authorizations to export Commissioning Volumes prior to the commencement of the first commercial exports of domestically sourced LNG from the Expansion Project (Trains 4 and 5). "Commissioning Volumes" are defined as the volume of LNG produced and exported under a short-term authorization during the initial start-up of each LNG train, before each LNG train has reached its full steady-state capacity and begun its commercial exports pursuant to Cameron LNG's long-term contracts.[252] The Commissioning Volumes will not be counted against the maximum level of volumes previously authorized in any of Cameron LNG's blanket short-term or long-term FTA and non-FTA authorizations, including this Order.

[252] For additional discussion of Commissioning Volumes and the Make-Up Period referenced below, see *Freeport LNG Expansion, L.P.*, *et al.*, DOE/FE Order Nos. 3282-B & 3357-A, Order Amending DOE/FE Order Nos. 3282 and 3357, FE Docket Nos. 10-161-LNG & 11-161-LNG, at 4-9 (June 6, 2014).

D. Make-Up Period

Cameron LNG will be permitted to continue exporting for a total of three years following the end of the 20-year term established in this Order, solely to export any Make-Up Volume that it was unable to export during the original export period. The three-year term during which the Make-Up Volume may be exported shall be known as the "Make-Up Period."

The Make-Up Period does not affect or modify the total volume of LNG previously authorized in any of Cameron LNG's FTA and non-FTA orders, including this Order. Insofar as Cameron LNG may seek to export additional volumes not previously authorized for export, it will be required to obtain appropriate authorization from DOE/FE.

E. Transfer, Assignment, or Change in Control

DOE/FE's natural gas import/export regulations prohibit authorization holders from transferring or assigning authorizations to import or export natural gas without specific authorization by the Assistant Secretary for Fossil Energy.[253] As a condition of the similar authorization issued to Sabine Pass in DOE/FE Order No. 2961, DOE/FE found that the requirement for prior approval by the Assistant Secretary under its regulations applies to any change of effective control of the authorization holder either through asset sale or stock transfer or by other means. This condition was deemed necessary to ensure that, prior to any transfer or change in control, DOE/FE will be given an adequate opportunity to assess the public interest impacts of such a transfer or change.

DOE/FE construes a change in control to mean a change, directly or indirectly, of the power to direct the management or policies of an entity whether such power is exercised through one or more intermediary companies or pursuant to an agreement, written or oral, and whether

[253] 10 C.F.R. § 590.405.

such power is established through ownership or voting of securities, or common directors, officers, or stockholders, or voting trusts, holding trusts, or debt holdings, or contract, or any other direct or indirect means. A rebuttable presumption that control exists will arise from the ownership or the power to vote, directly or indirectly, 10 percent or more of the voting securities of such entity.[254]

F. Agency Rights

Cameron LNG requests authorization to export LNG from the Expansion Project in a volume equivalent to 515 Bcf/yr on its own behalf and as agent for other entities that hold title to the LNG at the time of export, pursuant to long-term sales and purchase agreements with Cameron LNG. DOE/FE previously addressed the issue of Agency Rights in Order No. 2913, which granted Freeport LNG Expansion, L.P., *et al.* (FLEX) authority to export LNG to FTA countries.[255] In that order, DOE/FE approved a proposal by FLEX to register each LNG title holder for whom FLEX sought to export LNG as agent. DOE/FE found that this proposal was an acceptable alternative to the non-binding policy adopted by DOE/FE in *Dow Chemical*, which established that the title for all LNG authorized for export must be held by the authorization holder at the point of export.[256] We find that the same policy considerations that supported DOE/FE's acceptance of the alternative registration proposal in Order No. 2913 apply here as well. DOE/FE reiterated its policy on Agency Rights procedures in *Gulf Coast LNG Export,*

[254] For information on DOE/FE's procedures governing a change in control, see U.S. Dep't of Energy, Procedures for Changes in Control Affecting Applications and Authorizations to Import or Export Natural Gas, 79 Fed. Reg. 65,641 (Nov. 5, 2014) [hereinafter Procedures for Changes in Control].

[255] *Freeport LNG Expansion, L.P., et al.*, DOE/FE Order No. 2913, FE Docket No. 10-160-LNG, Order Granting Long-Term Authorization to Export Liquefied Natural Gas from Freeport LNG Terminal to Free Trade Nations (Feb. 10, 2011) [hereinafter *Freeport LNG*].

[256] *Dow Chem. Co.*, DOE/FE Order No. 2859, FE Docket No. 10-57-LNG, Order Granting Blanket Authorization to Export Liquefied Natural Gas, at 7-8 (Oct. 5, 2010), *discussed in Freeport LNG*, DOE/FE Order No. 2913, at 7-8.

LLC.[257] In *Gulf Coast*, DOE/FE confirmed that, in LNG export orders in which Agency Rights have been granted, DOE/FE shall require registration materials filed for, or by, an LNG title-holder (Registrant) to include the same company identification information and long-term contract information of the Registrant as if the Registrant had filed an application to export LNG on its own behalf.[258]

To ensure that the public interest is served, the authorization granted herein shall be conditioned to require that where Cameron LNG proposes to export LNG from the Expansion Projects (Trains 4 and 5) as agent for other entities that hold title to the LNG (Registrants), it must register with DOE/FE those entities on whose behalf it will export LNG in accordance with the procedures and requirements described herein.

G. Contract Provisions for the Sale or Transfer of LNG to be Exported

DOE/FE's regulations require applicants to supply transaction-specific factual information "to the extent practicable."[259] Additionally, DOE/FE regulations allow confidential treatment of the information supplied in support of or in opposition to an application if the submitting party requests such treatment, shows why the information should be exempted from public disclosure, and DOE/FE determines it will be afforded confidential treatment in accordance with 10 C.F.R. § 1004.11.[260]

DOE/FE will require that Cameron LNG file or cause to be filed with DOE/FE any relevant long-term commercial agreements, including liquefaction tolling agreements, pursuant to which Cameron LNG exports LNG as agent for a Registrant.

[257] *Gulf Coast LNG Export, LLC*, DOE/FE Order No. 3163, FE Docket No. 12-05-LNG, Order Granting Long-Term Multi-Contract Authority to Export LNG by Vessel from the Proposed Brownsville Terminal to Free Trade Agreement Nations (Oct. 16, 2012).
[258] *See id*. at 7-8.
[259] 10 C.F.R. § 590.202(b).
[260] *Id*. § 590.202(e).

DOE/FE finds that the submission of all such agreements or contracts within 30 days of their execution using the procedures described below will be consistent with the "to the extent practicable" requirement of section 590.202(b). By way of example and without limitation, a "relevant long-term commercial agreement" would include an agreement with a minimum term of two years, an agreement to provide gas processing or liquefaction services at the Cameron Terminal, a long-term sales contract involving natural gas or LNG stored or liquefied at the Terminal, or an agreement to provide export services from the Terminal.

In addition, DOE/FE finds that section 590.202(c) of DOE/FE's regulations[261] requires that Cameron LNG file, or cause to be filed, all long-term contracts associated with the long-term supply of natural gas to the Cameron Terminal, whether signed by Cameron LNG or the Registrant, within 30 days of their execution.

DOE/FE recognizes that some information in Cameron LNG's or a Registrant's long-term commercial agreements associated with the export of LNG, and/or long-term contracts associated with the long-term supply of natural gas to the Cameron Terminal, may be commercially sensitive. DOE/FE therefore will provide Cameron LNG the option to file or cause to be filed either unredacted contracts, or in the alternative (A) Cameron LNG may file, or cause to be filed, long-term contracts under seal, but it also will file either: i) a copy of each long-term contract with commercially sensitive information redacted, or ii) a summary of all major provisions of the contract(s) including, but not limited to, the parties to each contract, contract term, quantity, any take or pay or equivalent provisions/conditions, destinations, re-sale provisions, and other relevant provisions; and (B) the filing must demonstrate why the redacted information should be exempted from public disclosure.

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[261] *Id*. § 590.202(c).

To ensure that DOE/FE destination and reporting requirements included in this Order are conveyed to subsequent title holders, DOE/FE will include as a condition of this authorization that future contracts for the sale or transfer of LNG exported pursuant to this Order shall include an acknowledgement of these requirements.

H. Export Quantity

Cameron LNG sought authorization to export up 515 Bcf/yr of natural gas (1.41 Bcf/d), which is within the maximum liquefaction capacity of the Expansion Project as approved by FERC. As set forth herein, this Order authorizes the export of LNG in the full amount requested, up to the equivalent of 515 Bcf/yr of natural gas.

I. Combined FTA and Non-FTA Export Authorization Volumes

Cameron LNG is currently authorized in DOE/FE Order No. 3680 to export domestically produced LNG to FTA countries in the same volume authorized in this Order, equivalent to approximately 515 Bcf/yr of natural gas. Because the source of LNG for that FTA order and this Order is the Expansion Project (Trains 4-5), Cameron LNG may not treat the volumes authorized for export in the two proceedings as additive to one another.

However, the export volume in this Order is additive to the export volumes set forth in Cameron LNG's FTA and non-FTA authorizations for Trains 1-3 of the Cameron Terminal, set forth in DOE/FE Order Nos. 3059, 3620, 3391-A, and 3797.

XIV. FINDINGS

On the basis of the findings and conclusions set forth above, we find that it has not been shown that a grant of the requested authorization will be inconsistent with the public interest, and we further find that Cameron LNG's Application should be granted subject to the Terms and Conditions set forth herein. The following Ordering Paragraphs reflect current DOE/FE practice.

XV. ORDER

Pursuant to section 3 of the Natural Gas Act, it is ordered that:

A. Cameron LNG, LLC is authorized to export domestically produced LNG by vessel from Trains 4 and 5 of the Cameron Terminal (Expansion Project), located in Cameron and Calcasieu Parishes, Louisiana, in a volume equivalent to 515 Bcf/yr of natural gas. Cameron LNG is authorized to export this LNG on its own behalf and as agent for other entities that hold title to the natural gas, pursuant to one or more long-term contracts (a contract greater than two years).

B. The 20-year authorization period will commence when Cameron LNG commences commercial export of domestically sourced LNG from the Cameron Terminal, but not before. Cameron LNG may export Commissioning Volumes prior to the commencement of the terms of this Order, pursuant to a separate short-term export authorization. The Commissioning Volumes will not be counted against the maximum level of volumes previously authorized in any of Cameron's FTA and non-FTA orders, including this Order.

C. Cameron LNG may continue exporting for a total of three years following the end of the 20-year export term, solely to export any Make-Up Volume that it was unable to export during the original export period. The three-year Make-Up Period allowing the export of Make-Up Volumes does not affect or modify the total volume of LNG authorized for export in any of Cameron's existing FTA and non-FTA orders, including this Order. Insofar as Cameron LNG may seek to export additional volumes not previously authorized for export, it will be required to obtain appropriate authorization from DOE/FE.

D. Cameron LNG must commence export operations using the planned liquefaction facilities no later than seven years from the date of issuance of this Order.

E. The LNG export quantity authorized in this Order is equivalent to 515 Bcf/yr of natural gas. This quantity is not additive to the export volume in Cameron LNG's FTA Order for the Expansion Project (DOE/FE Order No. 3680). However, this quantity is additive to the export volumes set forth in Cameron LNG's FTA and non-FTA authorizations for Trains 1-3 of the Cameron Terminal (DOE/FE Order Nos. 3059, 3620, 3391-A, and 3797, respectively).

F. This LNG may be exported to any country with which the United States does not have a FTA requiring the national treatment for trade in natural gas, which currently has or in the future develops the capacity to import LNG, and with which trade is not prohibited by United States law or policy.

G. Cameron LNG shall ensure that all transactions authorized by this Order are permitted and lawful under United States laws and policies, including the rules, regulations, orders, policies, and other determinations of the Office of Foreign Assets Control of the United States Department of the Treasury and FERC. Failure to comply with this requirement could result in rescission of this authorization and/or other civil or criminal remedies.

H. Cameron LNG shall ensure compliance with all terms and conditions established by FERC in the EA, including the 72 environmental conditions adopted in the FERC Order. Additionally, this authorization is conditioned on Cameron LNG's on-going compliance with any other preventative and mitigative measures at the Cameron Terminal imposed by federal or state agencies.

I. (i) Cameron LNG shall file, or cause others to file, with the Office of Regulation and International Engagement a non-redacted copy of <u>all executed long-term contracts associated with the long-term export of LNG</u> as agent for other entities from the Cameron Terminal. The non-redacted copies may be filed under seal and must be filed within 30 days of their execution.

Additionally, if Cameron LNG has filed the contracts described in the preceding sentence under seal or subject to a claim of confidentiality or privilege, within 30 days of their execution, Cameron LNG shall also file, or cause others to file, for public posting either: (a) a redacted version of the contracts described in the preceding sentence, or (b) major provisions of the contracts. In these filings, Cameron LNG shall state why the redacted or non-disclosed information should be exempted from public disclosure.

(ii) Cameron LNG shall file, or cause others to file, with the Office of Regulation and International Engagement a non-redacted copy of all executed long-term contracts associated with the long-term supply of natural gas to the Cameron Terminal. The non-redacted copies may be filed under seal and must be filed within 30 days of their execution. Additionally, if Cameron LNG has filed the contracts described in the preceding sentence under seal or subject to a claim of confidentiality or privilege, within 30 days of their execution, Cameron LNG shall also file, or cause others to file, for public posting either: i) a redacted version of the contracts described in the preceding sentence, or ii) major provisions of the contracts. In these filings, Cameron LNG shall state why the redacted or non-disclosed information should be exempted from public disclosure.

J. Cameron LNG, or others for whom Cameron LNG acts as agent, shall include the following provision in any agreement or other contract for the sale or transfer of LNG exported pursuant to this Order and any other applicable DOE/FE authorization:

> Customer or purchaser acknowledges and agrees that it will resell or transfer U.S.-sourced natural gas in the form of LNG purchased hereunder for delivery only to countries identified in Ordering Paragraph F of DOE/FE Order No. 3846, issued July 15, 2016, in FE Docket No. 15-90-LNG and/or to purchasers that have agreed in writing to limit their direct or indirect resale or transfer of such LNG to such countries. Customer or purchaser further commits to cause a report to be provided to Cameron LNG, LLC that identifies the country of destination (or countries) into which the exported LNG or natural gas was actually

> delivered and/or received for end use, and to include in any resale contract for such LNG the necessary conditions to insure that Cameron LNG, LLC is made aware of all such actual destination countries.

K. Cameron LNG is permitted to use its authorization in order to export LNG as agent for other entities, after registering such entities with DOE/FE. Registration materials shall include an acknowledgement and agreement by the Registrant to supply Cameron LNG with all information necessary to permit Cameron LNG to register that person or entity with DOE/FE, including: (1) the Registrant's agreement to comply with this Order and all applicable requirements of DOE/FE's regulations at 10 C.F.R. Part 590, including but not limited to destination restrictions; (2) the exact legal name of the Registrant, state/location of incorporation/registration, primary place of doing business, and the Registrant's ownership structure, including the ultimate parent entity if the Registrant is a subsidiary or affiliate of another entity; (3) the name, title, mailing address, e-mail address, and telephone number of a corporate officer or employee of the Registrant to whom inquiries may be directed; and (4) within 30 days of execution, a copy of any long-term contracts not previously filed with DOE/FE, described in Ordering Paragraph I of this Order.

L. Each registration submitted pursuant to this Order shall have current information on file with DOE/FE. Any changes in company name, contact information, change in term of the long-term contract, termination of the long-term contract, or other relevant modification, shall be filed with DOE/FE within 30 days of such change(s).

M. As a condition of this authorization, Cameron LNG shall ensure that all persons required by this Order to register with DOE/FE have done so. Any failure by Cameron LNG to ensure that all such persons or entities are registered with DOE/FE shall be grounds for rescinding in whole or in part the authorization.

N. Within two weeks after the first export of domestically produced LNG occurs from Trains 4 and/or 5 of the Cameron Terminal, Cameron LNG shall provide written notification of the date that the first export of LNG authorized in Ordering Paragraph A above occurred.

O. Cameron LNG shall file with the Office of Regulation and International Engagement, on a semi-annual basis, written reports describing the progress of Trains 4 and 5 of the Cameron Terminal. The reports shall be filed on or by April 1 and October 1 of each year, and shall include information on the status of the long-term contracts associated with the long-term export of LNG and any long-term supply contracts.

P. With respect to any change in control of the authorization holder, Cameron LNG must comply with DOE/FE's Procedures for Change in Control Affecting Applications and Authorizations to Import or Export Natural Gas.[262] For purposes of this Ordering Paragraph, a "change in control" shall include any change, directly or indirectly, of the power to direct the management or policies of Cameron LNG, whether such power is exercised through one or more intermediary companies or pursuant to an agreement, written or oral, and whether such power is established through ownership or voting of securities, or common directors, officers, or stockholders, or voting trusts, holding trusts, or debt holdings, or contract, or any other direct or indirect means.[263]

Q. Monthly Reports: With respect to the LNG exports authorized by this Order, Cameron LNG shall file with the Office of Regulation and International Engagement, within 30 days following the last day of each calendar month, a report indicating whether exports of LNG have been made. The first monthly report required by this Order is due not later than the 30th day of the month following the month of first export. In subsequent months, if exports have not

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[262] *See* Procedures for Changes in Control at 65,541-42.
[263] *See id*. at 65,542.

occurred, a report of "no activity" for that month must be filed. If exports of LNG have occurred, the report must give the following details of each LNG cargo: (1) the name(s) of the authorized exporter registered with DOE/FE; (2) the name of the U.S. export terminal; (3) the name of the LNG tanker; (4) the date of departure from the U.S. export terminal; (5) the country (or countries) into which the exported LNG or natural gas is actually delivered and/or received for end use; (6) the name of the supplier/seller; (7) the volume in Mcf; (8) the price at point of export per million British thermal units (MMBtu); (9) the duration of the supply agreement; and (10) the name(s) of the purchaser(s).

(Approved by the Office of Management and Budget under OMB Control No. 1901-0294)

R. All monthly report filings shall be made to U.S. Department of Energy (FE-34), Office of Fossil Energy, Office of Regulation and International Engagement, P.O. Box 44375, Washington, D.C. 20026-4375, Attention: Natural Gas Reports. Alternatively, reports may be e-mailed to ngreports@hq.doe.gov or may be faxed to Natural Gas Reports at (202) 586-6050.

S. API's unopposed motion to intervene in this proceeding is deemed granted by operation of law. 10 C.F.R. § 590.303(g).

Issued in Washington, D.C., on July 15, 2016.

Christopher A. Smith
Assistant Secretary
Office of Fossil Energy