UNITED STATES OF AMERICA

DEPARTMENT OF ENERGY

OFFICE OF FOSSIL ENERGY

SABINE PASS LIQUEFACTION, LLC	)	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

DOE/FE ORDER NO. 3792

MARCH 11, 2016

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FREQUENTLY USED ACRONYMS

AEA	America's Energy Advantage, Inc.
AEO	Annual Energy Outlook
APGA	American Public Gas Association
API	American Petroleum Institute
Bcf/d	Billion Cubic Feet per Day
Bcf/yr	Billion Cubic Feet per Year
CEQ	The Council on Environmental Quality
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalents
DOE	U.S. Department of Energy
EA	Environmental Assessment
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
ES&T	Environmental Science & Technology (journal)
EUR	Estimated Ultimate Recovery
FE	Office of Fossil Energy, U.S. Department of Energy
FERC	Federal Energy Regulatory Commission
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
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
NEPA	National Environmental Policy Act
NERA	NERA Economic Consulting
NETL	National Energy Technology Laboratory
NGA	Natural Gas Act
NGL	Natural Gas Liquid
NOx	Nitrogen Oxides
PM	Particulate Matter
PNAS	Proceedings of the National Academy of Sciences
SPA	Sale and Purchase Agreement
SPL	Sabine Pass Liquefaction, LLC

Tcf/yr	Trillion Cubic Feet per Year
TGPNA	Total Gas & Power North America, Inc.
tpy	Tons per Year
VOC	Volatile Organic Compound

I. INTRODUCTION

On April 20, 2015, Sabine Pass Liquefaction, LLC (SPL or Sabine Pass)[1] filed an application (Application) with the Office of Fossil Energy of the Department of Energy (DOE/FE) in FE Docket No. 15-63-LNG requesting long-term, multi-contract authorization to export domestically produced liquefied natural gas (LNG) in a volume equivalent to approximately 203 billion cubic feet per year (Bcf/yr) of natural gas (0.56 Bcf per day). SPL seeks to export the LNG by vessel from Trains 1 through 4 of the Sabine Pass Liquefaction Project (Liquefaction Project), which SPL and its affiliate, Sabine Pass LNG, L.P., are currently constructing at the existing Sabine Pass LNG Terminal in Cameron Parish, Louisiana (Sabine Pass LNG Terminal).[2] SPL requests authorization to export this LNG to any country with which the United States does not have a free trade agreement (FTA) requiring national treatment for trade in natural gas, and with which trade is not prohibited by U.S. law or policy (non-FTA countries).[3] SPL states that the grant of this

[1] SPL is an indirect subsidiary of Cheniere Energy Partners, L.P., a limited partnership majority owned by Cheniere Energy, Inc., a developer of LNG terminals and natural gas pipelines on the Gulf Coast of the United States. *See infra* § IV.A.

[2] SPL states that the requested authorization would require no new construction or modification of authorized facilities. App. at 2 n.4.

[3] In a prior application filed in FE Docket No. 14-92-LNG on July 11, 2014, SPL requested authorization to export the same volume of LNG from the Liquefaction Project (Trains 1-4) to any nation that currently has, or may enter into, a FTA requiring national treatment for trade in natural gas, and with which trade is not prohibited by U.S. law or policy (FTA countries). On February 12, 2015, DOE/FE granted that request in Order No. 3595 pursuant to NGA § 3(c), 15 U.S.C. § 717b(c). *See Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 3595, FE Docket No. 14-92-LNG, Order Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Sabine Pass LNG Terminal in Cameron Parish, Louisiana, to Free Trade Agreement Nations (Feb. 12, 2015); *Sabine Pass Liquefaction, LLC*, Errata to DOE/FE Order Nos. 3595 & 3384, FE Docket Nos. 14-92-LNG & 13-121-LNG (Feb. 24, 2015). For additional procedural history, see *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, at 18-21 (June 26, 2015).

Application will align the volumes of LNG authorized for export to non-FTA countries with the maximum liquefaction production capacity of the Liquefaction Project, as approved by the Federal Energy Regulatory Commission (FERC).[4] According to SPL, the requested export volume (203 Bcf/yr) is incremental and therefore additive to the volumes of LNG previously authorized by DOE/FE for export from the Liquefaction Project to non-FTA countries. SPL requests the authorization for a 20-year term to commence on the date of first commercial export from the Liquefaction Project. SPL further seeks to export this LNG on its own behalf and as agent for other entities who will hold title to the LNG at the time of export. SPL filed the Application under section 3(a) of the Natural Gas Act, 15 U.S.C. § 717b(a).

Prior LNG Export Authorizations. SPL presently holds several long-term export authorizations from DOE/FE to export LNG produced in the lower-48 states to both FTA and non-FTA countries. These include: (1) an authorization to export up to 803 Bcf/yr from Trains 1-4 of the Sabine Pass LNG Terminal to FTA countries;[5] (2) an authorization to export the same volume to non-FTA countries;[6] (3) an authorization to export another 203 Bcf/yr from Trains 1-4 to FTA countries;[7] and (4) an authorization to export 503.3

[4] App at 2 n.5.
[5] *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 2833, FE Docket No. 10-85-LNG, Order Granting Long-Term Authorization to Export Liquefied Natural Gas from Sabine Pass LNG Terminal to Free Trade Nations (Sept. 10, 2010).
[6] *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 (May 20, 2011). In August 2012, DOE/FE granted final authorization. *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). The volumes authorized for export in Order Nos. 2833 and 2961-A are not additive.
[7] *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 3595, FE Docket No. 14-92-LNG, Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Sabine Pass LNG Terminal in Cameron Parish, Louisiana, to Free Trade Agreement Nations (Feb. 12, 2015).

Bcf/yr from Trains 5 and 6 at the Sabine Pass LNG Terminal to FTA countries.[8] These authorizations are for 20 year terms to commence on the date of the first commercial delivery from each of the respective liquefaction trains that will be used for shipment of the exports. Additionally, DOE/FE has granted SPL blanket authorization to engage in short-term exports of LNG up to the equivalent of 600 Bcf from the Terminal over a two year period commencing the earlier of the date of the first short-term export or January 15, 2016, to any country with the capacity to import LNG via ocean-going carrier and with which trade is not prohibited by U.S. law or policy.[9]

Procedural History. On August 26, 2015, DOE/FE published a Notice of Application in the Federal Register.[10] The Notice of Application called on interested persons to submit protests, motions to intervene, notices of intervention, and comments on the Application by October 26, 2015. In response to the Notice of Application, DOE/FE received motions to intervene from the American Petroleum Institute (API) and Sierra Club, and Sierra Club protested the Application. In addition, DOE/FE received comments in opposition to the Application from Jean Public and Curtis Morrison. On November 10, 2015, SPL filed the "Answer of Sabine Pass Liquefaction, LLC, in Opposition to Sierra Club Motion to Intervene, Protests, and Comments" (Answer).

Previously, on May 20, 2011, DOE/FE issued *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 2961, the Department's first order conditionally granting a long-term

[8] *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 3669, FE Docket Nos. 13-30-LNG, 13-42-LNG, and 13-121-LNG (Consolidated), Final Opinion and Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Sabine Pass Terminal Located in Cameron Parish, Louisiana to Non-Free Trade Agreement Nations (June 26, 2015).
[9] *Sabine Pass Liquefaction, LLC*, DOE/FE Order No. 3767, FE Docket Nos. 15-171-LNG, Order Granting Blanket Authorization to Export Liquefied Natural Gas by Vessel from the Sabine Pass LNG Terminal Located in Cameron Parish, Louisiana (Jan. 13, 2016).
[10] *Sabine Pass Liquefaction, LLC*, Application for Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas Produced to Non-Free Trade Agreement Countries for a 20-Year Period, 80 Fed. Reg. 51,792 (Aug. 26, 2015) [hereinafter Notice of App.].

authorization to export LNG produced in the lower-48 states to non-FTA countries.[11] In that order, DOE/FE conditionally authorized SPL to export a volume of LNG equivalent to 2.2 Bcf/d (503.3 Bcf/yr) of natural gas from the Sabine Pass LNG Terminal.

By August 2011, with 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.[12] Accordingly, 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 LNG exports.[13]

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 natural gas exports (at 6 Bcf/d and 12 Bcf/d) under numerous scenarios and cases based on projections from EIA's 2011 *Annual Energy Outlook* (AEO 2011), the most recent EIA projections available at the time.[14] 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.[15] As discussed below, EIA generally found that LNG exports will lead to higher domestic natural gas prices, increased domestic natural gas production, reduced

[11] *See* note 3 *supra*.
[12] 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.
[13] *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 (Federal Register Notice of Availability of the LNG Export Study).
[14] 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. *See infra* §§ V.A, XI.B. (discussion of AEO projections).
[15] *See* LNG Export Study – Related Documents, *available at* http://energy.gov/fe/downloads/lng-export-study-related-documents (EIA Analysis (Study - Part 1)).

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 (2012 NERA Study).[16] Among its key findings, NERA projected that the United States would gain net economic benefits from allowing LNG exports. For every market scenario examined, net economic benefits increased as the level of LNG exports increased.[17]

On December 11, 2012, DOE/FE published a Notice of Availability (NOA) of the EIA and NERA studies (collectively, the 2012 LNG Export Study or Study).[18] 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.[19] The NOA required initial comments by January 24, 2013, and reply comments between January 25 and February 25, 2013.[20] DOE/FE received over 188,000 initial comments and over 2,700 reply comments, of which approximately 800 were

[16] *See id*. (NERA Economic Consulting Analysis (Study - Part 2)).
[17] *See infra* § V.B.
[18] 77 Fed. Reg. at 73,627.
[19] *Id*. at 73,628.
[20] *Id.* at 73,627. On January 28, 2013, DOE issued a Procedural Order accepting for filing any initial comments that had been received as of 11:59 p.m., Eastern Time, on January 27, 2013.

unique.[21] The comments also included 11 economic studies prepared by commenters or organizations under contract to commenters.

The public comments represent a diverse range of interests and perspectives, including those of federal, state, and local political leaders; large public companies; public interest organizations; academia; industry associations; foreign interests; and thousands of U.S. citizens. While the majority of comments were short letters expressing support or opposition to the LNG Export Study or to LNG exports in general, others contained detailed statements of differing points of views. 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, including the present proceeding.[22] As discussed below, DOE/FE has carefully examined the comments and has considered them in its review of SPL's Application.

Additionally, 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 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*

[21] 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).

[22] *See* 77 Fed. Reg. at 73,629 & n.4.

Documents Concerning Exports of Natural Gas from the United States (Draft Addendum).[23] DOE/FE received comments on the Draft Addendum and, on August 15, 2014, issued the final Addendum (hereafter Addendum) with its response to the public comments contained in Appendix B.[24]

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* § X.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 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).[25] DOE/FE also received public comment on the LCA GHG Report, and provides its response to those comments in this Order. *See infra* § X.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.[26] As explained below, neither the Addendum nor the LCA GHG Report are required by the National

[23] 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.
[24] 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). *See infra* § IX.
[25] 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.
[26] By electronic mail, DOE/FE notified all parties to this proceeding of the issuance of both the draft Addendum and the LCA GHG Report, as well as the opportunity to submit comments on those documents.

Environmental Policy Act (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.

FERC Proceeding. The stated purpose of the Application is to align the volumes authorized for export using Trains 1-4 of the Liquefaction Project with the liquefaction production capacity of the Project approved by FERC. According to Sabine Pass, FERC originally authorized the construction and operation of the Liquefaction Project in 2012[27] and authorized an increase in the Project's liquefaction production capacity in 2014 to reflect maximum LNG production and export capability under optimized operational conditions.[28] SPL indicates that the Application is intended to reflect the capacity additions approved in the 2014 FERC order. SPL maintains that the needed FERC authority, therefore, has already been issued and that a grant of the Application in this proceeding will not involve any new construction activities not previously approved by FERC.

In this connection, we note that FERC staff released an environmental assessment (EA) for Trains 1-4 of the Liquefaction Project on December 28, 2011 (2011 EA).[29] FERC's 2011 EA examined numerous environmental impacts of the Liquefaction Project, including impacts on geology and soil resources; water resources; fisheries, vegetation, and wildlife resources; land use, recreation, and visual resources; socioeconomic impacts and environmental justice; cultural resources; air quality and noise; reliability and safety; and cumulative impacts. Additionally, the 2011 EA reviewed alternatives to the Project,

[27] *Sabine Pass Liquefaction, LLC and Sabine Pass LNG, L.P.*, 139 FERC 61,039 (2012), Order Denying Rehearing, 140 FERC P61,076 (2012); *Sabine Pass Liquefaction, LLC and Sabine Pass LNG, L.P.*, 144 FERC P61,099 (2013).
[28] *Sabine Pass Liquefaction, LLC and Sabine Pass LNG, L.P.*, 146 FERC P61,117 (2014).
[29] Environmental Assessment for the Sabine Pass Liquefaction Project, Sabine Pass Liquefaction, LLC, and Sabine Pass LNG, L.P., FERC Docket No. CP11-72-000 (Dec. 2011).

including a no-action alternative; alternative fossil energy sources; alternative systems (i.e., making use of other existing natural gas export facilities, pipelines, or other methods of transporting natural gas); and alternative configurations for the design of the Project. Based on these analyses, the 2011 EA drew 53 specific conclusions and recommendations and generally recommended that the FERC incorporate the 53 items as mitigating conditions that SPL must meet in order to construct and operate the Project. The 2011 EA also found that, subject to adoption of the 53 items, approval of the Liquefaction Project would not constitute a major federal action significantly affecting the quality of the human environment and recommended that FERC issue a finding of no significant impact (FONSI) to this effect in its order on the merits of the FERC application.

On April 16, 2012, FERC issued an order authorizing Trains 1-4 of the Project.[30] Because the Project would be built within the footprint of existing import facilities which were previously the subject of an environmental impact statement (EIS) and because there were only a relatively small and well-defined number of other environmental issues raised in the FERC proceeding, FERC generally agreed with the 2011 EA's conclusion that the Liquefaction Project would not have a significant impact on the quality of the human environment and rejected arguments raised by the Sierra Club challenging the FERC's decision not to prepare a new environmental impact statement for the Liquefaction Project. In particular, FERC reviewed the direct, indirect, and cumulative impacts from the Liquefaction Project and found that the potential for induced shale gas development was neither "reasonably foreseeable" nor an "effect" for purposes of a cumulative impacts analysis within the meaning of the regulations of the Council of Environmental Quality

[30] *Sabine Pass Liquefaction, LLC and Sabine Pass LNG, L.P.*, Order Granting Section 3 Authorization, 139 FERC P61,039 (2012); Order Denying Rehearing, 140 F.E.R.C. P61,076 (2012).

(CEQ). FERC, however, required that Sabine Pass satisfy the 53 environmental conditions set forth in the EA plus two additional mitigating conditions in order to site, construct, and operate the Liquefaction Project.[31]

Sierra Club filed comments on FERC staff's 2011 EA and also intervened in the FERC proceeding authorizing the siting, construction, and operation of the Liquefaction Project. On May 16, 2012, Sierra Club filed a request for rehearing of FERC's April 16, 2012 order. FERC denied that request on July 26, 2012.[32]

FERC staff released a second EA for Trains 1-4 of the Liquefaction Project on January 24, 2014 in response to an application from Sabine Pass and Sabine Pass LNG, L.P. to amend the 2012 authorization in order to increase the Project's authorized maximum peak day capacity from approximately 2.2 Bcf/day to 2.76 Bcf/day (2014 EA).[33] The 2014 EA addressed the potential impacts on air quality, cumulative impacts, and alternatives, and found that the proposed amendment would not constitute a major federal action significantly affecting the quality of the human environment.

On February 20, 2014, FERC authorized the requested increase in the Project's liquefaction production capacity to reflect maximum LNG production and export capability under optimized operational conditions.[34] In so doing, FERC found that the increase in production capacity did not involve the construction of new facilities or the modification of the facilities that FERC had previously reviewed and approved. Sierra Club requested rehearing of the February 20, 2014 FERC order. FERC denied that request on September

[31] See Order 2961-A at 11 n. 22.
[32] 140 F.E.R.C. P61,076.
[33] Environmental Assessment for the Sabine Pass Liquefaction Project, Sabine Pass Liquefaction, LLC, and Sabine Pass LNG, L.P., FERC Docket No. CP14-12-000 (Jan. 2014). (http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14180466).
[34] *Sabine Pass Liquefaction, LLC and Sabine Pass LNG, L.P.*, 146 FERC P61,117 (2014); Order Denying Rehearing, 148 FERC P61,200 (2014).

18, 2014. Sierra Club subsequently petitioned for review of FERC's 2014 orders and that petition is pending in the United States Court of Appeals for the District of Columbia Circuit in *Sierra Club* v. *Federal Energy Regulatory Commission*, Case No. 14-1249.

DOE acted as a cooperating agency in the FERC's environmental review that resulted in the 2011 EA and the April 16 and July 26, 2012 FERC orders.[35] As explained in DOE/FE Order No. 2961-A, DOE's participation as a cooperating agency meant that DOE would independently review FERC's analysis of the Project and would determine whether further environmental review was necessary prior to issuance of final agency action.[36]

DOE/FE's Environmental Review of Sabine Pass's NGA Section 3(a) Export Authorizations. After an independent review of FERC's 2011 EA and the April 16 and July 26, 2012 FERC orders, DOE/FE determined that granting the application of Sabine Pass for authority to export LNG using Trains 1-4 at the proposed Liquefaction Project subject to the environmental conditions in the 2011 EA and FERC's April 16, 2012 order would not have a significant effect on the human environment. On August 7, 2012, DOE/FE consequently issued a Finding of No Significant Impact (FONSI) for Trains 1-4,[37] and issued a final export authorization in Order No. 2961-A to SPL conditioned on SPL's compliance with the 55 environmental conditions developed in the FERC proceeding.

DOE/FE conducted an independent review in this proceeding of FERC's action on SPL's proposal to amend its FERC authorization to increase the volumes of LNG authorized

[35] 139 FERC 61,039, n.55 at 18.
[36] *Id.* at 6-7.
[37] Finding of No Significant Impact for Sabine Pass Liquefaction, LLC Regarding Order Granting Long-Term Authorization to Export Liquefied Natural Gas from Sabine Pass LNG Terminal to Non-Free Trade Agreement Nations, August 12, 2012, http://www.fossil.energy.gov/programs/gasregulation/authorizations/Orders_Issued_2010/FONSI.pdf

for export. Based on this independent review of the record in the FERC proceeding and considering the arguments raised in the instant proceeding by intervenors, DOE/FE finds that there is no need or sufficient justification to supplement the environmental review conducted by FERC. Accordingly, DOE/FE is issuing a Finding of No Significant Impact (FONSI) in the present proceeding (2016 FONSI).[38] The 2016 FONSI adopts and incorporates by reference FERC's 2014 EA (as DOE/EA-2036) and determines that granting SPL's Application in this proceeding will not have a significant effect on the human environment.

II. SUMMARY OF FINDINGS AND CONCLUSIONS

This Order presents DOE/FE's findings and conclusions on all issues associated with SPL's Application in this proceeding for authorization to export LNG under NGA section 3(a), including both environmental and non-environmental issues.[39] As the basis for this Order, DOE/FE has reviewed a substantial administrative record that includes (but is not limited to) the following: SPL's Application; the comments, motions, and the protest submitted in response to the Application; the 2012 LNG Export Study; FERC's 2011 EA and the 2014 EA; FERC's April 16, 2012 and February 20, 2014 orders authorizing Sabine Pass to site, construct, and operate the Liquefaction Project; FERC's July 26, 2012 and September 18, 2014 orders respectively denying Sierra Club's requests for rehearing of the April 16, 2012 and March 24, 2014 orders; the Addendum; the LCA GHG Report; and public comments received on DOE/FE's various analyses. Based on the record and for the

[38] Finding of No Significant Impact for Sabine Pass Liquefaction Project Regarding Application to Department of Energy to Increase Authorized Volumes of Liquefied Natural Gas for Export from Sabine Pass LNG Terminal to Non-Free Trade Agreement Nations (Mar. 2016).

[39] As discussed below, the non-environmental issues include economic and international impacts associated with SPL's proposed exports, as well as security of the natural gas supply in the United States. *See infra* § III (public interest standard).

reasons set forth below, DOE/FE finds that it has not been demonstrated that the proposed exports will be inconsistent with the public interest, as would be required to deny SPL's Application under NGA section 3(a).

On this basis, DOE/FE authorizes SPL's export of domestically produced LNG from Trains 1-4 of the Sabine Pass LNG Terminal to non-FTA countries in a total volume equivalent to 203 billion cubic feet per year (Bcf/yr) of natural gas (0.56 Bcf per day). This authorized volume of exports is in addition to the volume authorized for export from Trains 1-4 in DOE/FE Order Nos. 2833 and 2961-A of 803 Bcf/yr, respectively to FTA and non-FTA countries, but is not additive to the 203 Bcf/yr authorized for export to FTA countries in DOE/FE Order No. 3995. Further, this authorization is subject to the Terms and Conditions and Ordering Paragraphs set forth herein, which incorporate by reference the 55 environmental conditions imposed by FERC.

III. PUBLIC INTEREST STANDARD

Section 3(a) of the NGA sets forth the standard for review of SPL's 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[40]] 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

[40] 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.

unless opponents of the application overcome that presumption by making an affirmative showing of inconsistency with the public interest.[41]

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.[42]

DOE/FE's prior decisions have also looked to certain principles established in its 1984 Policy Guidelines.[43] 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] gas …. The federal government's primary responsibility in authorizing imports [or exports] should 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.[44]

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[41] *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).

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

[43] New Policy Guidelines and Delegations Order Relating to Regulation of Imported Natural Gas, 49 Fed. Reg. 6684 (Feb. 22, 1984) [hereinafter 1984 Policy Guidelines].

[44] *Id*. at 6685.

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.[45]

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."[46] In February 1989, the Assistant Secretary for Fossil Energy assumed the delegated responsibilities of the Administrator of ERA.[47]

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 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.

[45] *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)).
[46] DOE Delegation Order No. 0204-111, at 1; *see also* 1984 Policy Guidelines, 49 Fed. Reg. at 6690.
[47] *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)).

IV. DESCRIPTION OF REQUEST

A. Description of Applicant

The Application states that SPL is a limited liability company authorized to do business in the States of Texas and Louisiana and that its principal place of business is in Houston, Texas. The Application further states that SPL is an indirect subsidiary of Cheniere Energy Partners, L.P. (Cheniere Partners), a Delaware limited partnership majority owned by Cheniere Energy, Inc. (Cheniere Energy), a Delaware corporation. The Application also states that both Cheniere Partners and Cheniere Energy have their primary places of business in Houston, Texas.

B. Related DOE/FE Proceedings

On September 7, 2010, in DOE/FE Order No. 2833, DOE granted SPL's application for authorization to export the equivalent of 803 Bcf/yr to FTA countries from Trains 1-4 for a 30 year term to FTA countries. That application was unopposed. Pursuant to section 3(c) of the NGA, the application was deemed consistent with the public interest and DOE was required to grant the application without modification or delay.

On August 7, 2012, in DOE/FE Order No. 2961-A, DOE/FE granted final authorization to SPL to export up to the equivalent of 803 Bcf/yr from Trains 1-4 of the Sabine Pass LNG Terminal to non-FTA countries. The volumes authorized in DOE/FE Order No. 2833 for exports to FTA countries and the volumes authorized in Order No. 2961-A for exports to non-FTA countries were not additive to one another.

On February 12, 2015, DOE/FE issued Order No. 3595 granting SPL authorization to export up to the equivalent of 203 Bcf/yr from the Trains 1-4 of the Liquefaction Project to FTA countries for a 25 year term. This volume of authorized exports was in addition to the volumes previously authorized for export to FTA countries in Order No. 2833. Like the

Application in the current proceeding, the application that resulted in Order No. 3595 was premised on SPL's assertion that the requested authorization would enable SPL to align the volumes authorized for export with the liquefaction capacity from Trains 1-4 of the Sabine Pass LNG Terminal but would not require additional construction or modification of facilities previously authorized by FERC.[48]

The orders issued by DOE to SPL authorizing exports of LNG to FTA countries and non-FTA countries are identified in the following tables:

Table 1: Orders Issued by DOE/FE to SPL for the Long-Term Export of Domestic LNG from the Sabine Pass LNG Terminal to FTA Countries

Docket No.	Order No.	Date Issued	Trains	Volume (Bcf/yr)	Term/Type
10-85-LNG	2833	Sept. 7, 2010	1-4	803.0	30 years,[49] multi-contract
13-30-LNG	3306	July 11, 2013	5-6	101.0	20 years, LNG Sale and Purchase Agreement with Total Gas & Power North America (TGPNA)
13-42-LNG	3307	July 12, 2013	5-6	88.3	20 years, LNG Sale and Purchase Agreement with Centrica plc
13-121-LNG	3384	Jan. 22, 2014	5-6	314.0	20 years, multi-contract
14-92-LNG	3595	Feb. 12, 2015	1-4	203.0	25 years, multi-contract
Total Volume				**1,509.3**	

[48] DOE/FE Order No. 3595 at 5.
[49] *See Sabine Pass Liquefaction, LLC*, Errata to DOE/FE Order Nos. 3595 & 3384, FE Docket Nos. 14-92-LNG & 13-121-LNG (Feb. 24, 2015).

Table 2: Orders Issued by DOE/FE to SPL for the Long-Term Export of Domestic LNG from the Sabine Pass LNG Terminal to Non-FTA Countries

Docket No.	Order No.	Date Issued	Trains	Volume (Bcf/yr)	Term/Type
10-111-LNG	2961-A	Aug. 7, 2012	1-4	803.0	20 years, multi-contract
13-30-LNG 13-42-LNG 13-121-LNG	3669	June 26, 2015	5-6	503.3	20 years, multi-contract
15-63-LNG	3792	March 11, 2016	1-4	203.0	20 years, multi-contract
Total Volume				**1,509.3**	

C. Liquefaction Project

SPL states that it filed the current Application in conjunction with the development of Trains 1-4 of the Liquefaction Project at the Sabine Pass LNG Terminal in Cameron Parish, Louisiana. SPL states that Trains 1 through 4 are currently under construction and SPL anticipates that exports from those facilities will commence in 2016.[50]

D. Business Model

SPL requests long-term, multi-contract authorization to export LNG on its own behalf and as agent for other entities, after registering each such entity with DOE/FE. SPL states that it will comply with all DOE/FE requirements for exporters and agents, including

[50] We take notice of the fact that SPL has separately secured authorization from FERC to site, construct, and operate two additional liquefaction trains (Trains 5 and 6) at the Sabine Pass LNG Terminal. Trains 5 and 6 will add an additional 503 Bcf/yr or 1.3Bcf/d of natural gas liquefaction capacity to the Sabine Pas LNG Terminal (approximately 251.5 Bcf/yr per train). The proposed construction of Trains 5 and 6 will increase the Liquefaction Project's total authorized production capacity from 20 mtpa, or 2.76 Bcf/d, to approximately 29 mtpa, or 4.14 Bcf/d.

the registration requirements set forth in recent DOE/FE orders.[51] SPL states that it has not yet entered into any long-term export contracts specific to the authorization requested in the Application but that it will submit the contract specific information required by section 590.202(b) of DOE's regulations in compliance with the obligations imposed on other authorization holders in prior DOE orders.[52]

E. Source of Natural Gas

SPL states that it will purchase natural gas to be used as fuel and feedstock for LNG production from the interstate and intrastate grid at points of interconnection with other pipelines and points of liquidity both upstream and downstream of the Cheniere Creole Trail Pipeline, L.P. (CCTPL) system and other systems that interconnect with the Liquefaction Project.[53] SPL states that through these pipelines' interconnections with other interstate and intrastate pipeline systems, the Liquefaction Project will have access to virtually any point on the U.S. interstate pipeline system through direct delivery or by displacement. Further, SPL notes that the proximity of the Liquefaction Project to multiple interstate and intrastate pipelines will enable SPL to purchase natural gas from multiple basins located across the region, state, and virtually anywhere in the nation. SPL notes that it has entered into a number of long-term natural gas supply purchase confirmation transactions (Confirmations) associated with the long-term supply of natural gas to the Liquefaction Project. According to SPL, these Confirmations are not tied to individual trains or specific export sales and purchase agreements or DOE/FE authorizations, but

[51] SPL App. at 3-4.
[52] *Id.* at 8.
[53] SPL App. 1 at 6.

rather, the natural gas secured under the Confirmations will be liquefied for export as required to meet SPL's commercial commitments.[54]

V. 2012 LNG EXPORT STUDY

As noted above, in August 2011, with several non-FTA applications pending before it, DOE/FE determined that study of the cumulative economic impact of LNG exports was warranted to better inform its public interest review under section 3 of the NGA. To address this issue, DOE/FE undertook a two-part study of the cumulative economic impact of LNG exports. The first part of the study was conducted by EIA and looked at the potential impact of additional natural gas exports on domestic energy consumption, production, and prices under several export scenarios prescribed by DOE/FE. The EIA Study did not evaluate macroeconomic impacts of LNG exports on the U.S. economy. The second part of the study, performed by NERA Economic Consulting, assessed the potential macroeconomic impact of LNG exports using its energy-economy model (the "NewERA" model). NERA built on the EIA Study requested by DOE/FE by calibrating the NERA U.S. natural gas supply model to the results of the study by EIA. The EIA Study was limited to the relationship between export levels and domestic prices without considering whether those quantities of exports could be sold at high enough world prices to support the calculated domestic prices. NERA used its Global Natural Gas Model (GNGM) to estimate expected levels of U.S. LNG exports under several scenarios for global natural gas supply and demand. A more detailed discussion of each study follows.

[54] *See id.*; SPL App. 2 at 7; SPL App. 3 at 8.

A. EIA Study, *Effect of Increased Natural Gas Exports on Domestic Energy Markets*

1. Methodology

DOE/FE asked EIA to assess how four scenarios of increased natural gas exports could affect domestic energy markets, particularly consumption, production, and prices. The four scenarios assumed LNG exports of:

- 6 Bcf/d, phased in at a rate of 1 Bcf/d per year (low/slow scenario);
- 6 Bcf/d phased in at a rate of 3 Bcf/d per year (low/rapid scenario);
- 12 Bcf/d phased in at a rate of 1 Bcf/d per year (high/slow scenario); and
- 12 Bcf/d phased in at a rate of 3 Bcf/d per year (high/rapid scenario).

According to EIA, total marketed natural gas production in 2011 was approximately 66 Bcf/d. Thus, exports of 6 Bcf/d and 12 Bcf/d represent roughly 9 and 18% of natural gas production in 2011, respectively.

DOE/FE also requested that EIA consider the above four scenarios of increased natural gas exports in the context of four cases from EIA's AEO 2011. These four cases are:

- The AEO 2011 Reference Case;
- The High Shale Estimated Ultimate Recovery (EUR) case (reflecting optimistic assumptions about domestic natural gas supply, with the EUR per shale gas well for new, undrilled wells assumed to be 50 percent higher than in the Reference Case);
- The Low Shale EUR case (reflecting pessimistic assumptions about domestic natural gas supply, with the EUR per shale gas well for new, undrilled wells assumed to be 50 percent lower than in the Reference Case); and
- The High Economic Growth case (assuming the U.S. gross domestic product will grow at an average annual rate of 3.2 percent from 2009 to 2035, compared to 2.7 percent in the Reference Case, which increases domestic energy demand).

Taken together, the four scenarios with different additional export levels imposed from the indicated baseline case (no additional exports) presented 16 case scenarios:

Table 3: Case Scenarios Considered By EIA in Analyzing Impacts of LNG Exports

	AEO 2011 Cases	Export Scenarios
1	AEO 2011 Reference	Low/Slow
2	AEO 2011 Reference	Low/Rapid
3	AEO 2011 Reference	High/Slow
4	AEO 2011 Reference	High/Rapid
5	High EUR	Low/Slow
6	High EUR	Low/Rapid
7	High EUR	High/Slow
8	High EUR	High/Rapid
9	Low EUR	Low/Slow
10	Low EUR	Low/Rapid
11	Low EUR	High/Slow
12	Low EUR	High/Rapid
13	High Economic Growth	Low/Slow
14	High Economic Growth	Low/Rapid
15	High Economic Growth	High/Slow
16	High Economic Growth	High/Rapid

EIA used the final AEO 2011 projections issued in April 2011 as the starting point for its analysis and applied the NEMS model. Because NEMS did not generate a projection of LNG export demand, EIA specified additional natural gas demand levels as a proxy for projected export levels consistent with the scenarios prescribed by DOE/FE.

EIA assigned these additional exports to the West South Central Census Division. This meant that EIA effectively assumed that the incremental LNG exports would be shipped out of the Gulf Coast states or Texas.

EIA also counted any additional natural gas consumed during the liquefaction process within the total additional export volumes specified in the DOE/FE scenarios. Therefore the net volumes of LNG produced for export were roughly 10 percent below the gross volumes considered in each export scenario. By way of illustration, the cases where

cumulative export volumes are 6 Bcf/d, liquefaction would consume 0.6 Bcf/d and net exports of 5.4 Bcf/d.

EIA made other changes in modeled flows of gas into and out of the lower-48 United States where necessary to analyze the increased export scenarios.[55] Additionally, EIA assumed that a pipeline transporting Alaskan natural gas into the lower-48 states would not be built during the forecast period, thereby isolating the lower-48 states' supply response.

2. Scope of EIA Study

In the Preface to its Study, EIA identifies several limiting factors governing the results of the Study:

> The projections in this report are not statements of what *will* happen but of what *might* happen, given the assumptions and methodologies used. The Reference case in this report is a business-as-usual trend estimate, reflecting known technology and technological and demographic trends, and current laws and regulations. Thus, it provides a policy-neutral starting point that can be used to analyze policy initiatives. EIA does not propose, advocate, or speculate on future legislative and regulatory changes.[56]

Additionally, 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:

- The NEMS model is not a world energy model, and therefore does not address the interaction between the potential for additional U.S. natural gas exports and developments in world natural gas markets;

[55] U.S. natural gas exports to Canada and U.S. natural gas imports from Mexico are exogenously specified in all the AEO 2011 cases. U.S. imports of natural gas from Canada are endogenously set in the model and continue to be so for this study. However, U.S. natural gas exports to Mexico and U.S. LNG imports that are normally determined endogenously within the model were set to the levels projected in the associated AEO 2011 cases for this study. EIA Study at 2-3.

[56] EIA Study at ii (emphasis in original).

- Global natural gas markets are not integrated, and their nature could change substantially in response to significant changes in natural gas trading patterns;
- Macroeconomic results were not included in the analysis because energy exports are not explicitly represented in the NEMS macroeconomic module; and

The domestic focus of the NEMS model makes it unable to account for all interactions between energy prices and supply/demand in energy-intensive industries that are globally competitive.

3. Natural Gas Markets

The EIA Study recognized that natural gas markets are not integrated globally and natural gas prices span a wide range. EIA stated that the current large disparity in natural gas prices across major world regions is likely to narrow as markets become more globally integrated. However, key questions remain as to how quickly and to what extent convergence might occur.

U.S. market conditions are also variable, according to EIA, and lower or higher U.S. natural gas prices would tend to make additional exports more or less likely. EIA pointed out that prospects for LNG exports depend greatly on the cost-competitiveness of liquefaction projects in the United States relative to those at other locations.

EIA observed that relatively high shipping costs from the United States may add a cost disadvantage compared to exporting countries closer to key markets, such as in Asia. EIA notes that LNG projects in the United States would frequently compete not just against other LNG projects, but also against pipeline projects from traditional natural gas sources or projects to develop shale gas in Asia or Europe.

4. Results of EIA 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 increased natural gas imports from Canada via pipeline. The impacts of exports, according to EIA, included:

Increased natural gas prices at the wellhead. EIA stated that larger export levels would lead to larger domestic price increases; rapid increases in export levels would lead to large initial price increases that moderate somewhat in a few years; and slower increases in export levels would lead to more gradual price increases but eventually would produce higher average prices during the decade between 2025 and 2035.

Increased natural gas production and supply. Increased exports would result in a supply response, *i.e.,* increased natural gas production that would satisfy about 60 to 70 percent of the increase in natural gas exports, with a minor additional contribution from increased imports from Canada. Across most cases, EIA stated 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 gas consumed domestically. EIA states that the electric power sector, by switching to coal and renewable fuels, would account for the majority of this decrease but indicates that there also would be a small reduction in natural gas use in all sectors from efficiency improvements and conservation.

Increased end-user natural gas and electricity delivered prices. EIA states that even while consuming less, on average, consumers will see an increase in their natural gas and electricity expenditures.

Additional details regarding these conclusions are discussed in the following sections.

5. Wellhead Price Increases

EIA projects that natural gas prices will increase in the Reference Cases even absent

expansion of natural gas exports. This baseline increase in natural gas prices bears an inverse relationship to projected increases in the volumes of natural gas produced from shale resources. Thus, in the high shale EUR Reference Case, the long-term natural gas price is lower than it is in the low shale EUR case.

While EIA projected a rising baseline price of gas without exports, EIA also found that the price of gas will increase over the rising baseline when exports occur. Exports are projected to impact natural gas prices in two ways. First, the export scenarios that contained rapid growth in exports experienced large initial price increases that moderated in the long run, while cases projecting a slow growth in exports experienced more gradual price increases. Second, cases with larger cumulative exports resulted in higher prices in the long-term relative to those cases with lower overall export levels. The largest price increase over the baseline exists in the Low Shale EUR case. The High Shale EUR case yields the smallest price response.

6. 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 the higher prices associated with the increased exports.

7. Decreased Natural Gas Consumption

EIA projected that greater export levels would lead to decreases in natural gas consumption. Most of this projected decrease would occur in the electric power sector. Increased coal-fired generation accounts for about 65 percent of the projected decrease in natural gas-fired generation. However, EIA also noted that the degree to which coal might

be used in lieu of natural gas depends on what regulations are in place. As noted above, EIA's projections reflected the laws and regulations in place at the time AEO 2011 was produced.

EIA further projected that small increases in renewable generation would contribute to reduced natural gas-fired generation. Relatively speaking, the role of renewables would be greater in a higher-gas-price environment (*i.e.*, the Low Shale EUR case) when renewables can more successfully compete with coal, and also in a higher-generation environment (*i.e.*, the High Economic Growth case), particularly in the later years.

EIA projected that increased natural gas exports would result in reductions in industrial natural gas consumption. However, the NEMS model does not capture the link between energy prices and the supply/demand of industrial commodities in global industries. To the extent that the location of production is sensitive to changes in natural gas prices, EIA acknowledged that industrial natural gas demand would be more responsive than shown in its analysis.

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

EIA projected that, with increased natural gas exports, consumers would consume less and pay more on both their natural gas and electricity bills, and generally pay a little less for liquid fuels.

EIA projected that the degree of change to total natural gas bills with added exports varies significantly among economic sectors. This is because the natural gas commodity charge represents significantly different portions of each natural gas consuming sector's bill. However, EIA projected that natural gas expenditures would increase at the highest

percentages in the industrial sector, where low transmission and distribution charges constitute a relatively small part of the delivered natural gas price.

EIA projected that average electricity prices would increase between 0.14 and 0.29 cents per kilowatt-hour (kWh) (between 2 and 3 percent) when gas exports are added. The greatest projected increase in electricity prices occurs in 2019 under the Low Shale EUR case for the high export/rapid growth export scenario, with an increase of 0.85 cents per kWh (9 percent).

EIA projected that, on average between 2015 and 2035, total U.S. end-use electricity expenditures as a result of added exports would increase between $5 billion to $10 billion (between 1 to 3 percent), depending on the export scenario. The High Macroeconomic Growth case shows the greatest average annual increase in natural gas expenditures over the same time period, with increases over the baseline (no additional exports) scenario ranging from $6 billion to $12 billion.

9. Impact on Natural Gas Producer Revenues

As part of its analysis, EIA considered the impact of natural gas exports on natural gas producer revenues. According to EIA, total additional natural gas revenues to producers from exports would increase from 2015 to 2035 between $14 billion and $32 billion over the AEO 2011 Reference Case, depending on the export scenario. These revenues reflect dollars spent to purchase and move the natural gas to the export facility, but do not include any revenues associated with the liquefaction and shipping process.

EIA cautioned that these projected increases in natural gas producer revenues do not represent profits and a large portion of the additional revenues would be expended to cover the costs associated with increased production, such as for equipment (*e.g.*, drilling rigs) and labor. In contrast, the additional revenues resulting from the higher price of natural gas

that would have been produced and sold to largely domestic customers even in the absence of the additional exports posited in the analysis would preponderantly reflect increased profits for producers and resource owners.

10. Impacts Beyond the Natural Gas Industry

EIA stated that, other than impacts on their energy expenditures, impacts on non-energy sectors were generally beyond the scope of its study. However, EIA did project impacts on total energy use and energy-related CO_2 emissions. EIA projected that annual primary energy consumption in the AEO 2011 Reference Case will average 108 quadrillion Btu between 2015 and 2035, with a growth rate of 0.6 percent. Also, cumulative CO_2 emissions are projected to total 125,000 million metric tons for that 20-year period.

According to EIA, the changes in overall energy consumption would largely reflect changes in the electric power sector. While additional exports would result in decreased natural gas consumption, changes in overall energy consumption would be relatively minor as much of the decrease in natural gas consumption would be replaced with increased coal consumption.

While lower domestic natural gas deliveries resulting from added exports are projected to reduce natural gas related CO_2 emissions, EIA projected that the increased use of coal in the electric sector would generally result in a net increase in domestic CO_2 emissions. Exceptions occur in scenarios where renewables are better able to compete against natural gas and coal. However, when also accounting for emissions related to natural gas used in the liquefaction process, EIA projected that additional exports would increase domestic CO_2 levels under all cases and scenarios, particularly in the earlier years of the projection period. EIA did not evaluate the effect of U.S. LNG exports on global CO_2 emissions.

B. NERA Study, *Macroeconomic Impacts of LNG Exports from the United States*

Because the NEMS model used by EIA did not account for the impact of energy price changes on global energy utilization patterns and did not include a full macroeconomic model, DOE/FE commissioned NERA to provide such an analysis. NERA developed a two-step approach. First, it modeled energy markets by drawing on several of the scenarios that EIA had developed and adding global market scenarios developed through its GNGM model. Second, using its "N_{ew}ERA" energy-economy model, NERA drew conclusions regarding the domestic macroeconomic impacts of LNG exports. The impacts measured using the N_{ew}ERA macroeconomic model included price, welfare,[57] gross domestic product (GDP), aggregate consumption, aggregate investment, natural gas export revenues, sectoral output,[58] and wages and other household incomes. In addition, NERA identified impacts that would affect certain energy intensive, trade exposed (EITE) industries, as discussed below.

1. Overview of NERA's Findings

NERA's key findings include the following:

Net economic benefits across all scenarios. Across all the scenarios studied, NERA projected that the United States would gain net economic benefits from allowing LNG exports. For every market scenario examined, net economic benefits increased as the level of LNG exports increased. Scenarios with unlimited exports had higher net economic benefits than corresponding cases with limited exports. In all cases, the benefits that come from export expansion outweigh the losses from reduced capital and wage income to U.S.

[57] According to NERA, the measure of welfare used in its study is known as the "equivalent variation" and is the amount of income a household would be willing to give up in the case without LNG exports to achieve the benefits of LNG exports. NERA states that it measured welfare in present value terms, and therefore captures in a single number benefits and costs that might vary year by year over the period. NERA Study at 6, n.5 & 55.

[58] NERA evaluated seven key sectors of the U.S. economy: agriculture, energy intensive sector, electricity, natural gas, motor vehicle, manufacturing, refined petroleum products, and services. *Id*. at 9.

consumers, and hence LNG exports have net economic benefits in spite of higher domestic natural gas prices.

Net benefits to the United States would be highest if the United States is able to produce large quantities of gas from shale at low cost, if world demand for natural gas increases rapidly, and if LNG supplies from other regions are limited. If the promise of shale gas is not fulfilled and costs of producing gas in the United States rise substantially, or if there are ample supplies of LNG from other regions to satisfy world demand, the United States would not export LNG. Under these conditions, allowing exports of LNG would cause no change in natural gas prices and do no harm to the overall economy.

Natural gas price increases. U.S. natural gas prices would increase if the United States exports LNG. However, the global market limits how high U.S. natural gas prices can rise under pressure of LNG exports because importers will not purchase U.S. exports if U.S. wellhead price rises above the cost of competing supplies.

Natural gas price changes attributable to LNG exports remain in a relatively narrow range across the entire range of scenarios. Natural gas price increases at the time LNG exports could begin range from zero to $0.33 (2010$/Mcf). Price increases that would be observed after five more years of potentially growing exports could range from $0.22 to $1.11 (2010$/Mcf). The higher end of the range is reached only under conditions of ample U.S. supplies and low domestic natural gas prices, with smaller price increases when U.S. supplies are more costly and domestic prices higher.

Socio-economic impacts. How increased LNG exports will affect different socioeconomic groups will depend on their income sources. Like other trade measures, LNG exports will cause shifts in industrial output and employment and in sources of income. Overall, both total labor compensation and income from investment are projected

to decline, and income to owners of natural gas resources will increase. Different socioeconomic groups depend on different sources of income; workers with retirement savings that include shares of natural resource companies will benefit from higher incomes to those companies. Nevertheless, impacts will not be positive for all groups in the economy. Households with income solely from wages or government transfers, in particular, might not participate in these benefits.

Competitive impacts and impact on employment. Serious competitive impacts are likely to be confined to narrow segments of industry. About 10 percent of U.S. manufacturing, measured by value of shipments, has both energy expenditures greater than 5 percent of the value of its output and serious exposure to foreign competition. Employment in these energy-intensive industries is about one-half of one percent of total U.S. employment.

LNG exports are unlikely to affect the overall level of employment in the United States. There will be some shifts in the number of workers across industries, with those industries associated with natural gas production and exports attracting workers away from other industries. In no scenario is the shift in employment out of any industry projected to be larger than normal rates of turnover of employees in those industries.

Additional discussion of the above key findings is offered below and in the NERA Study itself.

2. Overview of NERA's Methodology

NERA states that it attempted to answer two principal questions:

- At what price can various quantities of LNG exports be sold?
- What are the economic impacts on the United States of LNG exports?

To answer these questions, NERA used the GNGM model to estimate expected levels of

U.S. LNG exports under several scenarios for global natural gas supply and demand. NERA also relied on the EIA Study to characterize how U.S. natural gas supply, demand, and prices would respond if the specified level of LNG exports were achieved. Further, NERA examined the same 16 scenarios for LNG exports analyzed by EIA but added additional scenarios to reflect global supply and demand. These additional scenarios were constructed on the basis of NERA's analytical model of global natural gas markets, as described below.

The resulting scenarios ranged from Reference Case conditions to stress cases with high costs of producing natural gas in the United States and exceptionally large demand for U.S. LNG exports in world markets. The three scenarios chosen for the U.S. resource outlook were the EIA Reference Case, based on AEO 2011, and two cases assuming different levels of EUR from new gas shale development. Outcomes of the EIA high demand case fell between the High and Low EUR cases and, therefore, would not have changed the range of results. The three different international outlooks were: (1) a Reference Case, based on EIA's International Energy Outlook 2011; (2) a Demand Shock case with increased worldwide natural gas demand caused by shutdowns of some nuclear capacity; and (3) a Supply/Demand Shock case that added to the Demand Shock a supply shock that assumed key LNG exporting regions did not increase their exports above current levels.

When the global and U.S. scenarios were combined with seven scenarios specifying limits on exports and export growth, NERA's analysis covered 63 possible scenarios. From these 63 scenarios, 21 scenarios resulted in some level of LNG export from the United States. Of these 21 scenarios, the GNGM model identified 13 "N_{ew}ERA scenarios" that spanned the range of economic impacts from all of the scenarios and

eliminated scenarios with essentially identical outcomes. The 13 scenarios included:

Table 4: NewERA Scenarios Analyzed by NERA

	U.S. Scenarios	International Demand and Supply Scenarios	Export Scenarios
1	Reference	Supply and Demand Shock	Low/Rapid
2	Reference	Supply and Demand Shock	Low/Slow
3	Reference	Supply and Demand Shock	High/Rapid
4	Reference	Supply and Demand Shock	High/Slow
5	Reference	Demand Shock	Low/Rapid
6	Reference	Demand Shock	Low/Slow
7	Reference	Demand Shock	Low/Slowest
8	High EUR	Supply and Demand Shock	High/Rapid
9	High EUR	Supply and Demand Shock	High/Slow
10	High EUR	Supply and Demand Shock	Low/Rapid
11	High EUR	Supply and Demand Shock	Low/Slow
12	High EUR	Supply and Demand Shock	Low/Slowest
13	Low EUR	Supply and Demand Shock	Low/Slowest

To project the macroeconomic impacts of the above scenarios, NERA used its NewERA model to compare the impacts of each of the 13 export scenarios to baselines with no LNG exports. NERA thus derived a range of projected impacts on the U.S. economy, including impacts on welfare, aggregate consumption, disposable income, GDP, and loss of wage income.

3. Scope of the NERA Study

NERA started its analysis with the domestic economic AEO 2011 cases and the export scenarios present in the EIA Study.[59] In addition to the export scenarios used by EIA, NERA added two export cases, including the "low/slowest case" and a "no restraints" case in which no regulatory restraints on exports existed. The low/slowest case assumed exports of

[59] For a full discussion of the scope, see pages 3-15 of the NERA Study, http://energy.gov/sites/prod/files/2013/04/f0/nera_lng_report.pdf.

6 Bcf/d, with a growth rate of 0.5 Bcf/d per year, which is half the growth rate in the slow scenarios used by EIA.

Because NERA, unlike EIA, modeled the international gas market, NERA also created three international gas market scenarios not contained in the EIA Study. The first was a business as usual Reference Case. The second assumed an international demand shock with increased worldwide natural gas demand caused by shutdowns of some nuclear capacity. Finally, NERA created an international scenario that added to the demand shock a supply shock that assumed key LNG exporting regions did not increase their exports above current levels.

While these additional aspects of the analysis expanded the scope of the NERA Study relative to the study conducted by EIA, significant elements of the dynamics of the global natural gas trade and its domestic economic implications were outside the scope of the NERA Study or beyond the reach of the modeling tools used.[60] NERA expressly excluded the following factors from its analysis:

- The extent to which an overbuilding of liquefaction capacity could affect the ability to finance the projects and profitably export natural gas;
- The extent to which engineering or infrastructure limitations would impact the rate at which liquefaction capacity would come online, potentially impacting the cost of that capacity;
- The locations of the liquefaction facilities, or alternatives;
- The impacts of the liquefaction and exportation of natural gas on various regions within the United States;
- The extent to which the impacts of LNG export vary among different socio-economic groups; and

[60] For a full discussion of the unexplored factors, see Appendix E of the NERA Study, http://energy.gov/sites/prod/files/2013/04/f0/nera_lng_report.pdf.

- The extent to which macroeconomic impacts to the United States would vary if the liquefaction projects were funded through foreign direct investment.

4. NERA's Global Natural Gas Model

The GNGM model is designed to estimate natural gas production, consumption, and trade in the major gas producing or consuming regions.[61] The model attempts to maximize the difference between surplus and cost, constrained by various factors including liquefaction capacity and pipeline constraints. The model divides the world into 12 regions and specifies supply and demand curves for each region. The regions are: Africa, Canada, China/India, Central and South America, Europe, Former Soviet Union, Korea/Japan, Middle East, Oceania, Sakhalin, Southeast Asia, and the United States. The GNGM model's production and consumption assumptions for these regions are based on projections contained in the Reference Cases of EIA's AEO 2011 and International Energy Outlook 2011. NERA ran the GNGM model in five-year increments between 2015 and 2035.

According to NERA, the characteristics of a regional market will affect LNG trading patterns and the pricing of natural gas within the region. With respect to trading patterns, NERA observed that a significant portion of LNG, such as LNG moving to Europe, is traded on a long-term basis using dedicated supplies and dedicated vessels moving to identified markets. On the other hand, NERA stated that some LNG markets, particularly those in Asia, operate on the basis of open market competitive bids in which LNG is delivered to those who value it the most. NERA also found that Southeast Asian and Australian suppliers most often market LNG to Asian markets; African suppliers deliver LNG most often to Europe; and Middle Eastern suppliers deliver LNG both to

[61] For a full discussion of GNGM, see page 20 of the NERA Study, http://energy.gov/sites/prod/files/2013/04/f0/nera_lng_report.pdf.

Europe and Asia.

With respect to the pricing of LNG in global markets, NERA states that the price differential, or "basis," between two regions reflects the difference in the pricing mechanism for each regional market. If pricing for two market hubs were set by the same mechanism and there were no constraints in the transportation system, the basis would simply be the cost of transportation between the two market hubs. NERA asserts, however, that different pricing mechanisms set the price in each regional market, so the basis is often not set by transportation differences alone.

NERA offers the following example: Japan depends on LNG as its source for natural gas and indexes LNG prices to crude oil prices. For Europe, on the other hand, NERA states that LNG is only one of three potential sources of supply for natural gas. The others are interregional pipelines and indigenous production. According to NERA, the competition for market share between these alternative sources of supply will establish the basis for LNG prices in Europe. NERA further states that within North America, pricing at Henry Hub has been for the most part set by competition between different North American supply sources and has been independent of pricing in Japan and Europe.

5. The NewERA Macroeconomic Model

NERA developed the NewERA model to forecast how, under a range of domestic and international supply and demand conditions, U.S. LNG exports could affect the U.S. economy.[62] Like other general equilibrium models, NewERA is designed to analyze long-term economic trends. NERA explained that, in any given year, actual prices, employment, or economic activity may differ from the projected

[62] For a full discussion of the NewERA macroeconomic model, see pages 20 to 22 of the NERA Study, http://fossil.energy.gov/programs/gasregulation/reports/nera_lng_report.pdf

levels.

The version of N_{ew}ERA used in NERA's analysis considered all sectors of the U.S. economy. In short, the model:

- Contains supply curves for domestic natural gas,
- Accounts for imports of Canadian pipeline gas and other foreign imports,
- Recognizes the potential for increases to U.S. liquefaction capacity, and
- Recognizes changes in international demand for domestically produced natural gas.

As discussed below, the results of the N_{ew}ERA model address changes in demand and supply of all goods and services, prices of all commodities, and impacts from LNG exports to U.S. trade, including changes in imports and exports. As with the GNGM model, NERA ran the N_{ew}ERA model in five-year increments for 2015 through 2035.

6. Relationship to the EIA Study

As explained above, EIA's study focused on potential impacts of natural gas exports to domestic energy markets. Specifically, the study considered impacts to natural gas supply, demand, and prices within the United States. To provide a fuller scope of analysis, DOE asked NERA to examine the net macroeconomic impact of domestic LNG exports on the U.S. economy. To conduct this analysis, NERA first modeled international demand for U.S. LNG utilizing its GNGM model. NERA then incorporated the results from the GNGM model into its NewERA model, using the same parameters governing natural gas supply and demand that EIA used in the NEMS model.

NERA concluded that, in many cases, the global natural gas market would not accept the full amount of exports assumed in the EIA scenarios at export prices high enough to cover the U.S. wellhead prices calculated by EIA. In these cases, NERA

replaced the export levels and price impacts found in the EIA scenarios with lower levels of exports (and prices) estimated by the GNGM model. These lower export levels were applied to the NewERA model to generate projected impacts to the U.S. economy from LNG exports.

7. Key Assumptions and Parameters of the NERA Study

NERA implemented the following key assumptions and parameters, in part to retain consistency with EIA's NEMS model:

i. All scenarios were derived from the AEO 2011 and incorporated EIA's assumptions about energy and environmental policies, baseline coal, oil and natural gas prices, economic and energy demand growth, and technology availability and cost in the corresponding AEO cases.

ii. U.S. exports compete with LNG exports from other nations, who are assumed to behave competitively and to adjust their export quantities in response to prevailing prices. The single exception to this assumption is that the export decisions of the global LNG market's one dominant supplier, Qatar, were assumed to be independent of the level of U.S. exports.

iii. Prices for natural gas used for LNG production were based on the Henry Hub price, plus a 15 percent markup (to cover operating costs of the liquefaction process).

iv. The LNG tolling (or reservation) fee—paid by the exporter to the operator of the liquefaction terminal for the right to reserve capacity—was based on a return of capital to the operator.

v. All financing of investment was assumed to originate from U.S. sources.

The United States is assumed to have full employment, meaning that U.S. unemployment rates and the total number of jobs in the United States will not change across all cases.

8. Results of the NERA Study

As a result of its two-step analysis, the NERA Study yielded two sets of results, reported in five-year intervals beginning with 2015.[63] First, the GNGM model produced information regarding the conditions that will support exports of natural gas from the United States. Second, the N_{ew}ERA model provided information about the domestic macroeconomic impacts of natural gas exports. NERA found:

LNG exports would result in higher U.S. natural gas prices. NERA found that the United States would only be able to market LNG successfully with higher global demand or lower U.S. costs of production than in the Reference Cases. According to NERA, the market limits how high U.S. natural gas prices can rise under pressure of LNG exports because importers will not purchase U.S. exports if the U.S. wellhead price rises above the cost of competing supplies. In particular, under NERA's modeling, the U.S. natural gas price does not become linked to oil prices in any of the cases examined.

Macroeconomic impacts of LNG exports are positive in all cases. NERA found that the United States would experience net economic benefits from increased LNG exports in all cases studied. Only three cases had U.S. exports greater than the 12 Bcf/d maximum exports allowed in the cases analyzed by EIA.[64] NERA estimated economic impacts for

[63] These calendar years are not actual, but represent modeling intervals after exports begin. For example, if the United States does not begin LNG exports until 2016, one year should be added to the dates for each year that exports commence after 2015.

[64] The first case combined U.S. Reference natural gas production with an international supply and demand shock. The second combined the High EUR domestic case with an international demand shock. The third combined the High EUR domestic case with an international supply and demand shock. NERA Study at 6.

these three cases with no constraint on exports, and found that even with exports reaching levels greater than 12 Bcf/d and associated higher prices than in the constrained cases, there were net economic benefits from allowing unlimited exports in all cases.

Across the scenarios, NERA projected that U.S. economic welfare would consistently increase as the volume of natural gas exports increased, including in scenarios with unlimited exports. The reason given was that even though domestic natural gas prices are pulled up by LNG exports, the value of those exports also rises so that there is a net gain for the U.S. economy measured by a broad metric of economic welfare or by more common measures such as real household income or real GDP. Although there are costs to consumers of higher energy prices and lower consumption and producers incur higher costs to supply the additional natural gas for export, these costs are more than offset by increases in export revenues along with a wealth transfer from overseas received in the form of payments for liquefaction services. The net result is an increase in U.S. households' real income and welfare. NERA noted, however, that net benefits to the U.S. economy could be larger if U.S. businesses were to take more of a merchant role. NERA assumed that foreign purchasers would take title to LNG when it is loaded at a U.S. port, so that any profits that could be made by transporting and selling in importing countries accrue to foreign entities. In cases where exports are constrained to maximum permitted levels, this business model sacrifices additional value from LNG exports that could accrue to the United States.

Sources of income would shift. NERA states that at the same time that LNG exports create higher total income in the United States, exports would shift the composition of income so that both wage income and income from capital investment decline. NERA's measure of total income is GDP measured from the income side, that is, by adding up income from labor, capital, and natural resources and adjusting for taxes and transfers.

According to NERA, expansion of LNG exports would have two major effects on income: it raises energy costs and, in the process, depresses both real wages and the return on capital in all other industries, but it also creates two additional sources of income. First, additional income would come in the form of higher export revenues and wealth transfers from incremental LNG exports at higher prices paid by overseas purchasers. Second, U.S. households also would benefit from higher natural gas resource income or rents. These benefits differentiate market-driven expansion of LNG exports from actions that only raise domestic prices without creating additional sources of income. According to NERA, the benefits that come from export expansion would more than outweigh the losses from reduced capital and wage income to U.S. consumers, and hence LNG exports would have net economic benefits in spite of higher natural gas prices. According to NERA, this is the outcome that economic theory describes when barriers to trade are removed.

Some groups and industries will experience negative effects of LNG exports.

NERA concluded that, through retirement savings, an increasingly large number of workers will share in the higher income received by natural resource companies participating in LNG export-related activities. Nevertheless, impacts will not be positive for all groups in the economy. According to NERA, households with income solely from wages or transfers, in particular, might not participate in these benefits. NERA stated that higher natural gas prices can also be expected to have negative effects on output and employment, particularly in sectors that make intensive use of natural gas, while other sectors not so affected could experience gains. There clearly would be greater activity and employment in natural gas production and transportation and in construction of liquefaction facilities. Overall, NERA projected that declines in output in other sectors would be accompanied by similar reductions in worker compensation in those sectors, indicating that there will be

some shifting of labor between different industries. However, even in the year of peak impacts, the largest projected change in wage income by industry would be no more than one percent, and even if all of this decline were attributable to lower employment relative to the baseline, NERA concluded that no sector analyzed in its study would experience reductions in employment more rapid than normal turnover. In fact, NERA asserted that most of the changes in real worker compensation are likely to take the form of lower than expected real wage growth, due to the increase in natural gas prices relative to nominal wage growth.

Peak natural gas export levels (as specified by DOE/FE for the EIA Study) and resulting price increases are not likely. The export volumes selected by DOE/FE for the EIA Study define the maximum exports allowed in each scenario for the NERA macroeconomic analysis. Based on its analysis of global natural gas supply and demand, NERA projected achievable levels of exports for each scenario. The NERA scenarios that found a lower level of exports than the limits specified by DOE/FE are shown in Figure 5 of the NERA Study, as modified from Tcf/yr to Bcf/d below.

Table 5: NERA Export Volumes in Bcf/d,
Adapted from Figure 5 of the NERA Report

NERA Export Volumes (in Bcf/d)	2015	2020	2025	2030	2035
U.S. Reference Case with International Demand Shock and lower than Low/Slow export levels	***1.02***	2.69	3.92	3.27	***6.00***
U.S. Reference Case with International Demand Shock and lower than Low/Rapid export levels	2.80	2.69	3.92	3.27	3.76

U.S. Reference Case with International Supply/Demand Shock and lower than High/Slow export levels	***1.02***	6.00	10.77	***12.00***	***12.00***
U.S. Reference Case with International Supply/Demand Shock and lower than High/Rapid export levels	***3.02***	***8.00***	10.77	***12.00***	***12.00***
U.S. High Shale EUR with International Supply/Demand Shock at Low/Slowest export levels	***0.50***	2.69	3.92	3.27	3.76

The cells in bold italics indicate the years in which the model's limit on exports is binding. All scenarios hit the export limits in 2015 except the NERA export volume case with Low/Rapid exports. In no case does the wellhead price increase by more than $1.11/Mcf due to market-determined levels of exports. Even in cases in which no limits were placed on exports, competition between the United States and competing suppliers of LNG limits increases in both U.S. LNG exports and U.S. natural gas prices.

To match the characterization of U.S. supply and demand for natural gas in EIA's NEMS model, NERA calibrated its macroeconomic model so that for the same level of LNG exports assumed in the EIA Study, the NERA model reproduced the prices projected by EIA. Thus natural gas price responses were similar in scenarios where NERA export volumes were at the EIA export volumes. However, NERA determined that the high export limits were not economical in the U.S. Reference Case and that in these scenarios there would be lower exports than assumed by EIA. Because NERA estimated lower export volumes than were specified by DOE/FE for the EIA Study, U.S. natural gas prices do not reach the highest levels projected by EIA. NERA states that this implies no disagreement with the EIA Study. Instead, it reflects the fact that at the highest wellhead prices estimated by EIA, world demand for U.S. exports would fall far short of the levels of exports

assumed in the EIA Study. Additionally, NERA found that U.S. wellhead prices would not become linked to oil prices in the sense of rising to oil price parity in any of the cases analyzed, even if the United States were exporting to regions where natural gas prices are presently linked to oil. NERA asserts that costs of liquefaction, transportation, and regasification would keep U.S. prices well below those in importing regions.

Serious competitive impacts are likely to be confined to narrow segments of U.S. industry. NERA gave special attention to the potential impact of LNG exports on EITE industries. NERA examined impacts on manufacturing industries where energy expenditures are greater than 5 percent of the value of the output created and the industries face serious exposure to foreign competition. Such industries, according to NERA, comprise about 10 percent of U.S. manufacturing and employment in these industries is one-half of one percent of total U.S. employment. NERA did not project that such energy-intensive industries as a whole would sustain a loss in employment or output greater than one percent in any year in any of the cases examined and pointed out that such a drop in employment would be less than normal rates of turnover of employees in the relevant industries.

Even with unlimited exports, there would be net economic benefits to the United States. NERA estimated economic impacts associated with unlimited exports in cases in which even the High, Rapid limits were binding. In these cases, both LNG exports and prices were determined by global supply and demand. Even in these cases, NERA found that U.S. natural gas prices would not rise to oil parity or to levels observed in consuming regions, and net economic benefits to the U.S. increased over the corresponding cases with limited exports. To examine U.S. economic impacts under cases with even higher natural gas prices and levels of exports than in the unlimited export cases, NERA

also estimated economic impacts associated with the highest levels of exports and U.S. natural gas prices in the EIA analysis, regardless of whether those quantities could actually be sold at the assumed netback prices. The price received for exports in these cases was calculated in the same way as in the cases based on NERA's GNGM model, by adding the tolling fee plus a 15 percent markup over Henry Hub to the Henry Hub price. Even with the highest prices estimated by EIA for these hypothetical cases, NERA found net economic benefits to the United States, with the net economic benefits growing as export volumes rise. Addressing this finding, NERA explained that LNG export revenues from sales to other countries at those high prices would more than offset the costs of freeing that gas for export.

VI. APPLICANT'S PUBLIC INTEREST ANALYSIS

SPL states that NGA section 3(a) creates a presumption that its proposed exports of natural gas are in the public interest and that opponents of the Application bear the burden of overcoming that presumption. SPL contends that there is ample evidence in the public record that exports of LNG, such as those requested by SPL in its Application, are in the public interest.

Further, SPL notes that in granting SPL's request for export authorization in DOE/FE Orders Nos. 2961 and 2961-A,[65] DOE/FE has already made a favorable public interest determination in the case of LNG exports from the Liquefaction Project. SPL maintains that that same rationale is equally applicable here and SPL incorporates by reference the record that it developed demonstrating the public interest benefits of exports in FE Docket No. 10-111-LNG.[66]

[65] *Sabine Pass*, DOE/FE Order No. 2961; *Sabine Pass*, DOE/FE Order No. 2961-A.
[66] *See* SPL App. at 5-6.

In support of its requested authorization, SPL appended a document, entitled "*Further Discussion of the Projected Need for the Natural Gas to be Exported*," to the Application. In this Appendix, SPL contends that the lack of domestic need for the LNG that is the subject of the Application is clear from existing and projected trends concerning U.S. gas demand and supply. SPL points out that DOE/FE has already determined in Order No. 2961-A that exports from the Liquefaction Project are not inconsistent with the public interest and, in fact, will result in various tangible economic and public benefits. SPL maintains these conclusions are bolstered by a study prepared by NERA in 2014, entitled *Updated Macroeconomic Impacts of LNG Exports from the United States* (NERA Update). Commissioned by SPL, the NERA Update reportedly found that "[a]cross the scenarios [analyzed], US economic welfare consistently increases as the volume of natural gas exports increases. This includes scenarios in which there are unlimited exports."[67] Further, SPL submits that the Liquefaction Project will support and encourage the continued development of natural gas resources during times when domestic prices of natural gas are depressed, and will subsidize the production of a quantity of natural gas that can be deployed on short notice when and if market prices induce the cancellation of the export of LNG cargoes. This will mitigate, according to SPL, natural gas price volatility that would otherwise arise and will ensure that domestic supplies will be available over the duration of commodity market cycles.

A. Domestic Natural Gas Supplies

SPL contends that innovations in the market have resulted in the availability of potential natural gas supplies that far exceed market need for the foreseeable future. SPL maintains that EIA's *Annual Energy Outlook 2014* (AEO 2014) demonstrates that the U.S.

[67] SPL App. at 12.

has significant natural gas resources available to meet projected future domestic needs, including the quantities contemplated for export under the Application. SPL states that since 2005, U.S. marketed natural gas production has grown approximately 44 percent, from 18.9 Tcf to 27.3 Tcf in 2014, representing the highest production levels in U.S. history. SPL also asserts that increased drilling productivity has enabled domestic production to continue expanding despite a sharp reduction in capital deployed by industry in upstream development. Furthermore, SPL maintains that AEO 2014 projects a 56 percent increase in total natural gas production between 2012 and 2040, with shale gas production accounting for 53 percent of total production by 2040. The Reference Case in AEO 2014 also projects, according to SPL, total U.S. dry gas production will be 37.54 Tcf by 2040 with a 1.6 percent annual growth rate between 2012 and 2040.

B. Domestic Natural Gas Demand

SPL points out that the development of shale gas formations has resulted in natural gas production outpacing demand despite demand increases since 2009. SPL states that AEO 2014 forecasts that the U.S. will become a net natural gas exporter before 2020 because increased production (coupled with a decline in natural gas imports) will outpace increasing demand. According to SPL, the AEO 2014 Reference Case predicts demand for natural gas to grow at an annual rate of 0.8 percent from 2012 to 2040 while total U.S. dry gas production is projected to double. In addition, according to SPL, the average energy use per person from 2012 to 2040 is forecast to decline as the U.S. economy is lowering energy use despite a population increase of 0.7 percent per year. SPL states that the AEO 2014 Reference Case indicates energy use per capita is projected to decline to 279 million Btu per person in 2040, down from 302 million Btu in 2012.

SPL also projects limited demand expansion through 2040 based on a sector-by-sector analysis drawn from the AEO 2014, as follows:

- **Industrial sector:** The AEO 2014 Reference Case projects U.S. industrial sector demand growth of 0.7 percent annually to total 8.68 Tcf in 2040 from 7.14 Tcf consumed in 2012.

- **Residential sector:** EIA forecasts a contraction in future residential consumption of natural gas as customer growth is offset by efficiency gains. SPL states that AEO 2014 shows a decline in residential natural gas demand of to 4.12 Tcf in 2040 from 4.17 Tcf in 2012.

- **Commercial sector:** Commercial sector natural gas use is projected to experience modest annual growth of 0.7 percent in the AEO 2014 Reference Case, reaching 3.57 Tcf in 2040 from 2.90 Tcf in 2012.

- **Electricity sector:** Demand by the electric generating sector is forecast to grow an average of 0.7 percent per year in the AEO 2014 Reference Case, expanding to 11.23 Tcf in 2040 from 9.25 Tcf in 2012.

- **Transportation sector:** Natural gas consumed for transportation is a small portion of domestic demand; the AEO 2014 Reference Case forecasts transportation sector demand will grow 11.3 percent annually from 0.04 Tcf in 2012 to 0.85 Tcf in 2040.

Pointing to the supply-demand balance, SPL contends there is lack of domestic need for the natural gas proposed for export. SPL argues domestic natural gas production has been growing at more than twice the rate of domestic demand growth since 2005[68] and, as indicated above, AEO 2014 forecasts that the U.S. will become a net exporter of natural gas after 2020 because production is growing faster than natural gas use.

C. Impact of the Proposed Exports on Domestic Prices of Natural Gas

SPL's analysis of the price impacts of LNG exports in Appendix A to the Application is based on the 2012 LNG Export Study, including both the EIA Study and the NERA Study; and EIA's 2014 study, entitled *Effect of Increased Levels of Liquefied*

[68] SPL App. 3 at 20.

Natural Gas Exports on U.S. Energy Markets (Increased Export Study or 2014 EIA Study), also commissioned by DOE.[69] According to SPL, these three studies confirm U.S. LNG exports will benefit the economy.

SPL notes the 2012 EIA Study did not consider the macroeconomic impacts of LNG exports but projected increased LNG exports would lead to increased natural gas wellhead prices. Yet SPL also states that, in all four scenarios studied, the price increases would be followed by price declines and the initial price increases were projected to be more significant in scenarios assuming lower supply.

Furthermore, SPL notes the 2012 NERA Study concluded that exports of LNG would result in net benefits to U.S. consumers even in the export scenarios that led to the most significant price increases projected by EIA. Also, according to SPL, NERA concluded that any natural gas price increases associated with LNG exports would be more modest than those projected by the 2012 EIA Study. This was the consequence, according to SPL, of NERA's express recognition that "[t]he market limits how high U.S. natural gas prices can rise under pressure of LNG exports, because importers will not purchase U.S. exports if the U.S. wellhead price rises above the cost of competing supplies."[70]

SPL observes that EIA's Increased Export Study in 2014 examined LNG exports from 12 Bcf/d to 20 Bcf/d. Yet, according to SPL, the Increased Export Study still concluded the increased export levels would yield higher levels of economic output and investment resulting from increased natural gas production would more than offset the adverse impact of somewhat higher natural gas prices.

[69] Available at http://energy.gov/sites/prod/files/2013/04/f0/fe_eia_lng.pdf
[70] SPL App. at 19 (quoting the 2012 NERA Study at 6).

D. Local, Regional, and National Economic Benefits

As stated above, SPL has incorporated by reference the record that it developed demonstrating the public interest benefits of exports in FE Docket No. 10-111-LNG. In addition to the benefits listed above, SPL identified a number of benefits to local, regional, and national economies in the application in Docket No. 10-111-LNG that it claims also support a finding that a grant of the requested authorization would be in the public interest. These benefits include:

- Manufacturing and supply of the required materials for the Project will result in an investment of over $400 million per LNG train, which equates to over $1.6 billion in domestic sourced materials;
- The Project will benefit the Louisiana and Gulf Coast regional economies during the construction and operation of the Liquefaction Project through the creation of approximately 3,000 jobs through the design, engineering, and construction of the Liquefaction Project, with most of the construction workforce expected to come directly from southern Louisiana and southeastern Texas;
- The Project, once operational, will generate significant tax revenues; and
- The Project indirectly will have a "profound multiplier effect" due to the wages, taxes, royalty, and lease payments in the natural gas supply chain.

E. International Benefits

SPL stated in the application in FE Docket No. 10-111-LNG that its request for export authority is supported by national policies in favor of free trade; will yield a significant benefit by leveling the United States' balance of payments and reducing the nation's trade deficit by an estimated $6.7 billion; will enhance the diversity of global natural gas supply and contribute to the security interests of the United States and its allies; and will advance the current Administration's initiatives to promote investment in energy infrastructure in neighboring Caribbean, Central American, and South America nations. Other geopolitical benefits identified by Sabine Pass include liberalization of the global gas

market through increased liquidity and trade at prices established by market forces and an increased potential for global decoupling of the link between the pricing of natural gas and competing crude oil products in international markets.

VII. CURRENT PROCEEDING BEFORE DOE/FE

A. Motions to Intervene, Comments, and Protests

As noted above, DOE received timely filed motions to intervene from API and Sierra Club. While API did not take a position on the merits of the Application, Sierra Club protested the Application. In addition, DOE/FE received comments in opposition to the Application from Jean Public and Curtis Morrison, and SPL filed the "Answer of Sabine Pass Liquefaction, LLC in Opposition to Sierra Club Motion to Intervene, Protests, and Comments" (Answer).

1. API's Motion to Intervene

API states that it is a national trade association representing more than 625 member companies involved in all aspects of the oil and natural gas industry in the United States, including 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 further states that its members have extensive experience with the drilling and completion techniques used in producing America's natural gas resources. API thus maintains that it has a direct and immediate interest in these proceedings which cannot be adequately protected by any other party.

2. Sierra Club's Motion to Intervene, Protest, and Comments

Intervention. In support of its intervention, Sierra Club states that the proposed exports from the Liquefaction Project will cause extensive environmental harm, impacting

the environment around the export site, inducing harmful natural gas production, likely increasing global greenhouse gas emissions, and resulting in economic harm, including natural gas price increases. Sierra Club maintains that its members live and work throughout the area that will be affected by SPL's export proposal and claims to have members who live in the domestic gas fields that will likely see increased production as a result of the exports. Sierra Club states that, as of October 2015, it had 2,880 members in Louisiana and 629,261 members overall. Sierra Club argues its members everywhere will be affected by the natural gas price increases and other economic harms associated with any expansion or change in natural gas production, especially in shale gas plays, as a result of increased gas exports. Sierra Club concludes its members thus have a direct interest in avoiding the environmental and economic harms that would follow from a grant of the Application and, therefore, Sierra Club should be granted intervention in this proceeding.

Protest and Comments. Sierra Club argues that the NGA and NEPA, as well as the Endangered Species Act and the National Historic Preservation Act, impose obligations upon DOE that must be considered before it can authorize the proposed exports. Sierra Club contends the public interest review required under section 3 of the NGA encompasses environmental concerns and, notwithstanding the language of section 3(a) creating a rebuttable presumption that a proposed export is in the public interest, DOE cannot extend this presumption to environmental impacts. Sierra Club further argues NEPA requires preparation of an EIS where, as here, a proposed federal action would significantly affect the quality of the human environment and there are substantial questions as to the severity of the impact of the proposed federal action. Sierra Club maintains the EIS must consider, among other factors, alternatives to the proposed export authorization as well as the direct and indirect effects and the cumulative impacts of the proposed action.

Sierra Club further urges DOE/FE to reject SPL's request for a categorical exclusion and argues DOE/FE cannot proceed with SPL's Application until the NEPA process is completed through the preparation of an EIS. Sierra Club contends that an increase in exports of 203 Bcf/yr represents nearly one percent of U.S. dry gas production and a 25 percent increase over the previously approved exports from the Liquefaction Project. This volume of exports, Sierra Club maintains, is not a minor operational change that qualifies for a categorical exclusion. Also, Sierra Club asserts that the proposed export authorization will involve some new construction. Moreover, Sierra Club contends CEQ regulations preclude use of a categorical exclusion where, as here, the scale of the Project's indirect effects may be significant.[71]

Sierra Club argues DOE/FE must not rely on the 1984 Policy Guidelines because those Guidelines dealt with natural gas imports and the primary issue addressed by the Guidelines was whether to directly regulate prices at which gas could be imported from Canada. According to Sierra Club, the willingness of a foreign consumer to purchase gas exported from the U.S. does not provide a presumptive indication of the domestic need for the gas and is independent of the environmental impacts that will result from producing and exporting the gas.

Sierra Club maintains that LNG exports have the potential to alter the American energy landscape and represent a significant policy shift. Consequently, Sierra Club submits DOE's policy change should be accompanied by a programmatic EIS that would allow DOE/FE and the public to understand the relationship between LNG export proposals and their cumulative environmental and economic impacts. Sierra Club notes DOE/FE has

[71] *Id.* at 14 (citing 40 C.F.R. 1508.4).

not responded to a petition for rulemaking that it submitted to DOE/FE in 2013.[72] While Sierra Club acknowledges that the 2012 LNG Export Study, the 2014 Updated Export Study, and the Addendum contributed important information to DOE/FE's review of export applications, Sierra Club asserts these studies are not a substitute for formal rulemaking or NEPA review (programmatic or otherwise).

Sierra Club maintains that, if DOE is going to review the Application in an individual docket, the review must incorporate the NERA Study and the 2014 environmental materials in this docket. Sierra Club incorporates by reference the comments that it submitted on the NERA Study and "the 2014 environmental materials" (presumably including its comments on the LCA GHG Report and the Addendum).[73]

Based partly on its comments on those earlier environmental materials and additional argument presented in this proceeding, Sierra Club argues the requested authorization is not in the public interest because it is not supported by adequate environmental and economic analysis. The environmental impacts that must be considered, according to Sierra Club, include the following:

(a) Environmental impacts from the construction and operation of the liquefaction facilities, export terminal, and related pipelines;

(b) Environmental impacts due to additional natural gas production, primarily hydraulic fracturing of unconventional gas sources, induced by the demand for natural gas from the Liquefaction Project;

(c) Increased emissions of greenhouse gases, and conventional and toxic air pollutants due to higher gas prices and an increase in coal-fired electricity generation; and

(d) Reduced use of wind, solar, and other clean renewable energy sources due to the competition created by LNG exports.

[72] Sierra Club, et al., *Petition for Rulemaking Regarding Natural Gas Export Policy* (April 8, 2013), attached to Sierra Club Mot. at Exhibit 2.
[73] Sierra Club Mot. at 10.

Environmental Impacts from Construction and Operation of LNG Export Facilities. Sierra Club maintains DOE/FE must consider the cumulative impacts of all potential future exports from the Sabine Pass facility plus all other natural gas export proposals currently pending before or approved by DOE/FE. In support of this position, Sierra Club argues the public will not experience each proposed terminal as an individual project but will experience them cumulatively through increased gas and electricity prices and the environmental damage that will follow. Sierra Club contends the Environmental Protection Agency (EPA) likewise has argued that NEPA review of proposed export projects should include "the context of the larger energy market, including existing export capacity and export capacity under application to the Department of Energy."[74]

If, notwithstanding Sierra Club's argument that all pending applications for export volumes should be considered in assessing the cumulative impact of export authorizations, DOE/FE looks only at the range of exports it deems likely to occur, Sierra Club states it still would be a mistake to rely on the NERA Study's prediction of export volumes. The NERA Study, according to Sierra Club, understated the market for likely exports by concluding exports would only occur when the spread between U.S. gas prices and prices in potential foreign markets exceeded the cost of liquefying, transporting, and re-gasifying domestic production.

Sierra Club contends NERA overstated these transaction costs, particularly the lower costs of exporting from proposed West Coast terminals to Asia *vis-à-vis* the

[74] *Id.* n.15 at 12 (citing to EPA, Scoping Comments – The Jordan Cove Energy Project LP, FERC Dkts. PF12-7 and PF12-17, at 3 (Oct. 29, 2012) (attached as Exhibit 6 to Sierra Club Mot.); EPA, Scoping Comments – Cove Point Liquefaction Project, FERC Dkt. PF12-16-000, at 2 (Nov. 15, 2012) (attached as Exhibit 7 to Sierra Club Mot.); and EPA, Scoping Comments – The Oregon LNG Export Project and Washington Expansion Project, FERC Dkts. PF12- 18 and PF12-20, at 3 (Dec. 26, 2012) (attached as Exhibit 8 to Sierra Club Mot.).

transportation costs experienced by Gulf Coast facilities, and ignored the ways in which take-or-pay contracts are likely to distort the market. In particular, Sierra Club asserts that the cost of processing and transporting LNG could be $0.44/MMBtu higher than the NERA Study estimates and this differential represents five to ten percent of NERA's predicted 2035 wellhead gas prices. Sierra Club explains that the NERA Study did not consider that "take or pay" liquefaction services arrangements will have the effect of requiring importers to pay a fee to reserve terminal capacity regardless of whether the capacity is used. This fee, Sierra Club charges, constitutes a sunk cost that will raise the price ceiling under which exports will occur. Sierra Club states it has raised this argument in other proceedings before DOE/FE but maintains the agency has not addressed it in its prior conditional authorizations.[75]

Environmental Impacts from Induced Production. With respect to induced gas production, Sierra Club asserts DOE has not acknowledged or discussed the models that have been developed to identify where induced production will occur. Sierra Club refers to its comments on the Addendum where it asserted that both EIA's National Energy Modeling System (NEMS) and Deloitte MarketPoint's world gas model can predict where this additional production is most likely to occur.[76] Sierra Club further contends EIA has already provided region-specific predictions of increases in gas production in response to DOE's own request in connection with both the 2012 EIA Study and the 2014 Updated Export Study. Furthermore, Sierra Club states that a report by ICF contains published forecasts of state-specific increases in gas production in response to exports. According to Sierra Club, the ICF map could be used to predict where production would increase in

[75] Sierra Club Mot. at 13.
[76] Sierra Club Mot. at 16.

response to the Liquefaction Project. Alternatively, Sierra Club maintains that the general export scenario conducted by the ICF study provides a basis for evaluating the cumulative impacts of proposed export projects.

Sierra Club contends DOE/FE must consider the upstream impacts, including induced natural gas production, and changes to U.S. energy markets as part of an EIS and the NGA public interest analysis in this proceeding. Sierra Club maintains that the 2012 EIA Export Study and private modelers agree that the exports at issue in this proceeding will cause an increase in domestic natural gas production equivalent to about 61 to 84 percent of the increase in natural gas demand from the exports.[77] Based on the high end of this range, Sierra Club projects the gas demand created by the proposal in this proceeding (which, Sierra Club states, is 223 Bcf/yr) could cause 188 Bcf/yr of new production.[78] Sierra Club charges that this additional gas production is a significant air pollution source that can disrupt ecosystems and watersheds, lead to industrialization of entire landscapes, and present challenging waste disposal issues.

Sierra Club maintains DOE/FE wrongly concluded that an analysis of these upstream impacts was not required by NEPA. Sierra Club further states that its comments on DOE's environmental materials explains the errors in DOE/FE not analyzing these upstream impacts as part of its NEPA analysis. Sierra Club refers particularly to alleged errors in the Addendum's methane leakage rate. Sierra Club charges additional peer-reviewed studies supporting the conclusion that DOE has underestimated methane leakage

[77] Sierra Club Mot. at 16.

[78] Sierra Club also indicates that DOE could identify the likely volume of induced production by drawing on studies by the National Energy Technology Laboratory (NETL) that assumes a combined cycle power plant will have a 46 percent efficiency rate and EIA's estimate of a natural gas heat content of 1025 Btu per cubic foot. Sierra Club states that, based on those assumptions, NETL has estimated that the production and transmission of natural gas emits 87 metric tons of NO_x per Bcf of natural gas. Sierra Club Mot. at 20.

rates were released after publication of DOE's environmental materials.[79] Sierra Club maintains that "DOE must acknowledge this additional science."[80] Moreover, Sierra Club argues the ozone impacts from the natural gas production induced by the Liquefaction Project will be far above the thresholds for major source permitting under the Clean Air Act and will be especially harmful because the majority of additional production is likely to occur in nearby shale gas plays and ozone from those production fields will exacerbate existing unhealthy ozone levels in the region.

Such an analysis must include, according to Sierra Club, a consideration of reasonable alternatives, even if not within the jurisdiction of the lead agency and appropriate mitigation measures not included in the proposed action. Sierra Club identifies several alternatives that, it asserts, could lessen the indirect environmental impacts of SPL's proposal and should be considered as part of the NEPA analysis:

- Whether export from other locations would better serve the public interest by mitigating or better distributing economic or environmental impacts;
- Whether limitations on the sources of exported gas – e.g., limiting export from particular plays, formations, or regions – would help to mitigate environmental and economic impacts;
- Whether conditioning export on the presence of an adequate regulatory framework, including the fulfillment of the recommendations for safe production made by the DOE's Shale Gas Subcommittee, would better serve the public interest by ensuring that the production increases associated with export will not increase poorly regulated unconventional gas production;
- Whether to delay, deny, or condition exports based upon their effect on the U.S. utility market (including changes in air pollution emissions associated with the impacts of increased export demand on fuel choice);
- Whether to require exporters to certify that any unconventional gas produced as a result of their proposal (or shipped through their facilities) has been produced in accordance with all relevant environmental laws and according to a set of best production practices (such as that discussed by the DOE's Shale Gas

[79] Sierra Club Mot. at 18-19.
[80] Sierra Club Mot. at 19.

Subcommittee); and

- Whether to permit exports only if the export facilities are designed and operated so as to minimize their environmental impacts.

Increased Emissions of Greenhouse Gases and Air Pollutants. Sierra Club states that exports will increase the production of natural gas and, in turn, will drive an increase in the price of natural gas. This projected increase in natural gas prices, according to Sierra Club, will likely increase greenhouse gas emissions from the U.S. electricity sector as the generators of electricity shift from natural gas to coal. Sierra Club notes it discussed this issue in its comments on the LCA GHG Report.[81]

[81] Sierra Club Mot. n.45 at 21.

Sierra Club refers to comments that it submitted in response to the 2012 NERA Study[82] and contends the NERA Study attempted to downplay these economic impacts by stating that the benefits of additional natural gas production are passed to American consumers that own stock in natural gas production companies. Sierra Club submits NERA's conclusion is not well-founded because (a) only about half of American families own any stock and only a small subset of those stockholders own stock in the gas production companies that will benefit from LNG exports; (b) NERA incorrectly assumed gas production and liquefaction service companies are American-owned; and (c) without any evidentiary support, DOE/FE has assumed in conditionally approving LNG exports in DOE/FE Order No. 3282 for Freeport LNG Expansion and FLNG Liquefaction, LLC (FLEX) that foreign investment in gas production would cause a dollar-for-dollar displacement of domestic investment into other industries.[83] Sierra Club also disputes DOE/FE's statement in DOE/FE Order No. 3282 that the commenters questioning the income distributional effects of LNG exports had not made a "sufficiently compelling" argument because they had not performed a quantitative analysis of impacts at the household level. Sierra Club maintains: "In light of the aggregate job data, ratepayer effects, and shareholder data provided by the Sierra Club, there is no apparent reason why a household-level study is necessary."[84] Moreover, Sierra Club contends that because of the distributional impacts on the less well-to-do, LNG exports are not consistent with the policies of the present Administration which has emphasized the need to avoid regressive wealth transfers.

[82] Sierra Club Mot. at 22.
[83] Sierra Club Mot. at 24, citing *Freeport LNG Expansion and FLNG Liquefaction, LLC*, Order Conditionally 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, DOE/FE Order No. 3282 (May 17, 2013) at 93.
[84] Sierra Club Mot. at 24.

Monitoring Conditions. If, notwithstanding Sierra Club's arguments to the contrary, DOE/FE approves SPL's Application, Sierra Club asserts DOE/FE must impose rigorous conditions to monitor economic, environmental, and other relevant considerations. Sierra Club maintains that the monitoring conditions imposed in DOE/FE Order No. 2961-A need to be significantly expanded by identifying specific terms and thresholds which will trigger agency actions in the following areas:

(1) Regional and national economic dislocations and disruptions caused by natural gas extraction;

(2) National increases in gas and electricity prices and resulting shifts to more polluting fuels; and

(3) Environmental Impacts.

3. Other Protests

As stated above, DOE/FE received timely filed protests opposing the Application by email from Curtis Morrison and Jean Public. Mr. Morrison argues that the proposal to export LNG "violates the rights of future generations to a safe and stable atmosphere, guaranteed under the public trust doctrine." Ms. Public opposes building LNG ports to send energy out of the U.S. and opposes hydraulic fracturing as a means of extracting natural gas.

B. Answer of Applicant

On November 10, 2015, SPL filed its Answer to Sierra Club's Motion to Intervene, Protest, and Comments. SPL argues Sierra Club's Motion to Intervene should be denied because Sierra Club has not supported the assertion that it has an interest in the environmental consequences of any exports from the Liquefaction Project. SPL points out the basis for this assertion is Sierra Club's claim that it has 2,880 members in Louisiana and 629,261 overall. According to SPL, this does not "remotely support" Sierra Club's claim that its members live in

the specific areas relevant to the Application and they will be impacted individually by a grant of the Application. SPL adds that insofar as Sierra Club may be basing its claim of an interest in the outcome of this proceeding on matters relating to the siting, construction, and operation of the Liquefaction Project, those matters are solely within the purview of FERC; hence, according to SPL, intervention in this proceeding based on such matters would be duplicative and unnecessary and should not be granted.

SPL states Sierra Club's Protest also should be rejected because Sierra Club has failed to submit evidence to rebut the presumption that granting the Application would be consistent with the public interest. SPL incorporates by reference numerous filings that it and its affiliates submitted in response to Sierra Club in other LNG export proceedings before DOE.[85] SPL argues Sierra Club's Motion in the current proceeding, like its prior filings, "consists almost entirely of generalized assertions regarding the putative environmental effects of induced natural gas production that will supposedly result from LNG exports in general, rather than an argument specific to the Application."[86] SPL stresses that the requested authorization requires no additional facility construction or modification beyond that already authorized by FERC and that FERC has already examined potential environmental impacts associated with the LNG export volumes at issue in this proceeding. SPL notes DOE/FE has repeatedly rejected Sierra Club's arguments about increased natural gas prices and economic harms and concluded such effects are speculative and not reasonably foreseeable.

SPL also disputes Sierra Club's argument that DOE/FE should not issue a categorical exclusion in this proceeding. SPL notes that FERC's regulations do not allow for a categorical

[85] App. Answer, n.17 at 4-5.
[86] App. Answer at 5.

exclusion. As a consequence, according to SPL, FERC has already considered the potential environmental impacts associated with the additional volumes of LNG exports contemplated by the Application and FERC concluded the increase did not constitute a major federal action significantly affecting the quality of the human environment.[87] SPL maintains Sierra Club has not identified any extraordinary circumstances that require additional review. SPL points out DOE/FE has issued a categorical exclusion in similar circumstances[88] and contends that it should do the same here.

Furthermore, SPL contests Sierra Club's assertion that the rebuttable presumption in section 3(a) of the NGA does not apply to environmental impacts. According to SPL, the text of the statute does not distinguish between environmental and non-environmental impacts. Moreover, to the extent Sierra Club may be arguing for wholesale changes to the NGA section 3 process, SPL maintains that such arguments are beyond the scope of an individual application.

SPL contends Sierra Club's NEPA arguments, are substantively flawed. There is no basis, according to SPL, for Sierra Club's insistence that DOE prepare a programmatic EIS in this proceeding. SPL observes FERC's common practice is to use an environmental assessment to evaluate the impacts of proposed increases to LNG terminal capacity in cases where the previously approved project is still under construction. Also, SPL contends reviewing courts have stated that a programmatic EIS reflects "broad environmental consequences attendant upon a wide-ranging federal program." Yet, according to SPL, the Liquefaction Project is not part of a coordinated federal program and there is no basis, therefore, to prepare a programmatic EIS.

[87] App. Answer at 8.
[88] App. Answer at 9.

SPL contests Sierra Club's argument that DOE/FE's assessment of the Application must include a review of induced natural gas production. SPL points out FERC and DOE both have rejected Sierra Club's argument and states courts have held that a plaintiff mounting a NEPA challenge must establish that an alleged effect is proximately caused by the proposed agency action. SPL likewise argues FERC has consistently rejected the proposition that any induced natural gas production that might occur following a grant of the Application constitutes a "cumulative impact" under NEPA that must be considered in an EIS.[89]

SPL challenges Sierra Club's argument that the 2014 EIA Study shows that the export authorization requested in this proceeding, if granted, will cause an increase in domestic gas production equivalent to 61 to 84 percent of the increase in natural gas demand from LNG exports. SPL states that the portion of the 2014 EIA Study that forms the basis of Sierra Club's claim refers to LNG exports nationwide and not to any particular LNG project or specific authorization. SPL also states the 2014 EIA Study recognizes that its projections cover a 25-year period and are subject to many unforeseen events, particularly as to LNG exports.

SPL also contests Sierra Club's claims of economic harms due to approval of the Application. SPL urges Sierra Club's position is not based on evidence in the record. On the other hand, according to SPL, the 2012 NERA Study found increased economic welfare in all export scenarios, including scenarios in which there are unlimited exports.

SPL argues that much of the job losses and other economic harms projected by Sierra Club would theoretically be attributable to induced production of natural gas; those alleged effects, according to SPL, are not a cognizable indirect effect of the Liquefaction Project. On the

[89] App. Ans. at 15.

other hand, SPL maintains Sierra Club's concern for the working class does not prevent it from opposing a project that would support thousands of construction jobs as well as higher export revenues and higher natural gas income.

SPL disputes Sierra Club's contention LNG exports will reduce GDP. This is contradicted, according to SPL, by the 2012 NERA Study which predicted positive impacts under all modeled scenarios, by DOE/FE decisions,[90] and by the Updated NERA Study.

VIII. COMMENTS ON THE LNG EXPORT STUDY AND DOE/FE ANALYSIS

In the NOA, DOE/FE sought public comment on the EIA and NERA studies, including the modeling scenarios used in both studies.[91] DOE/FE specifically invited comment on "the impact of LNG exports on: domestic energy consumption, production, and prices, and particularly the macroeconomic factors identified in the NERA analysis, including Gross Domestic Product (GDP), welfare analysis, consumption, U.S. economic sector analysis, and … any other factors included in the analyses."[92] 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."[93]

As explained above, DOE/FE spent several months reviewing the more than 188,000 initial and 2,700 reply comments received in response to the NOA. Given the volume of comments, it is neither practical nor desirable for DOE/FE to summarize each of them. Therefore, DOE/FE identifies below both: (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

[90] App. Ans., n.76 at 18, citing *Lake Charles*, DOE/FE Order No. 3324.
[91] 77 Fed. Reg. at 73,629.
[92] *Id.*
[93] *Id.*

those comments. In so doing, DOE/FE will respond to the relevant, significant issues raised by the commenters.[94]

A. Data Inputs and Estimates of Natural Gas Demand

1. Comments

Several commenters, including Sierra Club,[95] Dow Chemical Company (Dow), along with U.S. Representative Edward Markey, U.S. Senator Ron Wyden, Alcoa, Save Our Supplies, the Industrial Energy Consumers of America (IECA), and Jannette Barth, challenge the data used as inputs to the LNG Export Study. Most of these commenters assert NERA should have used projections from AEO 2012 or AEO 2013, rather than from AEO 2011, to produce a more accurate picture of the current and likely future state of the natural gas market and the likely macroeconomic impacts of LNG exports. These commenters assert the AEO 2011 projections significantly underestimate actual and future demand for natural gas, especially in the U.S. electric, manufacturing, and transportation sectors, and in international markets. Some commenters identify additional factors, other than the vintage of the AEO 2011 data, to support their arguments that NERA underestimated present and future demand for natural gas. For example, Save Our Supplies argues that NERA underestimated international demand because the GNGM model did not appear to account for the continued growth of international LNG import infrastructure. Together, these commenters assert that the NERA Study underestimated future demand for natural gas and, consequently, underestimated the likely increases to natural gas prices from LNG exports.

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[94] *See, e.g., Public Citizen v. F.A.A.*, 988 F.2d 186, 197 (D.C. Cir. 1993).

[95] For purposes of this discussion, Sierra Club filed comments on the LNG Export Study on behalf of itself and a coalition of non-profit organizations, including Catskill Citizens for Safe Energy, Center for Biological Diversity, Clean Air Council, Columbia Riverkeeper, Delaware Riverkeeper, Lower Susquehanna Riverkeeper, Shenandoah Riverkeeper, and Upper Green River Alliance [hereinafter Sierra Club].

A number of commenters, including Sierra Club, Dow, Senator Wyden, Representative Markey, Jannette Barth, and Save Our Supplies maintain that, as compared to AEO 2011, the AEO 2013 Early Release Overview projects a substantial increase in demand for natural gas in the industrial manufacturing sector.[96] Dow claims there has been a manufacturing renaissance since completion of AEO 2011 involving announcements of approximately 100 capital investments representing some $95 billion in new spending and millions of jobs driven largely by the supply and price outlook for natural gas. These investments, according to Dow, will add about 5 million new jobs and 6 Bcf/d of industrial gas demand by 2020, which Dow states is nearly a 30 percent increase in industrial demand relative to 2009, the baseline year for AEO 2011.

Dow also asserts that projections of future natural gas demand by industry are more than double the demand predicted in AEO 2011's High EUR case, which includes significantly higher demand than the Reference Case. In addition to significantly higher projections of demand for manufacturing, Dow refers to projections from Wood Mackenzie, CERA, and others that indicate a potential increase of transportation demand from 0.2 to 1.5 Bcf/d from 2013 to 2020. This compares to AEO 2011's projection of a modest increase for natural gas demand in the transportation sector of 0.1 to 0.2 Bcf/d of natural gas. Dow states that the higher level of demand derived from Wood Mackenzie and CERA is the result of a projection of fleet vehicles converting to LNG and compressed natural gas.

[96] During the time of the comment period on the LNG Export Study, the AEO 2013 Early Release was the most current AEO available, and is therefore discussed in many of the comments. On May 2, 2013, after the comment period had closed, EIA issued its final AEO 2013 projections. *See* U.S. Energy Information Administration, *Annual Energy Outlook 2013 with Projections to 2040* (April 2013), *available at* http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf [hereinafter AEO 2013]. This Order references both the final projections from AEO 2013 and more recent EIA projections, as noted.

According to Dow, AEO 2011 projects that natural gas demand for power generation will decrease through the end of the decade, whereas Wood Mackenzie and CERA predict that natural gas use in the power sector will increase 14 percent by 2020, ultimately resulting in 24.7 Bcf/d of power sector demand. This projected increase is due to unidentified, anticipated changes in carbon policy, renewables policy, and nuclear policy favoring the use of natural gas in the power sector.

In addition to criticizing the projections of demand based on AEO 2011, Dow maintains that the level of exports authorized to date and additional exports that may be authorized in the future will drive up demand levels even higher. Specifically, Dow asserts that NERA's conclusion that prices will not increase by more than $1.11/Mcf is based on a faulty assumption that natural gas exports will never rise above 6.72 Tcf/yr, or roughly 18.5 Bcf/d by 2025. Dow points out that authorized exports to FTA nations as of January 1, 2013 had already reached approximately 28 Bcf/d. Dow complains that NERA did not consider what would happen if exports attained the authorized levels. In that event, Dow asserts that domestic gas prices undoubtedly would spike. Other commenters, such as Citizens Against LNG, make similar arguments. Citizens Against LNG alleges that the NERA Study is flawed because it failed to estimate the impact of the full potential volume of exports of approximately 31.41 Bcf/d to FTA nations and 24.80 Bcf/d to non-FTA nations.

Contrary to the above arguments, several commenters, such as Dominion Cove Point LNG, LP, Lakes Charles Exports, and Gulf LNG Liquefaction Company, LLC (Gulf LNG), argue that NERA reasonably relied on data from AEO 2011. These commenters state that NERA used the AEO 2011 data because the EIA portion of the LNG Export Study used that data, and DOE/FE sought to ensure consistency across both parts of the LNG Export Study.

Further, a number of commenters, including America's Natural Gas Alliance, Exxon Mobil Corporation (ExxonMobil), Golden Pass Products LLC, American Petroleum Institute, former Secretary of Energy Spencer Abraham, Carl Foster, and the Western Energy Alliance, argue that NERA's use of the AEO 2011 data does not undermine the results of the LNG Export Study. These commenters contend that the AEO 2013 Early Release data show higher production of natural gas and a more elastic supply of natural gas than the AEO 2011 data used by NERA, indicating that the domestic resource base could more easily accommodate increasing domestic demand as well as demand from new LNG export projects.

With respect to Dow's claim that there is $95 billion of new investment in domestic manufacturing, Lake Charles Exports, LLC and Secretary Abraham argue that many of the projects listed by Dow are currently under consideration and not projected to commence operation until far into the future. These commenters assert that Dow provided no information as to when or whether these projects will materialize. The commenters conclude that there is no reasonable basis to believe that these domestic manufacturing investments will lead to an additional 6 Bcf/d in domestic natural gas demand as claimed by Dow.

2. DOE/FE Analysis

a. Use of AEO 2011 Projections

DOE's basis for relying on AEO 2011. The LNG Export Study was based on AEO 2011 projections, which were the most recent, final projections available in August 2011 when DOE commissioned the EIA Study, and also in October 2011 when DOE commissioned the NERA Study. As explained above, the NERA Study was designed so that NERA would use the results from the EIA Study as inputs to the NERA model to ensure congruence between the two studies, which together formed the single LNG Export Study. If both studies had not relied on

the same data, meaningful comparison and cross-analysis of the two studies would have been impossible.

Although some commenters have asserted that DOE should have required EIA and NERA to use newer projections than those in AEO 2011, this argument does not acknowledge either the timing of the AEO publication cycles, or the lead time required of EIA and NERA to conduct their work. Using the final AEO 2011 projections, EIA published its study on January 19, 2012. Only four days later, on January 23, 2012, EIA published the 2012 AEO "Early Release Overview," which was a preliminary, abridged version of EIA's forthcoming AEO 2012. It would not have been possible for EIA to use the 2012 Early Release projections in its study without starting over once that data had been published.

Indeed, EIA did not publish the final AEO 2012 until June 2012, six months after EIA had published its study for this proceeding. By that time, the NERA Study was well underway. NERA published its final report in December 2012—the same month that EIA released the AEO 2013 Early Release Overview. As stated above, EIA did not publish the final AEO 2013 projections until May 2, 2013.

In an undertaking of this scope and magnitude, it was perfectly reasonable to base the LNG Export Study on AEO 2011, which contained the best, most authoritative economic projections available when DOE/FE commissioned the EIA and NERA studies. Once both studies were underway, a decision to use AEO 2012 or AEO 2013 Early Release projections would have required EIA and NERA to abandon their existing work and redo much, if not all, of their analyses.

Courts have repeatedly recognized that agencies are not required to redo a study simply because newer data become available, "particularly given the many months required to conduct

full [analysis] with … new data."[97] Requiring DOE to start over with new data "would lead to significant costs and potentially endless delays."[98] Moreover, under the commenters' rationale, DOE's LNG Export Study and administrative process would run indefinitely, as DOE would have to start over with new AEO projections whenever they became available. As the Supreme Court has observed, if an agency were required to rehear new evidence before it issues a final administrative decision, "there would be little hope that the administrative process could ever be consummated in an order that would not be subject to reopening."[99]

No material change using post-AEO 2011 projections. Further, we are not persuaded that using post-AEO 2011 EIA projections would have materially affected the findings of the LNG Export Study. Commenters point to the fact that AEO 2012 and the AEO 2013 Early Release Overview forecast greater domestic natural gas consumption in the years ahead than did AEO 2011. The commenters are correct in this observation, but it is also true that AEO 2012 and the AEO 2013 Early Release Overview projected much greater domestic natural gas production than did AEO 2011. For example, in the LNG Export Study proceeding, Jordan Cove submitted an analysis from Navigant correctly noting the increasing gas production projections in the later EIA analyses: For the period of 2013-2035, there was an average percentage increase in forecast total domestic natural gas consumption between AEO 2011 and AEO 2013 of 5.6 percent, while the increase in forecast total natural gas production was 16 percent. This important context helps explain why the AEO 2013 assumptions actually indicate the beneficial

[97] *Theodore Roosevelt Conserv. P'ship v. Salazar*, 616 F.3d 497, 511 (D.C. Cir. 2010) (quotations and citations omitted) (alteration in original).
[98] *Sierra Club v. U.S. Envtl. Prot. Agency*, 356 F.3d 296, 308 (D.C. Cir. 2004) (upholding EPA's decision to use an existing computer model in lieu of a newly-released version).
[99] *Vermont Yankee Nuclear Power Corp. v. Natural Res. Def. Council*, 435 U.S. 519, 554-55 (1978).

market impacts that come from LNG exports.[100]

Using the later-published final AEO 2013 Reference Case (see Table 6 below) illustrates that, although total natural gas consumption projected for 2035 was projected to increase by 6 Bcf/d between AEO 2011 and 2013 (from 72.7 Bcf/d to 78.7 Bcf/d), total domestic dry gas production was projected to increase by more than twice that amount, increasing by 13.8 Bcf/d (from 72.1 Bcf/d to 85.9 Bcf/d). In addition, the projected 2035 Henry Hub price declined from $7.07/MMBtu to $6.32/MMBtu, despite net exports (including both pipeline and LNG exports) rising from -0.5 Bcf/d in AEO 2011 to +7.0 Bcf/d in AEO 2013. Although the data used in Table 6 for "AEO 2013 Reference Case" refer to the final AEO 2013 projections, the data are unchanged from EIA's projections in the AEO 2013 Early Release Overview. As the table shows, the final AEO 2013 Reference Case projects domestic supply and demand conditions that are more, not less, favorable to exports.

Likewise, on April 14, 2015, EIA issued its most recent update, the Annual Energy Outlook 2015 (AEO 2015), with projections to 2040.[101] As depicted in Table 6, projections from that report reflect net LNG exports from the United States in a volume equivalent to 9.0 Bcf/d of natural gas in 2035.[102] This estimate compares with projected net LNG imports of 0.4 Bcf/d in the lower-48 states for 2035 in the AEO 2011 Reference Case. The 2035 Henry Hub price in the AEO 2015 Reference Case is $6.50/MMBtu, down from $7.31/MMBtu in the AEO 2011 Reference Case (both in 2012 dollars).

[100] Comments of Navigant Consulting, Inc., at 6 (attached to Initial Comments of Jordan Cove Energy Project, L.P.).
[101] U.S. Energy Information Administration, *Annual Energy Outlook 2015* (April 14, 2015), *available at* http://www.eia.gov/forecasts/aeo/ [hereinafter AEO 2015].
[102] *See* AEO 2015 at A-27, Table A13.

Table 6 also compares the AEO 2015 Reference Case to the AEO 2013 Reference Case, indicating that:

- Total natural gas consumption for 2035 is projected to increase by 0.3 Bcf/d, from 78.7 Bcf/d to 79.0 Bcf/d;
- Net exports (including both pipeline and LNG exports) are projected to increase by 7.2 Bcf/d, from 7.0 Bcf/d to 14.2 Bcf/d; and
- The projected 2035 Henry Hub price is projected to increase by $0.17/MMBtu, from $6.43/MMBtu to $6.50/MMBtu (in 2012 dollars).

Indeed, in comparing the AEO 2015 Reference Case and AEO 2013 Reference Case projections, total domestic dry gas production is projected to rise by 7.6 Bcf/d of natural gas, from 85.9 Bcf/d to 93.5 Bcf/d. For these and other reasons, these post-AEO 2011 projections in no way undermine our conclusion regarding the consistency of the proposed exports with the public interest.

Table 6: Comparison of AEO Cases

Projections for 2035	**AEO 2011 Reference Case**	**AEO 2012 Reference Case**	**AEO 2013 Reference Case**	**AEO 2015 Reference Case**	**AEO 2011 High Shale EUR Case**
Total Natural Gas Consumption (Bcf/d)	72.7	73.0	78.7	79.0	81.2
Electric Power Sector Consumption (Bcf/d)	21.6	24.5	25.9	25.1	26.4
Transportation Sector Consumption (Bcf/d)	0.4	0.4	1.6	0.8	0.7
Domestic Dry Gas Production (Bcf/d)	72.1	76.5	85.9	93.5	82.5
Net Natural Gas Exports by Pipeline (Bcf/d)	-0.1	1.9	3.0	5.2	1.9
Net Natural Gas Exports as LNG (Bcf/d)	-0.4	1.8	4.0	9.0	-0.4
Henry Hub Price, $/MMBtu (Reference Basis)	$7.07 (2009$)	$7.37 (2010$)	$6.32 (2011$)	$6.60 (2013$)	$5.35 (2009$)
Henry Hub Price (2012$ Basis)	$7.31/MMBtu	$7.62/MMBtu	$6.43/MMBtu	$6.50/MMBtu	$5.53/MMBtu

We again note that NERA also modeled a wide range of possible future supply and demand conditions, thereby reducing the dependence of its results on the accuracy of the AEO 2011 Reference Case. The AEO 2011 High Shale EUR case, for example, is represented in the table above showing EIA's AEO 2011 assumption of no new LNG exports. The AEO 2011 High Shale EUR case projected natural gas consumption growth that was even greater than the AEO 2013 Reference Case and domestic natural gas production growth that was less than the AEO 2013 Reference Case. Using the AEO 2011 High Shale EUR as a baseline, NERA modeled LNG exports across a range of international market conditions and found positive economic benefits to the U.S. economy in all cases where LNG exports were economically

viable.[103] The inclusion of the AEO 2011 High Shale EUR case in NERA's analysis reinforces our conclusion that there is no reason to believe that using AEO 2013 Reference Case projections (or the more recent AEO 2015 projections) would have altered the central conclusion of the LNG Export Study.

Further, as reflected in the comments submitted by Lake Charles Exports[104] and Secretary Abraham,[105] Dow does not substantiate its claim that $95 billion of new investment in the manufacturing sector has led (or will lead) to an increase of 6 Bcf/d in incremental domestic consumption of natural gas by 2020. In making these estimates, Dow includes many projects that merely have been announced or that are under consideration with start dates far into the future. Dow provides no information as to when or whether these projects will be constructed or will begin operations.

b. Significance of Prior FTA Authorizations

Dow argues that the 28 Bcf/d of exports authorized to FTA countries (as of the date of Dow's comment) shows that the LNG Export Study underestimated future demand for natural gas.[106] However, the volume of authorized exports to FTA countries is by no means a reliable predictor of the number and capacity of LNG export facilities that will ultimately be financed, constructed, and placed in operation.[107] Indeed, while many of the FTA authorizations have

[103] NERA Study at 6.
[104] Reply Comments of Lake Charles Exports, LLC at 12-13.
[105] Reply Comments of Secretary Spencer Abraham at 8.
[106] As of the date of this Order, DOE/FE has authorized the export of 46.07 Bcf/d of natural gas to FTA countries.
[107] As America's Natural Gas Alliance explains, when domestic gas supply was forecast to be insufficient to meet domestic demand, many LNG import facilities were proposed, but few were constructed. Specifically, from 2000 through 2010, over 40 applications to build new LNG import facilities were submitted to federal agencies, but only eight new facilities were built. The increase in domestic natural gas production had reduced the need for imported LNG. Further, of those import facilities constructed, public records show their use has declined. In 2004, the United States imported 244 cargoes of LNG at the four terminals existing at that time. By comparison, in 2013, only 36 cargoes were imported at five of the 12 then-existing terminals (note that the U.S. Department of

been in place for several years, DOE/FE is aware of only one application submitted to date in which a liquefaction facility was planned with the sole purpose of exporting LNG to FTA countries. Therefore, we are not persuaded that the current FTA authorizations undermine the assumptions of the LNG Export Study.

We note also that applicants typically request both FTA and non-FTA export authorizations for the entire output capacity of their proposed export facilities. Thus, as we explained above, the FTA and non-FTA authorizations are not additive. Citizens Against LNG contends that the NERA Study failed to consider the full potential volume of exports of 31.41 Bcf/d to FTA nations and 24.80 Bcf/d to non-FTA nations, but this argument is incorrect insofar as Citizens Against LNG is claiming that FTA and non-FTA authorization volumes must be added to calculate demand caused by LNG exports. Nevertheless, it bears mention that NERA did remove export constraints in its model for several of the cases evaluated. NERA found that, at the price required in the United States to free up 55 Bcf/d for export, there would be zero global demand for U.S. exports under any combination of domestic and international supply and demand conditions evaluated. Thus, the 55 Bcf/d case was found to be infeasible and was not included in the macroeconomic analysis.

Transportation's Maritime Administration terminated the license for Gulf Gateway Energy Bridge on June 28, 2013). Seven of the 12 existing terminals did not receive any cargoes in 2013. *See* http://www.marad.dot.gov/ports_landing_page/deepwater_port_licensing/deepwater_port_licensing.htm; http://www.ferc.gov/industries/gas/indus-act/lng.asp; *Natural Gas Imports and Exports Fourth Quarter Report 2004*, DOE/FE-0485, Office of Natural Gas Regulatory Activities, Office of Fossil Energy, U.S. Department of Energy; *Natural Gas Imports and Exports Fourth Quarter Report 2013*, DOE/FE-0563, Office of Natural Gas Regulatory Activities, Office of Fossil Energy, U.S. Department of Energy;http://energy.gov/fe/listings/lng-reports.

B. Distributional Impacts

1. Comments

GDP Versus Welfare. Several commenters, including Sierra Club, allege that the NERA Study overstated the likely macroeconomic benefits from LNG exports. The National Resources Defense Council (NRDC), Sierra Club, and Clean Ocean Action, among others, maintain that NERA incorrectly conflated growth in GDP with growth in welfare. By concluding that LNG exports would create a net benefit to the economy, NERA also allegedly relied too much on the fact that exports would increase GDP and failed to give adequate weight to projected natural gas price increases and to deleterious socio-economic, sectoral, and regional impacts on consumers, households, and the middle class, including wage-earners.

A number of other commenters, including American Petroleum Institute, Paul Eikelboom, Gary Lambert, and Helen Rice, however, assert that LNG exports will create jobs and boost the economy. For example, American Petroleum Institute 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.

2. DOE/FE Analysis

The NERA Study presented the macroeconomic impacts of LNG exports using the different statistical measures noted above—price, welfare, GDP, aggregate consumption, aggregate investment, natural gas export revenues, sectoral output, and wages and other household incomes. NERA did not confuse the concepts of welfare growth and GDP growth. The study clearly shows that NERA distinguished these concepts and separately

examined the macroeconomic impacts of LNG exports using both measures.[108] Welfare is a term of art in economics that measures the well-being of consumers and reflects changes in the value placed on consumption and leisure by individuals. NERA calculated welfare in the study as the "equivalent variation," which measures the amount of money that, if taken away from the average household, would make the household no better off with LNG exports than without.[109] GDP, as NERA explained, is "another economic metric that is often used to evaluate the effectiveness of a policy by measuring the level of total economic activity in the economy."[110] NERA thus acknowledged the distinction between GDP and welfare, yet used both metrics, among others, to ensure that its conclusions were robust across various measures.

C. Sectoral Impacts

1. Comments

Numerous commenters debate whether LNG exports will impact the domestic EITE sectors disproportionately, at too high of a cost to the U.S. economy to justify exporting LNG. Specifically, Dow, the Fertilizer Institute, Alcoa, and other commenters assert that higher natural gas prices caused by the demand for LNG exports will make it difficult for U.S. manufacturing to compete in global markets, reversing the gains these industries have made in recent years due to low domestic gas prices. According to these commenters, LNG exports will lead to lost jobs and lower wages in the EITE sectors—such as the chemical, fertilizer, and primary metal manufacturing sectors. These commenters, together with the Aluminum Association, the American Iron and Steel Institute, and others, contend that EITE jobs tend to be high-paying, highly-skilled, and of strategic national importance, whereas they allege that jobs created due to

[108] NERA Study at 6.
[109] *Id*.
[110] *Id.* at 56.

LNG exports will be short-lived and potentially of lower value to the U.S. economy. In this regard, Alcoa, Representative Markey, and IECA, among others, charge that NERA failed to analyze the unique tradeoffs between the domestic natural gas industry—which obviously stands to benefit from LNG exports—and EITE industries, which they argue will feel the brunt of higher gas prices and price volatility brought on by LNG exports.

In addition, Dow argues that the NERA model should have addressed industry-specific impacts. Dow submits that NERA erred by positing that the impact of expanded natural gas exports will affect the chemical, paper, and plastic industries in the same ways. It contends that the single bundled sector represented in the NERA model as the energy intensive sector is actually comprised of five sectors, and that NERA mistakenly assumed that average behavior from the EITE sector is representative of each of the five sectors:

> By bundling these industries, NERA applies the same labor, capital, fuel, and other material inputs in the same way across industries. Such an aggregation mutes the true impact to the industries, especially the chemical products industry. The chemical products subsector varies significantly from the other four industries in terms of value added to the economy (GDP) and energy consumption by fuel source ….[111]

According to Dow, the chemical industry is composed of dozens of different business models with different inputs and outputs. Consequently, Dow contends that "[s]hoe horning the chemical industry into an aggregated EIS [energy intensive sector] is not appropriate for studying the impact of LNG exports on the economy."[112]

More broadly, Dow maintains that NERA gave significant weight to a narrow economic benefit from LNG exports, but did not consider the greater economic value (the "value-added

[111] Initial Comments of Dow Chem. Co. at 27.
[112] *Id*. at 28.

multiplier effect") when natural gas is used in the United States to manufacture finished goods for export, instead of being exported as LNG. Similarly, the Fertilizer Institute offers a study prepared at its request by Charles Rivers Associates to support its claim that NERA underestimated the economic value of the fertilizer industry to the broader economy. Dow also contends that "take-or-pay" contracts used in the international trade of LNG will cause export activities to continue even if not economically warranted, thereby prolonging higher domestic gas prices.[113]

Senator Wyden, Representative Markey, Dow, and others contend that NERA misinterpreted a government-prepared 2009 Interagency Report that evaluated the effects of proposed greenhouse gas cap-and-trade legislation on EITE industries. According to these commenters, the findings in the Interagency Report led Congress to conclude that it was unacceptable to raise energy prices on EITE manufacturers because of the adverse employment implications across the economy. These commenters charge that the NERA Study, while borrowing heavily from the Waxman-Markey congressional debate, did not address the predictions of adverse employment impacts. Dow cites statistics from the Bureau of Economic Analysis indicating that, in 2011, total employment in the oil and gas industry was 171,000 while the chemical industry employed 785,000, the plastic and rubber industry employed 635,000, and the paper industry employed 388,000.[114] In addition, the Fertilizer Institute claims that the NERA Study should have assumed that the fertilizer industry directly supported 7,565 jobs while the NERA Study states that there were 3,920 jobs directly supported by the fertilizer industry.

[113] *Id*. at 16-17.
[114] *Id*. at 28 (Dow table citing figures from the U.S. Bureau of Economic Analysis, *Gross Domestic Product by Industry Data*).

On the other hand, a number of commenters, including ExxonMobil, American Petroleum Institute, the Energy Policy Research Foundation, Inc., and General Electric Oil & Gas, dispute these arguments. They specifically challenge the notion that an LNG export industry cannot co-exist with a growing domestic manufacturing base, and that EITE industries should be given priority, whether directly or indirectly, over the LNG industry.

ExxonMobil supports NERA's conclusion that exports will yield net economic benefits to the United States, and states that, in fact, NERA understated those benefits because (among other reasons) NERA did not factor in the greater supply of NGLs that will be produced in conjunction with increased natural gas production due to exports. The Institute for 21st Century Energy (an affiliate of the U.S. Chamber of Commerce) and the American Petroleum Institute, among others, note that additional production of NGLs will benefit chemical companies with U.S. plants because NGLs, such as ethane, are critical feedstock in chemical manufacturing processes. These commenters state that an increase in the supply of NGLs will exert downward price pressure on the cost of manufactured goods that use NGLs as a feedstock, thereby at least in part offsetting for those industries (primarily EITE industries) any increases in domestic natural gas prices associated with LNG exports.

ExxonMobil, American Petroleum Institute, Shell Oil Company, and many other commenters emphasize the size and productivity of the U.S. natural gas resource base, stating that there is an abundance of natural gas to support both LNG export demand and continued growth in the EITE industries. According to ExxonMobil, Western Energy Alliance, Energy Policy Research Foundation, Inc., and others, 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 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. According to these commenters, opponents of LNG exports are incorrect in speculating that natural gas used for export otherwise would be used for domestic manufacturing when, in fact, the natural gas likely would not be extracted if there is not increased demand created by LNG exports.

Further, 110 members of the U.S. Congress,[115] ExxonMobil, and others maintain that there would be serious consequences to hindering the export of LNG. If exports are prohibited or constrained, they believe 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. Numerous commenters, including ExxonMobil, the National Association of Manufacturers, and the Energy Policy Research Foundation, Inc., 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. As noted above, these commenters state that restricting exports of natural gas would subsidize domestic manufacturing at the expense of the larger U.S. economy. They contend that the U.S. Government should not suppress trade in one industry to benefit other industries.

2. 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 observe 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 gas used in manufacturing and gas diverted for export.

[115] 110 members of the U.S. House of Representatives filed a single set of comments in support of LNG exports.

Although commenters are correct that such a trade-off may exist at the margin, this competition between the demand for natural gas for domestic consumption and the demand for natural gas for export is captured in the N_{ew}ERA model. The model projected that under the majority of scenarios examined, no exports would occur, thereby indicating that, for those scenarios, the gas was of greater value to domestic consumers than to foreign ones. On the other hand, in supply and demand conditions where exports were projected to occur and were not prohibited or limited, the model found that greater economic value was being placed on the LNG by foreign markets and, at the same time, greater economic benefits, both in terms of welfare and GDP accrued to the U.S. economy due to those exports.

NERA grouped the U.S. economy into a workable number of supply and demand sectors as appropriate for a macroeconomic model of this nature. NERA divided the EITE industries into five categories: paper and pulp manufacturing, chemical manufacturing, glass manufacturing, cement manufacturing, and primary metal manufacturing, including iron, steel and aluminum. NERA projected that the overall impact across these categories will be relatively muted, with no individual industry experiencing a dramatic negative impact:

Serious competitive impacts are likely to be confined to narrow segments of industry. About 10% of U.S. manufacturing, measured by value of shipments, has both energy expenditures greater than 5% of the value of its output and serious exposure to foreign competition. Employment in industries with these characteristics is about one-half of one percent of total U.S. employment. LNG exports are not likely to affect the overall level of employment in the U.S. There will be some shifts in the number of workers across industries, with those industries associated with natural gas production and exports attracting workers away from other industries. In no scenario is the shift in

employment out of any industry projected to be larger than normal rates of turnover of employees in those industries.[116]

Some commenters contend that NERA grouped the EITE industries too broadly and assert that greater economic harms could have been identified by focusing more narrowly on the most gas-dependent industries. While we take these concerns seriously, ultimately we are guided by the principle that the public interest requires us to look to the impacts to the U.S. economy as a whole, without privileging the commercial interests of any industry over another. Similarly, 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 our Policy Guidelines that resource allocation decisions of this nature are better left to the market, rather than the Department, to resolve.

The Fertilizer Institute charges that the industry-specific employment data used by NERA is erroneous. The Fertilizer Institute claims that NERA underestimated employment directly supported by the nitrogen fertilizer industry and should have used a figure of 7,565 positions. However, NERA drew industry-specific employment data from the U.S. Census Bureau's Economic Census for 2007, which remains the most recent Economic Census data available. In estimating 3,920 positions directly supported by the nitrogen fertilizer industry, NERA selected a figure that is reasonably supported by an authoritative source.[117]

With respect to the Interagency Report prepared for the Waxman-Markey bill, we note that NERA used that report solely as a means of identifying industry segments that would be most acutely affected by higher energy costs, not as a way of determining the magnitude of such

[116] NERA Study at 2.
[117] *Id*. at 69.

impacts. Therefore, although we acknowledge that the Interagency Report was prepared in a different context, we find nothing unreasonable in NERA's use of the Interagency Report.

D. Household and Distributional Impacts

1. Comments

Several commenters 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.

Other commenters assert that a majority of Americans will experience negative economic impacts, such as higher gas and electric bills, due to LNG exports. Senator Wyden, Dow, and Sierra Club, among others, contend that the NERA Study examined impacts on the labor market in terms of wages but failed to consider employment levels in terms of job equivalents or employment income. According to Clean Ocean Action, Dow, and Sierra Club, NERA also incorrectly assumed full employment and overestimated the positive job impacts associated with LNG exports. Dow, among others, charge that the NERA Study failed to adequately consider the cost of LNG exports in terms of lost jobs in the manufacturing sector and the cost of retraining workers for the LNG industry.

Several commenters support the LNG Export Study and argue that the macroeconomic impacts of LNG exports favor the public interest. ExxonMobil, the Center for Liquefied Natural Gas, and others, including several applicants for LNG export authorizations, submit that the NERA Study is comprehensive and rigorous and that LNG exports are in the public interest. ExxonMobil supports NERA's conclusion that exports will yield net economic benefits but

asserts that the study understates the potential employment benefits from LNG exports. ExxonMobil argues that, because the NERA model assumed full employment, it did not identify the positive impact LNG exports would have on jobs. ExxonMobil observes that the economy is far from full employment, with forecasts prepared by the Congressional Budget Office in 2012 showing the unemployment rate above a full employment level through most of this decade. By exporting LNG, ExxonMobil argues, the U.S. economy can reach full employment faster than it can without exports. ExxonMobil also contends that the lingering effects of the recession mean that capital is underutilized today; and that, where there is significant slack in the economy, there is no necessary trade-off between jobs in one sector versus another.

2. DOE/FE Analysis

NERA examined three components of household income directly affected by natural gas exports: income from wages, income from capital holdings (stocks, etc.), and income from resource ownership (royalties, rents, etc.). The NERA Study projected that for the economy as a whole, increases in resource income earned in the natural gas production process more than offset reductions in wage and capital income earned from all other activities outside of the natural gas production process. The NERA Study acknowledged, however, that exports would be accompanied by a shifting of income sources, and stated that some segments of the economy are likely not to participate in the benefits of LNG exports but are likely to face increased energy costs.

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. 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. Therefore, given the finding in the LNG Export Study that exports will benefit the economy as a whole, and absent stronger record evidence on the distributional consequences of authorizing SPL's proposed exports, we cannot say that those exports are inconsistent with the public interest on these grounds.

E. Regional Impacts

1. Comments

Many commenters addressed the issue of negative and positive regional impacts potentially associated with LNG exports. Commenters including Alice Zinnes, Keith Schue, Jannette Barth, APGA, Alex Bomstein, and Sierra Club assert that shale gas production associated with increasing LNG exports will trap local communities in a "boom-and-bust" cycle associated with extractive natural gas drilling. In a phenomenon they refer to as the "resource curse," they argue that natural gas production will cause long-term economic damage to local communities, leaving the communities poorer once the gas resource is depleted. Jennifer Davis, Dina DeWald, Andrew Goff, and others agree that shale gas development and production will have a negative impact on local industries that are incompatible with extraction-related activities, such as agriculture and tourism. Numerous commenters, including Hope Punnett, Robert M. Ross, the Environmental Working Group, Citizens Against LNG, and Sierra Club, enumerate specific ways in which they allege local communities near shale gas production areas or pipelines could be adversely affected if LNG exports lead to increased natural gas production.

They cite increased noise, property devaluation, degradation of infrastructure, environmental and public health issues, and safety risks, among other issues.

Many 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. Commenters including Freeport LNG Expansion and FLNG Liquefaction, LLC (FLEX), the Independent Petroleum Association of America, and scores of local, state, and federal political leaders—including 110 Members of the U.S. House of Representatives and several U.S. Senators[118]—cite regional economic benefits associated with each LNG project, including the potential for thousands of new jobs, substantial direct and indirect business income, and millions of dollars in new tax revenue. Further, U.S. Representative Charles W. Boustany, Jr., 14 members of the Ohio House of Representatives, and numerous other commenters assert that authorizing exports of LNG will help to sustain natural gas exploration and production efforts, which will mitigate any local "boom-bust" cycle.

Finally, several other commenters, including Southern LNG Company, L.L.C., and Gulf LNG, assert that any general consideration of regional impacts is outside the scope of the NERA Study and is most appropriately considered by DOE/FE in reviewing individual export applications.

2. DOE/FE Analysis

We agree with the commenters who contend that a general consideration of regional impacts is outside of the scope of the LNG Export Study, and that regional impacts may be

[118] U.S. Senators James Inhofe, Lisa Murkowski, David Vitter, Mary Landrieu, Heidi Heitkamp, and John Cornyn submitted comments generally supporting LNG exports.

considered by DOE/FE on a case-by-case basis during the review of each LNG export application. The case-specific issue of regional impacts is discussed *infra* at Section XI.B.1.

F. Estimates of Domestic Natural Gas Supplies

1. Comments

Several commenters assert that, in addition to underestimating the demand for domestically produced natural gas, the NERA Study overestimated future domestic supplies of natural gas. Representative Markey, for example, argues that current projections provide for only 20 to 40 years of domestic natural gas supplies but NERA did not adequately consider these projections. Senator Wyden, the Fertilizer Institute, and others maintain that the NERA Study purports to treat the United States and Canada as a single North American market, but its assumptions ignore the potential effect of Canadian LNG exports to international markets.[119] These commenters are largely concerned that NERA has overestimated domestic supplies and that having lower supplies than estimated will exacerbate the likely price increases due to exports.

Contrary to these arguments, many commenters, such as American Petroleum Institute and Shell, argue that the United States has abundant domestic natural gas reserves. Center for LNG and Cheniere Energy argue that EIA and NERA underestimated the domestic natural gas resource base and, therefore likely overestimated the price impacts of LNG exports.

Dow, however, is concerned about certain indirect impacts that could arise if domestic supplies are exported. It asserts that domestic gas production would be unable to keep up with

[119] In his comments, Senator Wyden stated that Canada's National Energy Board has approved two LNG export projects in British Columbia and is considering a third. According to Senator Wyden, these projects could begin in 2014 and result in LNG exports totaling 9 Bcf/d. DOE/FE notes that Canada has approved the third LNG export project mentioned by Senator Wyden—the Royal Dutch Shell Plc project.

the demand required to meet unlimited LNG exports and that one-third of new shale gas production will be required to replace a decline in conventional gas production. Dow maintains that, as a consequence, gas production will have to ramp up significantly and this development will mean that gas supply will be diverted away from domestic industrial and other sectors of the economy:

> There would need to be rapid deployment of new drilling rigs, increased steel pipe manufacturing and an expanded work force throughout the value chain to be able to service such unprecedented growth in [natural gas] production. With an already well-documented skills shortage in the labor market, basic supply and demand economics will prevail and drive labor prices higher, which would in turn have a chilling impact on investment in the manufacturing sector.[120]

Other commenters take a somewhat longer view of the potential indirect impacts of LNG exports on domestic energy supplies. These commenters contend that, to become energy independent, the United States must preserve its supply 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, the size of which is uncertain. Moreover, they assert, investment in LNG exports will take away from potential investment in renewable energy supplies, which will compound this country's dependency on fossil fuels.

Some commenters, such as Dow, IECA, and Citizens Against LNG, maintain that the NERA Study does not address significant policy changes that could impact domestic natural gas supply. These comments are focused in two areas: availability of energy production tax credits and uncertainty surrounding future environmental regulation regarding hydraulic fracturing. Specifically, Dow points to the possible elimination of energy production tax credits and states that elimination of this tax credit could result in a 5 percent decline in natural gas production and

[120] Initial Comments of Dow Chem. Co. at 16.

the loss of nearly 60,000 barrels per day of oil production. Dow, along with Jannette Barth, IECA and Citizens Against LNG, argue that potential state and federal environmental regulations pertaining to hydraulic fracturing should have been considered by NERA. These commenters assert that these potential additional regulatory costs and could lower supply, increase demand, and raise prices of natural gas.

2. DOE/FE Analysis

Measures of Supply. Before turning to a consideration of the specific comments, it is important to clarify the various measures of supply used by commenters. DOE/FE notes that, by three measures of supply, there are adequate natural gas resources to meet demand associated with SPL's 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. As shown in Table 6 above, the Reference Case projection of dry natural gas production in 2035 increased significantly (by 21.4 Bcf/d) in AEO 2015 compared with AEO 2011, while projections of domestic natural gas consumption in 2035 also increased in AEO 2015 compared with AEO 2011 (by 6.3 Bcf/d). Even with higher production and consumption, the 2035 projected natural gas market price in the Reference Case declined from $7.31/MM Btu (2012$) in AEO 2011 to $6.50/MM Btu (2012$) in AEO 2015. The implication of the latest EIA projections is that a greater quantity of natural gas is projected to be available at a lower cost than estimated four 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 the table below demonstrates, reserves have increased from 9 years of production in 2000 to 14.3 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 31 percent, demonstrating the growing supply of natural gas available under existing economic and operating conditions.

Table 7: U.S. Dry Natural Gas Proved Reserves[121]

	Proved Reserves (R)		**U.S. Dry Natural Gas Production (P)**		
Year	**(Bcf)**	**Percent change versus year 2000**	**(Bcf)**	**Percent change versus year 2000**	**R/P Ratio - Years**
2000	177,427	--	19,616	--	9.0
2005	204,385	15	18,050	8	11.3
2010	304,625	72	21,316	9	14.3
2014	368,704	108	25,728	31	14.3

iii) <u>Technically recoverable resources (TRR)</u>. Technically recoverable resources have also increased significantly. Technically recoverable resources are resources in accumulations

[121] EIA, *U.S. Dry Natural Gas Proved Reserves* (Feb. 26, 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); and EIA, U.S. Dry Natural Gas Production (Feb. 26, 2016), available at http://www.eia.gov/dnav/ng/hist/n9070us2a.htm http://www.eia.gov/dnav/ng/hist/n9070us2a.htm

producible using current recovery technology but without reference to economic profitability. They include both proved reserves and unproved resources.[122]

DOE/FE notes that EIA's natural gas TRR estimates have varied from below 2,000 Tcf in AEO 2010 to more than 2,500 Tcf in AEO 2011 and 2,266 Tcf in AEO 2015.[123] These TRR estimates include proved and unproved TRR shale gas resources, which have fluctuated in recent AEOs, as the EIA continues to monitor and estimate this resource base. For example, in AEO 2010, unproved shale gas TRR was estimated at 347 Tcf, which increased to 827 Tcf in AEO 2011, and was revised to 489 Tcf in AEO 2015.

Supply Impacts. Although TRR estimates in AEO 2011 were higher than the AEO 2015 estimates, we do not agree that NERA employed overly optimistic projections of domestic gas supply. The EIA and NERA studies 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 90 years of natural gas supply at the 2014 domestic consumption level of 27.12 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.

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

[123] *See* U.S. Energy Information Administration, *Assumptions to the Annual Energy Outlook 2014* (June 2014), Table 9.2. Technically recoverable U.S. dry natural gas resources as of January 1, 2012, at 114, *available at*: http://www.eia.gov/forecasts/aeo/assumptions/pdf/0554(2014).pdf.

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 further discussed below. With regard to the adequacy of supply, however, it bears noting that while Dow contends that U.S. natural gas production would not be able to meet unlimited LNG exports and domestic demand, the NERA Study supports a different conclusion. The NERA Study included scenarios in which LNG exports were unconstrained. In these cases, LNG exports from the United States compete with LNG exports from all other international natural gas sources. 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, and, in some instances, no exports, from the United States. By way of example, NERA modeled a number of Low EUR scenarios, which had U.S. resources that were less robust and more expensive than other cases. In these Low EUR scenarios, U.S. wellhead natural gas prices were driven up by higher production costs to meet domestic demand, and in those cases prices increased to a level that choked off demand for exports so that LNG exports were limited or disappeared, leaving the available natural gas for domestic use. In other unconstrained cases evaluated with the High EUR scenarios, domestic natural gas production was able to keep up with the demand required to meet the unconstrained LNG export scenario. In this case, the EIA scenarios reflect the changes that would occur in the domestic market and reflect the limitations, as modeled in the NEMS model, of domestic natural gas production and consumption by different sectors of the economy. 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.

Supply Impacts Related to Alternative Energy Sources. To the degree that natural gas prices may increase, alternative sources of energy will become more attractive to consumers and investors. Accordingly, in nearly every year in which natural gas exports were reflected in the EIA Study, electricity from renewable energy resources increased compared to the no export case. Therefore, we do not agree with the suggestion that LNG exports would diminish investment in renewable energy.

Supply Impacts Related to Canadian LNG Exports. DOE/FE also disagrees with the argument that the NERA Study erred in its treatment of potential Canadian LNG exports to international markets. Although DOE/FE did not ask NERA to evaluate potential LNG exports from Canada, we note that LNG exports from Canada would compete with U.S. exports, thereby most likely reducing U.S. exports. Therefore, treating U.S. and Canadian LNG exports as those from a single market is a reasonable assumption, and would be consistent with the unconstrained LNG export cases evaluated by NERA, with the price impact more or less in line with the cases evaluated by NERA. DOE/FE would expect that benefits estimated to accrue to the United States from U.S. LNG exports likely would be similar to the benefits that would accrue to Canada resulting from Canadian LNG exports.

The LNG Export Study did not evaluate the steps to become energy independent, as that was not part of the criteria evaluated. However, the NERA Study 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.

Supply Impacts Related to Tax Law and Environmental Policy. NERA stated that the NewERA macroeconomic model includes a simple tax representation in which indirect taxes

are included in the output values and not explicitly modeled.[124] NERA thus assumed no changes specific to existing law governing production tax credits. EIA did the same. On the other hand, at DOE/FE direction, NERA and EIA accounted for potential variability in domestic natural gas supply such as would occur due to changes in environmental regulation and other factors, including changes to production tax credits. They did so by incorporating the High EUR and Low EUR scenarios into their model.[125]

We find that it was reasonable for EIA and NERA to use the High EUR and Low EUR cases to capture a range of factors that may impact domestic natural gas supply. We further find that, given the range of scenarios studied, the decision not to specifically model the possible revocation of production tax credits or changes to environmental regulation does not lessen the reliability of the EIA or NERA studies. As a practical matter, EIA and NERA were required to establish certain key assumptions as a foundation for their studies. They reasonably evaluated alternative scenarios that would capture possible changes that would affect natural gas supplies.

G. Modeling the LNG Export Business

1. Comments

Some commenters complain that NERA failed to capture accurately the business model being employed by those involved in the business of LNG exports. Sierra Club states that NERA erroneously modeled the fossil fuel industry by assuming a zero-profit condition. Some commenters, including NRDC, maintain that NERA failed to consider that LNG exports will take place pursuant to long-term, *e.g.*, 25-year, contracts containing take-or-pay provisions, rather than contracts containing flexible or market-sensitive pricing provisions. IECA makes a

[124] NERA Study at 110.
[125] *Id.* at 25.

similar argument in its reply comments. According to these commenters, the take-or-pay provisions in long-term contracts will inhibit the free flow of price signals. The commenters argue that NERA incorrectly assumed that: (1) exports of LNG from the United States would cease if the gap in prices between domestic and foreign supplies is closed; and (2) a foreign country will cease purchases of U.S.-sourced LNG if the country gains access to less expensive supplies. These commenters maintain that take-or-pay provisions in long-term contracts will have the effect of driving LNG exports even under circumstances when it would be more economical for the same natural gas to be sold in the domestic market. In this regard, Dow criticizes NERA's assertion that the global market for natural gas will limit how high U.S. natural gas prices can rise as a result of export activity because importing nations will not purchase U.S. supplies if U.S. wellhead prices rise above the cost of competing supplies. Dow contends that this arbitrage phenomenon may occur in competitive markets but does not make sense in the global LNG market due to the broad use of long term take-or-pay contracts.

Additionally, several commenters, including Representative Markey, NRDC, Sierra Club, Citizens Against LNG, and Alcoa, charge that NERA 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. Contrary to these arguments, FLEX and Lake Charles Exports argue that foreign financing of LNG export projects is beneficial. These commenters argue that foreign direct investment in the U.S. LNG industry frees up domestic capital for other investments. These commenters conclude that, as a result,

NERA's results likely underestimate the benefits to the U.S. economy that will result from LNG exports.

Another commenter, Save Our Supplies, contends that the structure of international markets for natural gas and LNG and the high cost of building international LNG export infrastructure will give a cost advantage to U.S. LNG exports. This cost advantage, coupled with greater international demand than projected by NERA, allegedly will exacerbate the projected price increases within the United States due to LNG exports. More generally, Save Our Supplies claims that NERA made a series of incorrect assumptions concerning the structure of international natural gas markets. These include erroneously assuming that international natural gas markets are competitive. Save Our Supplies identifies the following three considerations: (1) the international market is not perfectly competitive because there are barriers to entry, trade, and foreign investment due in part to the participation of state-sponsored enterprises; (2) there is an international oligopoly in oil that, because of a link between the international price of oil and the international price of natural gas in certain markets, makes it impossible for the international market in natural gas to be perfectly competitive; and (3) NERA erroneously assumed that natural gas is a "perfect substitute" for oil in all circumstances.[126] Based on these comments, Save Our Supplies challenges the NERA Study for allegedly assuming that Qatari and Russian suppliers of natural gas will cut their prices to compete with the lower priced supplies available from the United States. Save Our Supplies argues that such price competition will not be significant and, therefore, that there will be greater demand for U.S.-exported LNG. According to some commenters, NERA's asserted underestimate of international demand for natural gas

[126] Initial Comments of Save Our Supplies at 34, 41.

was also exacerbated by its failure to account for the construction of natural gas infrastructure on a global basis. According to these commenters, NERA appears to underestimate both the supply cost of international LNG projects and the magnitude and trajectory of global LNG demand. NERA also appears to underestimate U.S. natural gas demand and potentially the elasticity of the U.S. natural gas supply curve.

A number of commenters take an opposing position by arguing that the domestic natural gas resource base is sufficient to meet both the domestic and international demand for U.S. natural gas. Center for LNG, Cheniere, and others go further by arguing that EIA and NERA underestimated the size of the resource base, and therefore overestimated the potential domestic price impacts of LNG exports. Dominion Cove Point LNG, America's Natural Gas Alliance and others argue that the international market will constrain the total volume of natural gas exported from the United States.

Several commenters, including Sierra Club and Dow, argue that NERA overestimated LNG transaction costs (*e.g.*, costs of liquefaction, transportation, and insurance). Sierra Club argues that NERA overstated the transportation costs associated with the export of U.S. gas by assuming all LNG would be exported from the Gulf Coast. Sierra Club states that several export terminals are planned for the West Coast, where it will be less expensive to transport gas to the Asian market than it would be from the Gulf Coast. Dow states that NERA's estimate of transportation and insurance costs for shipping LNG to Asia would be on the order of $2.60/Mcf. Dow claims that official trade statistics published by the U.S. Census Bureau, however, establish that these costs would be closer to $0.50/Mcf. Commenters such as Dow and Sierra Club state that had NERA properly accounted for LNG transaction costs, the foreseeable volumes of LNG exports would have exceeded those predicted by NERA, thereby intensifying the impact of LNG

exports on U.S. natural gas prices. For this reason Sierra Club and Dow argue that NERA's projected price ceiling on domestic natural gas is too low. In addition, numerous individual members of the Sierra Club contend that NERA appears to have misrepresented the amount of natural gas used by LNG terminals in the liquefaction process, which understates the demand associated with exports.

2. DOE/FE Analysis

As explained below, we find that the NERA Study reflects an accurate understanding of the contractual terms and market environment affecting the fossil fuel industry and, more narrowly, provides a plausible future scenario of international trade in LNG with U.S. exports. It is DOE/FE's view also that NERA's conclusions of the impact of LNG exports would not have materially changed with alternative international market assumptions. In this regard, we note that NERA included one scenario in which LNG exports reached 23 Bcf/d, with a positive impact on the U.S. economy. We find as follows:

a. Zero Profit Condition

Sierra Club's charge that NERA erroneously modeled the fossil fuel industry by assuming a zero-profit condition appears to reflect a misunderstanding of the term "zero-profit" as used by NERA. The "zero-profit condition" assumed in the NERA Study does not mean that firms in the natural gas industry will not make a "profit" as that word is ordinarily used. Rather, the zero-profit condition means only that firms will not make a profit above the risk-adjusted cost of capital. The assumption of a zero-profit condition is another way of saying that the model assumes a competitive market for natural gas, because in competitive markets new firms can enter and drive any profits above a risk-adjusted cost of capital down to zero. The assumption of a competitive market for natural gas production in the United States is valid given

that natural gas wellhead prices have been deregulated for more than 30 years.[127] Moreover, Sierra Club and other commenters have not provided any evidence to suggest a lack of competition in the market for U.S. natural gas production.

b. Contract Terms

We disagree with the contention that NERA erred in the assumptions it used to model the export contracts that will be used by authorization holders. NERA assumed that these contracts will include payments to the exporting facility in the form of a tolling charge that is fixed based on the total export capacity reserved under the tolling agreement plus 115% of the Henry Hub price for each unit of gas that is liquefied. These assumptions correspond closely with the 20-year tolling agreement filed publicly with DOE by Sabine Pass on April 2, 2013. In that filing, the tolling agreement carries a tolling fee (or "reservation charge") with a per unit liquefaction charge of 115% of the Henry Hub price.[128]

Because there is neither a throughput obligation nor a fixed commodity price in the commercial arrangements assumed by NERA (or in the publicly filed Sabine Pass contract), the supplies of natural gas or LNG subject to the contracts are not locked up for the export market. Instead, as NERA has properly assumed for purposes of its model, foreign and U.S. purchasers will compete for domestically produced supplies and, if the domestic price rises, the owners of the gas (in most cases, either the authorization holder or the foreign purchasers that are party to the export-related contracts) will have an incentive to sell the gas into the domestic market rather than the international market.

[127] Natural Gas Policy Act of 1978, 15 U.S.C. § 3301, *et seq.* (establishing a policy for phasing out the regulation of wellhead prices).
[128] *Sabine Pass Liquefaction LLC*, LNG Sale and Purchase Agreement with Centrica PLC, FE Docket No. 13-42-LNG at 51-52 (Apr. 2, 2013).

Commenters criticizing NERA's model on these assumptions have not submitted evidence to support their position that contracts will lock up natural gas for export. Moreover, we find it unlikely that a broad cross-section of commercial parties would lock themselves permanently into arrangements whereby LNG will be exported from the United States even when it is uneconomical to do so. Even contracts entered improvidently may be amended when there is a possibility for mutual benefit in doing so, as there would be in a case where domestic gas prices exceed netback prices.

c. Foreign Direct Investment

As described above, several commenters charge that the NERA Study incorrectly assumed that the financing of investments in natural gas supplies for export and in LNG liquefaction and export facilities would come from domestic sources. An examination of the NERA Study indicates that claim is not valid as to natural gas supplies. Early in the study, NERA noted as follows:

> Net benefits to the U.S. economy could be larger if U.S. businesses were to take more of a merchant role. Based on business models now being proposed, this study assumes that foreign purchasers take title to LNG when it is loaded at a United States port, so that any profits that could be made by transporting and selling in importing countries accrue to foreign entities. In the cases where exports are constrained to maximum permitted levels, this business model sacrifices additional value from LNG exports that could accrue to the United States.[129]

On the other hand, the commenters are correct to the extent they argue that the NERA Study assumed that the financing for the liquefaction and export facilities associated with LNG exports would come solely from domestic sources. The NERA Study indicates that the timing of macroeconomic effects could be affected as a consequence:

[129] NERA Study at 6-7.

> In this report it is assumed that all of the investment in liquefaction facilities and in increased natural gas drilling and extraction come from domestic sources. Macroeconomic effects could be different if these facilities and activities were financed by foreign direct investment ("FDI") that was additional to baseline capital flows into the U.S. FDI would largely affect the timing of macroeconomic effects, but quantifying these differences would require consideration of additional scenarios in which the business model was varied.[130]

In the above statement, NERA has indicated that the timing of the impacts of LNG exports could change due to FDI. On the other hand, NERA has not stated that the nature of the impacts will change and no commenter has introduced evidence that FDI will produce negative economic benefits. Indeed, Lake Charles Exports explains why FDI may enhance the economic benefits to the United States:

> NERA thus acknowledged the possibility that investment necessary for LNG exports may come from foreign sources. The NERA model's assumption of domestic investment explicitly fails to capture the macroeconomic benefits that will result from the injection of any foreign investment into natural gas production and infrastructure.
>
> The United States has the leading economy in the world in part because the US is the leading destination of international flows of capital. Each dollar of new foreign investment capital into the US results in an equivalent increase in US GDP. The main positive components of GDP are private consumption, investment, government expenditures, and exports. Any foreign direct investment stemming from the development of a US LNG industry would not decrease domestic capital investment, but would merely free up such domestic capital for other investments. Therefore the total amount of investment in the US would increase, dollar-for-dollar, with foreign investment, increasing US GDP by the same amount. If that foreign investment earns a return and, after taxation by US local, state and federal governments, some of that return is repatriated, this reflects a small countervailing outflow (which seems to be what, for example, Representative Markey is focusing on). Nonetheless, foreign direct investment remains a major net contributor to the US economy. The 2012 LNG Export Study's simplifying assumption regarding the source of investment in LNG production infrastructure fails to capture the benefits of any capital provided from foreign sources and thus understates the impact of such investment on US GDP.[131]

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[130] *Id.* at 211.

[131] Reply Comments of Lake Charles Exports at 31 (citations omitted).

Accordingly, while FDI may be used to finance purchases of natural gas for export as LNG and the construction of LNG liquefaction and export facilities, we are not persuaded that the inflow of foreign capital for these purposes would be inconsistent with the public interest or would lessen the net economic benefits projected in the LNG Export Study.

d. International Natural Gas Markets

We are not persuaded by Save Our Supplies' claim that a projected cost advantage to exports of LNG from the United States as opposed to exports from other gas producing nations will necessarily exacerbate projected price increases within the United States due to LNG exports. This argument assumes that LNG will be available for export at a landed price overseas that is competitive with the international price set by foreign competitors. But NERA concluded that in many cases, the world natural gas market would not accept the full amount of exports assumed in the EIA scenarios at prices high enough to cover the U.S. wellhead domestic prices calculated by the EIA. Alternatively, foreign competitors supplying natural gas and LNG in international markets may match or, possibly, undercut the landed price of LNG exported from the United States.

With respect to the competitiveness of global LNG markets, NERA assumed that the production decisions of the world's dominant producer, Qatar, would be fixed no matter what the level of U.S. exports and that, generally, "there is a competitive market with exogenously determined export limits chosen by each exporting region and determined by their liquefaction capacity."[132] NERA described these assumptions as a "a middle ground between assuming that the dominant producer will limit exports sufficiently to maintain the current premium apparent in

[132] NERA Study at 34.

the prices paid in regions like Japan and Korea, or that dominant exporters will remove production constraints because with U.S. entry their market shares fall to levels that do not justify propping up prices for the entire market."[133] We find this to be a reasonable simplifying assumption and note further that even imperfectly competitive markets are not static. The arrival of new entrants, such as U.S.-based LNG exporters, may well have a disruptive impact on markets where competition may presently be constrained.

Finally, we note that NERA also modeled a "supply shock" case that assumed key LNG exporting regions did not increase their exports above current levels. NERA found positive economic benefits to the United States in each supply shock scenario in which the United States exports LNG. These results strengthen our conclusion that the prospect of non-competitive behavior in global LNG markets is unlikely to have a material impact on the central conclusions of the LNG Export Study.

e. Estimates of LNG Transaction Costs

We disagree with the comments from Sierra Club and Dow arguing that NERA overestimated LNG transaction costs, including liquefaction, transportation, insurance, and the like. NERA based its liquefaction, shipping costs and regasification costs on a review of publicly available literature, including the International Group of LNG Importers 2010 LNG Industry report and other sources referenced in the NERA Study.[134]

With respect to transportation costs, Dow states that NERA's estimate of shipping cost to Asia was on the order of $2.60/Mcf, while statistics presented by Dow claim these to be $0.50/Mcf. In presenting this figure, Dow relies on trade statistics reported by the U.S. Census

[133] *Id*. at 34-35.
[134] *Id.* at 84-90.

Bureau based on the average cost of insurance and freight expenses associated with U.S. *imports* of LNG in 2010 and 2011. As NERA points out, however, LNG transportation costs in large measure are a function of the distance traveled. Therefore, data on LNG imports, which largely travel shorter distances,[135] do not furnish a reliable basis for drawing inferences regarding transportation costs for LNG exports to Asia. Further, NERA provided a detailed description of the assumed transportation cost buildup, which is based on a daily charter rate of $65,000, and other reasonable assumptions.[136] Dow does not provide evidence challenging the accuracy of the information used by NERA or NERA's method of calculating transportation costs. Nor does Dow provide other evidence of daily charter rates.

As for the cost of natural gas consumed in the liquefaction process, NERA's model assumes a consumption level equal to 9 percent of the natural gas feedstock, a cost that is included in the NERA model. NERA based this assumption on publicly available information of liquefaction costs. Similarly, EIA assumed that 10 percent of feedstock was consumed in the liquefaction process.

Therefore, we find that NERA's cost build-up is appropriate and that the estimated costs for delivering LNG to end users considered in the NERA Study are reasonable.

[135] DOE/FE statistics show that the majority of LNG imports to the United States for 2010 and 2011 came from Atlantic Basin/North African sources. More than one-third of U.S. LNG imports in 2010 and 2011 came from Trinidad and Tobago, and none came from East Asia. *See* DOE/FE 2010 LNG Import Annual Report and DOE/FE 2011 LNG Import Annual Report, *available at* http://fossil.energy.gov/programs/gasregulation/publications/.

[136] NERA Study at 87.

H. Cost of Environmental Externalities

1. Comments

Sierra Club, along with Delaware Riverkeeper Network,[137] Jannette Barth, NRDC, Dow, and Save Our Supplies, among others, maintain that LNG exports will increase demand for natural gas, thereby increasing negative environmental and economic consequences associated with natural gas production. These commenters assert that NERA 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;
- Opportunity costs associated with the construction of natural gas production, transport, and export facilities, including the costs of investing in shale gas infrastructure to support LNG exports, as opposed to investing in renewable or sustainable energy infrastructure;
- Costs and implications associated with eminent domain necessary to build new pipelines to transport natural gas; and
- Potential for switching from natural gas-fired electric generation to coal-fired generation, if higher domestic prices cause domestic electric generation to favor coal-fired generation at the margins.

2. DOE/FE Analysis

Insofar as relevant to this proceeding, we have addressed these issues in the Discussion and Conclusions below. *See infra* § XI.

[137] Delaware Riverkeeper Network filed comments on behalf of itself and more than 80 other organizations.

I. Prices and Volatility

1. Comments

Natural Gas Price Volatility. Several commenters, such as Huntsman Corporation, address potential natural gas price volatility associated with LNG exports. Janette Barth, Dow, Sierra Club, and Save Our Supplies, among others, state that NERA did not account for price volatility. Sierra Club points to the results of the LNG Export Study, which project higher domestic natural gas price impacts when exports phase in rapidly. Additionally, Sierra Club argues that, pending the pace of DOE/FE approvals, demand for domestic natural gas may increase more rapidly than production, leading to periods of scarcity and price spikes. Sierra Club also contends that there is little evidence that domestic natural gas price volatility will be reduced by LNG exports.

America's Natural Gas Alliance argues that there is no evidence that LNG exports will increase volatility. According to the Alliance, LNG exports will lead to increased investment in domestic gas production, which will help protect against price volatility. American Petroleum Institute contends that the NERA and Brookings studies project natural gas prices to remain in a narrow, low range through 2030 in all scenarios. Further, American Petroleum Institute points out that in October 2009, a Dow representative testified before the Senate Energy and Natural Resources Committee that the U.S. chemical industry could operate successfully if natural gas prices remain in the $6-8 MMBtu range. American Petroleum Institute asserts that recent studies projecting natural gas prices—even with high, unconstrained levels of LNG export—do not forecast natural gas prices higher than that range. Several commenters, including America's Natural Gas Alliance and American Petroleum Institute, further assert that the market will have significant advanced notice of LNG export facilities. As a result, natural gas producers will be

able to adjust supply to meet anticipated increases in demand. American Petroleum Institute also argues that, because the facilities and liquefaction trains at each facility will be built in sequence, a market buffer will be created where supply will grow incrementally and supply shocks will not be created in the market. Additionally, Lake Charles Exports argues that Dow's analysis of domestic natural gas exports is incorrect, and the additional investment in domestic natural gas reserve development associated with increases in LNG exports will insulate the United States from natural gas price volatility.

The Bipartisan Policy Center, through its own analysis, forecasts that LNG exports are unlikely to result in large domestic price impacts. The Bipartisan Policy Center states that the results of its analysis indicate that LNG exports are likely to have only modest impacts on domestic natural gas prices—and that LNG export levels will adjust as domestic prices rise or fall.

2. 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, NERA's study was a long-term analysis covering a 20-year period that correctly did not 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 has been captured in EIA's supply curves and, consequently, in NERA's analysis. On balance, we are not persuaded that LNG exports will substantially increase the volatility of domestic natural gas prices.

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

1. Comments

Several commenters, including APGA, Dow, and IECA, 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. A number of other commenters, however, contend that domestic prices would not become linked to world prices. Citing the importance of the domestic natural gas price in determining the level of exports, the Bipartisan Policy Center and Southern LNG Company argue that domestic natural gas prices will remain independent of international prices.

In its reply comments, Dow expands on its argument that domestic natural gas prices will become linked to international prices. Dow argues that exports to Asia, where natural gas prices

are "oil-indexed," will invariably lead to increases in domestic price. Dow also argues that it is incorrect to assume liquefaction, transportation and regasification costs will act as a buffer against world prices, pointing to the experience in Australia in which LNG exports resulted in a tripling of domestic natural gas prices. In reply comments, American Petroleum Institute and several LNG export applicants (and/or authorization holders) argue 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. These commenters argue 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. Several LNG export applicants also contend that the availability of bi-directional terminals will serve to limit domestic price increases.

2. DOE/FE Analysis

The NERA Study examined whether LNG exports from the United States will cause domestic prices to rise to the level of international prices and found that such a result is unlikely. NERA asserts that there will always be a difference between the international LNG price and the U.S. market price. That difference will be represented by the cost of inland transportation, liquefaction, shipping, and regasification. NERA's model assumes competition among different suppliers such that Asian 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.

In addition, all proposed LNG exports from the United States in applications DOE/FE has received to date would be pursuant to long-term contracts. To the extent that these contracts supply end-users in foreign markets, these exports represent a base-load demand for U.S. natural gas. As a base load, the United States market would adjust to this increased demand through increases in production, and plan for its delivery utilizing the significant production and storage infrastructure that exists. On average, prices would rise to levels that provide incentives for full marginal cost recovery for the incremental production of natural gas needed to meet this demand.

Hence we agree with those commenters, such as the Bipartisan Policy Center, that 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. They point out that the international supply of natural gas is growing, and the mobility of that supply is increasing as other countries develop their own LNG export capabilities. Further, there is no evidence before us that demonstrates that the prices of natural gas or LNG in the international market are more volatile than the prices in the U.S. domestic market.

K. Integrity of the LNG Export Study

1. Comments

Several commenters, such as Clean Ocean Action and Sierra Club, argue that DOE/FE cannot rely on the NERA report unless DOE/FE discloses more details about the process by which DOE/FE selected NERA to conduct the study, DOE/FE's funding mechanism for paying NERA, and DOE/FE's involvement (if any) in guiding the study or reviewing drafts of the study prior to publication. In addition to Sierra Club, commenters Eugene Bruce, Ellen Osuna, Dow,

and IECA assert that DOE/FE cannot rely on the study because NERA has not disclosed all technical details of its proprietary N_{ew}ERA model to the public. According to Sierra Club, DOE/FE "has refused to make [all of] this information available for review during the public comment period."[138] Further, Sierra Club, Save Our Supplies and several other commenters argue that, due to this alleged lack of transparency, DOE/FE should conduct a new study of the potential cumulative impacts of granting LNG export licenses for shipment to non-FTA countries. Sierra Club and other commenters also contend that NERA and/or NERA's Vice President (and the principal author of the NERA Study) Mr. David Montgomery may be biased in favor of LNG exports, which they argue necessitates a new study by a different contractor.

2. DOE/FE Analysis

DOE has evaluated all submissions in this proceeding on their own merits, including the LNG Export Study and the arguments and analyses submitted by commenters. NERA conducted the study within DOE/FE's requested parameters (which are included as Appendix F to the NERA Study) and provided detailed information regarding its assumptions, model design and methodology, and results. This information is set forth at length in the NERA Study and is discussed in Section VI.B.2 and 5 of this Order. As evidenced by the number of detailed comments received, including additional studies offered by several of the commenters, NERA's explanation of its modeling design, methodology, and results has provided a sufficient basis both for the public to provide meaningful comments and for the Department to evaluate NERA's conclusions.

[138] Reply Comments of Sierra Club at 20.

L. Peer Review

1. Comments

Dow, along with Eugene Bruce, IECA, and others, charge that the NERA Study is invalid because NERA failed to validate its proprietary N$_{ew}$ERA model by means of technical peer review. These commenters argue that technical peer review is required by the Office of Management and Budget's (OMB) guidance entitled, "Final Information Quality Bulletin for Peer Review" (OMB Bulletin).[139] The OMB Bulletin establishes that "important scientific information shall be peer reviewed by qualified scientists before it is disseminated by the Federal government." Dow asserts that the NERA Study should be considered "highly influential scientific information," subject to the highest standards outlined in the OMB Bulletin, and/or subject to internal DOE peer review guidelines. Due in part to these concerns, several commenters, including Sierra Club and Save Our Supplies, urge that DOE/FE commission a new study by another independent contractor.

Cameron LNG, LLC, in its reply comments, counters that the OMB Bulletin does not apply to adjudications or permit proceedings such as this one. Cameron therefore asserts that the public comment period held by DOE/FE on the LNG Export Study is more than adequate for DOE/FE to obtain constructive review of both the EIA and NERA studies.

2. DOE/FE Analysis

The OMB Bulletin establishes a framework for independent, expert review of influential scientific information before the information is publicly disseminated. It defines "scientific information" as "factual inputs, data, models, analyses, technical information, or scientific

[139] Final Information Quality Bulletin for Peer Review, 70 Fed. Reg. 2664 (Jan. 14, 2005).

assessments based on the behavioral and social sciences, public health and medical sciences, life and earth sciences, engineering, or physical sciences."[140] "Scientific information" does not include opinions where the presentation makes it clear the information is "opinion rather than fact or the agency's views."[141] Further, the OMB Bulletin, while applicable to rulemakings, provides that "official disseminations that arise in adjudications and permit proceedings" are exempt from peer review, unless "the agency determines that peer review is practical and appropriate …."[142]

We have considered commenters' request for peer review in light of the OMB Bulletin. Because this proceeding is an adjudication, peer review is not required unless DOE/FE determines that such review is appropriate. After consideration, we find that peer review is not required because the conclusions reached in the LNG Export Study are in the nature of expert opinion, not scientific fact, and also because the principal purpose of peer review of government-sourced documents—ensuring the government is well-informed by independently produced expert analyses—was accomplished in this proceeding.

Both the EIA and NERA studies use market assumptions to project a range of possible future results. No claim is made by the authors of either study that the studies contain scientific fact. To the contrary, both studies caution the reader on the limits to their economic projections. The EIA Study states: "The projections in this report are not statements of what *will* happen but of what *might* happen, given the assumptions and methodologies used."[143] Similarly, the NERA

[140] *Id*. at 2675.
[141] *Id.*
[142] *Id*. at 2677.
[143] EIA Study at ii.

Study was developed around assumptions of future scenarios and repeatedly acknowledges the uncertainties that could shift the results within the range of likely outcomes.[144]

Further, the procedures followed by DOE/FE in this proceeding have allowed numerous commenting parties and third-party experts to offer differing analyses. The comments included several expert studies critiquing the LNG Export Study. For example, Professor Wallace Tyner of Purdue University submitted results from a study that shows different results from NERA's. Sierra Club submitted a study by Synapse Energy Economics, Inc., that examined NERA's study and pointed out alleged "problems and omissions" in NERA's analysis.[145] Conversely, Southern LNG Company, Gulf LNG, and Jordan Cove Energy Project each submitted a study by Navigant that concluded that NERA's analyses were sound.[146]

DOE/FE has carefully weighed these competing analyses and viewpoints, and has conducted its own internal review of the LNG Export Study. In so doing, DOE/FE has recognized that its ultimate decision on the pending export applications would benefit from a public exchange of judgments and expert opinions.[147] The major purpose motivating the OMB Bulletin—to ensure that the government is well-informed by independent, expert analysis—was accomplished in this proceeding without the need for peer review.

[144] *See*, *e.g.*, NERA Study at 25-26.
[145] Synapse Energy Economics, Inc., *Will LNG Exports Benefit the United States Economy?* (Jan. 23, 2013), at 1, submitted with Initial Comments of Sierra Club.
[146] *See*, *e.g.*, Navigant Consulting, Inc. and Navigant Economics, Analysis of the Department of Energy's LNG Export Study (Jan. 24, 2013), App. A of Initial Comments of Gulf LNG.
[147] *See* 77 Fed. Reg. at 73,628 ("The LNG Export Study and the comments that DOE/FE receives … will help to inform our determination of the public interest in each case.")

M. Procedural Arguments

1. Comments

Several commenters, including Sierra Club, Senator Wyden, NRDC, and others argue that the current public interest standard, which focuses on meeting the nation's "essential domestic needs" for natural gas, is too narrow and that DOE/FE must undertake a rulemaking to establish criteria for making such a determination under the NGA. Similarly, Sierra Club, Alcoa, IECA, and CarbonX Energy Company, Inc., argue that DOE/FE should articulate, in the context of a separate rulemaking proceeding, the framework it will use in making its public interest determinations for individual export applications. Dow makes a related comment, stating that each of the individual LNG export dockets contains an insufficient record on which to base a public interest determination on the cumulative impact of LNG exports, and therefore DOE/FE is required to conduct a notice and comment rulemaking before it decides on any of the pending LNG export applications.

Dow, Sierra Club, Save Our Supplies, and other commenters contend that DOE/FE should conduct a public hearing regarding the applicable public interest standard in light of the cumulative impacts of LNG exports. Additionally, several commenters request that DOE/FE reopen the dockets of LNG export applicants to solicit additional public comment. Commenter Mary Altmann argues that DOE/FE should invite public comment on individual LNG applications before approving exports. IECA argues that many commenters could not reasonably have been expected to intervene in individual license proceedings at the time license applications were filed, since they had no way of anticipating that more than 20 applications would eventually be filed. IECA argues that DOE/FE, therefore, has no alternative other than to allow every interested party to intervene in each proceeding. Along these same lines, CarbonX

requests that its comment on the LNG export study be incorporated into the dockets for each pending LNG export applications.

Several commenters raise issues associated with their ability to comment on economic studies conducted by third parties and whether DOE/FE may rely on such studies in making a determination. Regarding DOE/FE's request for public comment in the NOA, Sierra Club, IECA, and others argue that DOE/FE narrowly instructed parties to address only the EIA and NERA studies. Proponents of this argument assert that DOE/FE cannot assess whether it is in the public interest to issue additional LNG export permits by addressing only one aspect of the public interest analysis (*i.e.*, potential impacts on energy costs). Similarly, Sierra Club, IECA, CarbonX, and others, assert that citations to third-party studies in the record do not discharge DOE/FE's responsibility to evaluate the public interest because the studies are based on undisclosed proprietary data and models with limited information regarding their development and age.

Other commenters argue that DOE/FE should act now to decide each pending export application. These commenters contend additional administrative process is neither necessary nor appropriate as DOE/FE has already provided the "opportunity for hearing" required under NGA section 3(a) to make its public interest determination. Commenters such as ExxonMobil and the Center for Liquefied Natural Gas argue that the initial and reply comments submitted in response to the LNG Export Study do not change the NGA statutory and regulatory requirements that place the burden of proof on opponents to demonstrate, with sufficient evidence, that each application is inconsistent with the public interest. These commenters argue that the record before DOE/FE regarding each individual application is sufficient for DOE/FE to determine whether LNG exports have been shown to be inconsistent with the public interest.

2. DOE/FE Analysis

Fundamentally, all of the above requests for procedural relief challenge the adequacy of the opportunity that we have given to the public to participate in this proceeding and the adequacy of the record developed to support our decision in this proceeding.

With respect to opportunity for public participation, we find that the public has been given ample opportunity to participate in this proceeding, as well as the other pending LNG export proceedings. Within this proceeding, the Notice of Application contained a detailed description of the Application, and invited the public to submit protests, motions to intervene, notices of intervention, and comments.[148] As required by DOE regulations, similar notices of application have been published in the Federal Register in each of the other non-FTA export application proceedings. Additionally, in December 2012, DOE/FE published the NOA in the Federal Register.[149] As explained above, the NOA described the content and purpose of the EIA and NERA studies, invited the public to submit initial and reply comments, and stated that these comments will be part of the record in each individual docket proceeding.[150] DOE/FE thus has taken appropriate and necessary steps by offering the public multiple opportunities to participate in the non-FTA LNG export proceedings.

We also find the record is adequate to support the action we are taking in this Order. DOE/FE has reviewed all of the submissions made in this proceeding. Moreover, this Order sets out the reasons that support each of the determinations contained herein. Consequently, we do not find it is necessary or appropriate to delay issuance of this Order to augment the record, either through a rulemaking or public hearing. In this regard, we note that DOE/FE retains broad

[148] 80 Fed. Reg. 51792 (Aug. 26, 2015).
[149] 77 Fed. Reg. at 73,627.
[150] *Id*. at 73,628.

discretion to decide what procedures to use in fulfilling its statutory responsibilities under the NGA,[151] and our view is that the record is sufficient to support the actions that we are taking. The requests for additional procedures summarized above are denied.

IX. 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 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.[152] DOE provided a summary of the comments received and responses to substantive comments in Appendix B of the Addendum.[153] 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

[151] *See*, *e.g.*, *Process Gas Consumers v. FERC*, 930 F.2d 926, 929 (D.C. Cir. 1991).
[152] Addendum at 3.
[153] *Id*. at 79-151.

Export Study, projected that more than 90% of the incremental natural gas produced to supply LNG exports would come from these unconventional sources.[154]

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 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.[155] 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

[154] *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).
[155] Addendum at 10.

well has been put into production. As shown in the Addendum, the following table captures differences in water intensity across energy sources.

Table 8: Water Intensity[156]

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."[157] The following table shows the variation in the proportion of water usage by activity in shale gas regions:

[156] *Id*. at 11 (Table 2).
[157] *Id*. at 12.

Table 9: Water Usage in Shale Gas Regions[158]

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."[159]

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

[158] *Id.* at 12 (Table 3) (citations omitted).
[159] *Id.* at 13.

protect fresh water aquifers.[160] The Addendum acknowledges, however, that while unconventional natural gas formations are thousands of feet below aquifers associated with public 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.[161]

The fluid used for hydraulic fracturing consists of over 98 percent water, but also may include several different chemical compounds.[162] 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.[163] Further, chemical additives may contaminate groundwater should the integrity of the casing or cement seal of the well be compromised.[164]

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

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[160] 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).
[161] *Id.* at 14.
[162] *Id.* at 14-15.
[163] *Id.* at 18.
[164] *Id.*

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, implementing best management practices, and administering pollution prevention concepts, may have temporary, minor impacts to water resources."[165] 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."[166]

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 the table below:

[165] Addendum at 19.
[166] *Id.* at 19.

Table 10: Source Categories of Airborne Emissions from Upstream Natural Gas Activities (EPA, 2013)[167]

Category	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.

The Addendum describes the regulatory framework relating to such emissions, as well as the U.S. Environmental Protection Agency's (EPA) 2012 New Source Performance Standards for hydraulically fractured natural gas wells[168] and EPA's 2013 update to those standards covering storage tanks.[169] 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,

[167] *Id*. at 23 (Table 6).
[168] *Id*. at 20-22. EPA has modified this framework in a new final rule, effective Dec. 31, 2014 (79 Fed.Reg. 79018 (Dec. 31, 2014) and is in the process of reviewing additional proposed updates and revisions to the regulatory framework (http://www3.epa.gov/airquality/oilandgas/actions.html).
[169] *Id*. at 22.

especially methane, VOCs, and HAPs. 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.[170]

C. GHG Emissions

Separate from the LCA GHG Report described below in Section IX, 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 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.[171] 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.[172]

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[170] *Id*. at 32.
[171] 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).
[172] *Id*. at 44.

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."[173]

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 relatively low."[174] By contrast, the Addendum states that the "incidence of felt earthquakes is 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."[175] 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

[173] *Id.* at 40.
[174] *Id.* at 51.
[175] *Id*. at 52.

principally one of alarm to the public and minor property damage, as opposed to significant disruption.[176]

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."[177] 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."[178] The Addendum identifies siting and design considerations that may minimize land use impacts, as well as traffic and road way impacts associated with large vehicles and concerns for vehicular safety for the motoring public.

X. 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

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

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*.[179] On June 4, 2014, DOE/FE provided notice of the documents in the *Federal Register* and invited public comment.[180] The 45-day public comment period closed July 21, 2014. In this section, we 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* § X.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?

[179] *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://energy.gov/fe/LCA-GHG-Report (link to "NETL Natural Gas LCA Model and Analysis") [hereinafter NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation*].

[180] 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 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*.

- 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 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.[181]

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

[181] 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.

Table 11: LCA GHG Scenarios Analyzed by NETL[182]

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.[183] • 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-fired power plant.	This scenario models two types of coal widely used to generate steam-electric power: surface mined sub-bituminous coal and underground mined bituminous coal. Additionally, U.S. mining

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

		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.[184] 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 used as fuel to generate steam-electric power. NETL used its existing LCA model for the

[184] *See* LCA GHG Report at 3 (*citing* NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Gener*ation).

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,[185] (3) coal type (sub-bituminous or bituminous),[186] (4) the flaring rate for natural gas,[187] (5) transport distance (ocean tanker for LNG transport, and rail for coal transport),[188] and (6) the efficiency of the destination power plant.

[185] 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.

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

[187] 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.

[188] The distances used for pipeline transport of Russian gas are provided in Table 5-2. *See id*. at 6.

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.[189] 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).[190]

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.[191] 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).[192]

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[189] *See* LCA GHG Report at 5.
[190] The methane leakage breakeven analysis is described in the LCA GHG Report at 14 and 15.
[191] *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.
[192] The study limitations are described in the LCA GHG Report at 18.

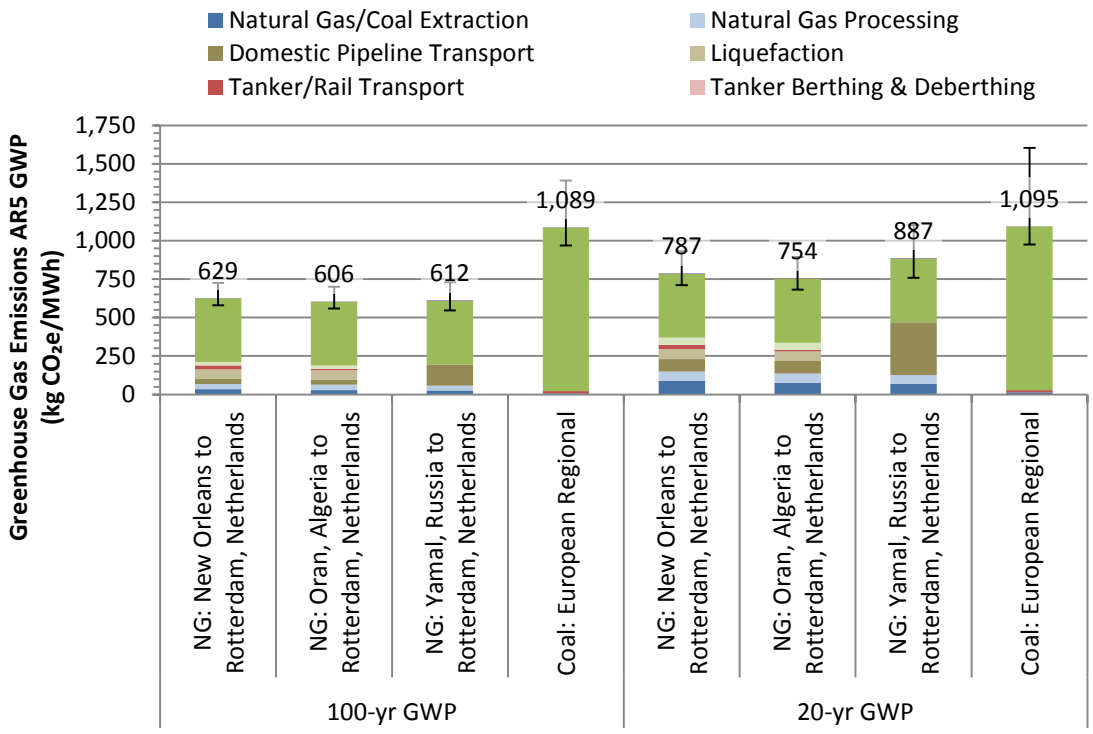
7. Results of the LCA GHG Report

NETL states that two primary conclusions may be drawn from the LCA GHG Report.[193] 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, 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.[194] (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.

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

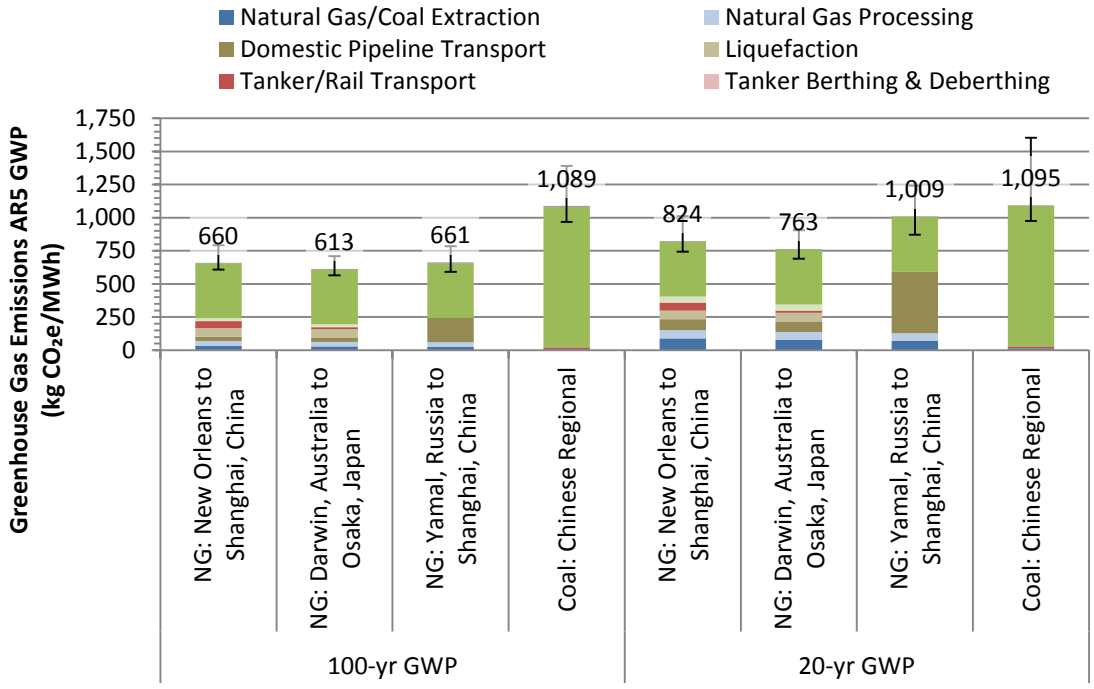
[194] Although these figures present an expected value for each of the four scenarios, NETL states that the figures should not be interpreted as the most likely values due to scenario variability and data uncertainty. Rather, the values allow an evaluation of trends only—specifically, how each of the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

Table 12: Life Cycle GHG Emissions for Natural Gas and Coal Power in Europe[195]



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

Table 13: Life Cycle GHG Emissions for Natural Gas and Coal Power in Asia[196]



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.

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

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

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.[197]

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 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 14 below, [(415 – 1,063)/1,063 x 100]). The life cycle of baseload

[197] 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.

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.

The following table shows the life cycle GHG emissions of carbon dioxide (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 14: 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,[198] Food & Water Watch,[199] 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.

[198] 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 Earth Justice.

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

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 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 the American Petroleum Institute (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.[200] API proposes the use of newer data for both 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, LLC, and Freeport LNG Expansion, L.P., *et al.* (each of which has been granted one or more non-FTA LNG export orders by DOE/FE) that, according to API, 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

[200] 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.

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.[201]

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 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.[202] 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.

[201] 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.
[202] *See id*.

(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,[203] after NETL's model had been finalized and during the time that NETL was completing the LCA GHG Report. These 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.[204] They also match the factors used by EPA's 2013 GHG inventory.[205]

NETL's current model accounts for liquids unloading emissions from conventional wells, but does not account for liquids unloading from unconventional wells. Applying liquids

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[203] 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.
[204] *Characterizing Pivotal Sources of Methane Emissions from Natural Gas Production: Summary and Analysis of API and ANGA Survey Responses.* Final Report (Sept. 21, 2012).
[205] U.S. Envtl. Prot. Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011 (Apr. 12, 2013).

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.[206] When liquids unloading is added to unconventional natural gas in our 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, 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

[206] *See* NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation*.

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 took effect on December 31, 2014,[207] 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.[208] 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

[207] *See* note 173 *supra*.
[208] 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.

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 refer to the same document.[209] 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.

[209] U.S. Envtl. Prot. Agency, Greenhouse Gas Emissions Reporting from the Petroleum and Natural Gas Industry: Background Technical Support Document (2011), *available at:* http://www.epa.gov/ghgreporting/documents/pdf/2010/Subpart-W_TSD.pdf.

This limitation is noted in the LCA GHG Report and is accounted for by uncertainty.[210] 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). 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.

[210] *See, e.g.,* NETL, *Life Cycle Analysis of Natural Gas Extraction and Power Generation.*

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%.[211] 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 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

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

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.[212] 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

[212] 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.

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.[213] 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.[214] Researchers are trying to discern why "top-down" studies such as Pétron's measurements in northeast Colorado[215] 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 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

[213] 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.
[214] Methane measurements studies are typically referred to as "bottom-up" or "top-down" studies to describe the type of field measurement strategies employed. Bottom-up studies refer to measurements taken at or on a specific piece of equipment or at the facility fence line to describe a specific operation. In most bottom-up measurement studies the methane emissions can be directly contributed to a source; i.e., a piece of equipment or site. In contrast, top-down measurement studies refer to atmospheric concentration measurements of methane taken using aircraft or ground-based towers over a specific area for defined sampling time period. Top-down measurements are typically difficult to associate to a specific anthropogenic source but provide a depiction of the concentration of methane resident in the atmosphere. Recent studies are working to bridge the gap between these two primary measurement techniques to reconcile the differences and advance the understanding of methane emissions.
[215] 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).

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

[216] 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.

We note Sierra Club has introduced into the record additional argument and evidence to bolster its position that the LCA GHG Report underestimated the life cycle natural gas leakage rate. Sierra Club refers to a paper by Stephan Scheietzke, et al., researchers at Carnegie Mellon University and the National Ocean and Atmospheric Administration (Scheietzke),[217] that concludes that the most likely methane (CH_4) leak rate is between 2 and 4 percent. Scheietzke, however, is a top-down study of global natural gas systems and is not directly comparable to NETL's bottom-up model of U.S. natural gas systems. Many researchers, like NETL and Scheietzke, are aware of the differences between top-down and bottom-up approaches and are improving their analyses as more data representative of the U.S. natural gas sector becomes available. Bottom-up data used in the NETL analysis is highly representative of natural gas operations in the United States on a life cycle basis.

There are three findings by Scheietzke of particular interest. First, Scheietzke observes a downward trend in global natural gas CH_4 emissions since the year 2000. Second, Scheietzke's likely range for natural gas CH_4 emission rate is between 2% and 4% -- a range that is lower than those shown by other top-down measurements from the last 4 years.[218] Third, Scheietzke notes

[217] Sierra Club Mot. n. 34 at 18, citing Stefan Scheietzke *et al*., "Natural gas fugitive emissions rates constrained by global atmospheric methane and ethane" *Environmental Science & Technology*, (June 19, 2014), DOI: 10.1021/es501204c.

[218] Caulton, D. R., Shepson, P. B., Santoro, R. L., Sparks, J. P., Howarth, R. W., Ingraffea, A. R., . . . Miller, B. R. (2014). Toward a better understanding and quantification of methane emissions from shale gas development. *Proceedings of the National Academy of Sciences, 111*(17), 6237-6242**;** Miller, S. M., Wofsy, S. C., Michalak, A. M., Kort, E. A., Andrews, A. E., Biraud, S. C., . . . Sweeney, C. (2013). Anthropogenic emissions of methane in the United States. *Proceedings of the National Academy of Sciences*. doi: 10.1073/pnas.1314392110 (); and Pétron, G., Frost, G., Miller, B. R., Hirsch, A. I., Montzka, S. A., Karion, A., . . . Miller, L. (2012). Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study. *Journal of Geophysical Research: Atmospheres (1984–2012), 117*(D4). We express no opinion regarding the merits of the above-referenced studies and do not rely on them for purposes of our decision in this Order. However, we take notice that these studies reached conclusions at variance with Scheietzke.

that most top-down analyses to date have been based on spatially- and temporally-restrictive boundaries that are just a snapshot of industry operations.

In addition to relying on the Scheietzke study, Sierra Club proffers its own estimates of the emissions that will be associated with production induced by the Sabine Pass Liquefaction Project. For the purpose of this exercise, Sierra Club assumes multiple leak rates, including a 1% leak rate (which is included as a conservative case to reflect air pollution controls more extensive than those that EPA has promulgated), the 1.4% figure used in the NETL LCA GHG Report, and a 3.0% leak rate.[219] Sierra Club argues even the 3.0% leak rate is likely to be conservative and that, in the 17 months since the NETL reports were released, numerous additional peer-reviewed studies have been published that provide further indication that the actual amount of natural gas emitted during the gas lifecycle exceeds NETL's estimate.

We disagree with Sierra Club's analysis. First, Sierra Club errs by comparing CH_4 emission rates without considering the boundary differences between two or more values. The computation of emission rates from a single system can vary widely, merely by shifting boundaries. Second, Sierra Club's reliance on seven studies as examples of research and analysis that are contrary to NETL's findings on the CH_4 emission rate[220] is misplaced because those studies do not support its claims. A more complete interpretation of the CH_4 emission rate is provided below with specific reference to the studies cited by Sierra Club:

(a) Schneising, O, et al., *Remote sensing of fugitive methane emissions from oil and gas production in North American tight geologic formations* (Earth's Future: 2014). The authors quantify the CH_4 emission rates from Bakken Shale and Eagle Ford Shale as

[219] Sierra Club Mot. at 19.
[220] *Id.*

10.1% +/-7.3% and 9.1% +/-6.2%. The authors note that the large uncertainties are due to the averaging of wind conditions within the temporal boundaries of the study, which complicates the mass balancing of CH_4 emissions. The two production regions that were measured are representative of tight oil wells, with natural gas produced as "associated gas." The unique spatial and temporal boundaries, technologies, and wind balancing complications of Schneising et al.'s analysis prevent direct comparisons with NETL's CH_4 emission rates.

(b) Lavoie et al., *Aircraft-based measurements of point source methane emissions in the Barnett Shale Basin* (ES&T: 2015). The authors focused on a non-random sample by taking top-down measurements in a production region where high emitters are known to exist. They concluded that CH_4 emissions in the sampled region have skewed distributions, indicative of a small number of emission events that contribute a disproportionately large share to total CH_4 emissions. Their conclusion is not that all natural gas production sites across the United States have emission rates as high as demonstrated by their non-random sample; rather, they conclude that a new type of emission category, called "super-emitters", should be used to account for skewed emission distributions. Finally, they note that top-down and bottom-up analyses are complementary approaches that can be used to improve one another.

(c) Lyon et al., *Constructing a spatially resolved methane emission inventory for the Barnett Shale region* (ES&T: 2015). The authors used multiple data sources to characterize CH_4 emissions from the Barnett Shale region. They note the existence of positively-skewed emission distributions, which they characterize as "relatively rare sources that contribute a large fraction of emissions." Their CH_4 emission rate for the region, including natural

gas supply chain activities from production through distribution, is 1.1% (and ranging from 1.0% to 1.3%). This emission rate is based on one region, so it is not directly comparable to NETL's national emission rate.

(d) McKain et al., *Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts* (PNAS: 2015). The authors measured atmospheric CH_4 at four stations in Boston for one year, and, combined with geospatial supply and consumption data, calculated a CH_4 emission rate of 2.7% (+/-0.6%) for an entire urban region, including transmission, storage, distribution and *end use*. They offer possible explanations (not all emission sources are identified, current protocols for developing emission factors are limited, etc.) for why their results do not align with existing inventories. As is the case with other top-down studies, the analysis is based on atmospheric measurements, such that specific emission sources cannot be identified.

(e) Marchese et al. *Methane emissions from United States natural gas gathering and processing* (ES&T: 2015). The authors do indeed identify an emission source – gathering facilities – that has been overlooked by past studies. However, Marchese et al. focus on just one stage (gathering and processing) of the natural gas supply chain, so their results are not directly comparable to NETL's CH_4 emission rates. Again, the computation of emission rates from a single system can vary widely, merely by shifting boundaries.

(f) Miller et al. *Anthropogenic emissions of methane in the United States* (PNAS: 2013). The authors do not express their results in terms of a CH_4 emission rate, although they do note that their inventory is higher than the EPA GHG inventory and EDGAR (a global CH_4 emission inventory developed by the EPA). They note the south-central United States has the greatest discrepancy between their calculations and other inventories. As is the case

with other top-down studies, the analysis is based on atmospheric measurements, such that specific emission sources cannot be identified.

(g) Zimmerle et al., *Methane emissions from the natural gas transmission and storage system in the United States* (ES&T: 2015). The authors use recent measurements and modeling to calculate the emissions from transmission and storage. Their T&S emission rate is similar to EPA's GHG inventory, upon which NETL's current CH_4 emissions from T&S are based. (Zimmerle et al. have a lower central value than EPA's inventory, but their uncertainty bounds overlap those of EPA's inventory.) However, Zimmerle et al. focus on just one stage (transmission and storage) of the natural gas supply chain, so their results are not directly comparable to NETL CH_4 emission rates. Moreover, the computation of emission rates from a single system can vary widely, merely by shifting boundaries.

None of the above studies refute NETL's calculated CH_4 emission rate from natural gas systems. Due to temporal and geographical boundary differences, no two studies can be directly compared. However, when all of these studies are considered in aggregate, they all point to limitations in data quality and consistency in both top-down and bottom-up analyses, and demonstrate that both types of analysis can be used to derive a reasonable representation of CH_4 emission rates.

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.

XI. DISCUSSION AND CONCLUSIONS

In reviewing SPL'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 SPL's LNG export

proposal is 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:

- SPL's Application, the submissions of API, Sierra Club, and other commenters in response to the Application, and any other filings in the docketed proceedings, including all documents that have been incorporated by reference;
- FERC staff's 2012 and 2014 EAs for Trains 1-4 of the Sabine Pass Liquefaction Project; FERC's April 16, 2012 order, including the 55 environmental conditions adopted in that order; FERC's July 26, 2012 order on rehearing; FERC's March 24, 2014 order authorizing an increase in the production capacity of the Liquefaction Project; and FERC's September 18, 2014 order denying rehearing of the March 24, 2014 order;
- The 2012 LNG Export Study, including comments received in response to the Study;
- The Draft Addendum, comments received in response to the Draft Addendum, and the final Addendum; and
- The LCA GHG Report (and the supporting NETL document), including comments submitted in response to those documents.

To avoid repetition, the following discussion focuses on arguments and evidence presented by SPL and the intervenors, commenters, and protestors to the extent that DOE/FE has not already addressed the same or substantially similar arguments raised in these proceedings in its responses to comments on the LNG Export Study, the Addendum, or the LCA GHG Report.

A. Procedural Issues

1. API's Motion to Intervene

No opposition has been filed in response to the motion to intervene submitted in these proceedings by API. Consequently, that motion to intervene is deemed granted. 10 C.F.R. § 590.303(g).

2. Sierra Club's Motion to Intervene

SPL opposes the motion to intervene filed by Sierra Club. SPL contends that Sierra Club has articulated only a generalized interest in the outcome of these proceedings that is not sufficient to warrant intervention. SPL also argues that Sierra Club's intervention is duplicative and unnecessary because Sierra Club could have filed comments in FERC's environmental review proceeding had it wished to challenge the environmental impacts of the Liquefaction Project.

On review, we find that Sierra Club's motion to intervene in this proceeding should be granted. Sierra Club has set forth on its own behalf and on behalf of its members a direct and material interest in the outcome of this proceeding and its intervention will not unduly prejudice the interests of the Applicant.

B. Non-Environmental Issues

In considering non-environmental issues in this proceeding, we have reviewed the Application; the pleadings submitted by API, Sierra Club, and the other commenters; and the 2012 LNG Export Study (including both the EIA and 2012 NERA studies). We also take administrative notice of EIA's most recent authoritative supply data and projections, set forth in AEO 2015 and discussed in the sections below.

The Application reviews natural gas supply and demand conditions in the United States and the likely impact that the proposed exports will have on natural gas prices and the domestic economy. The 2012 LNG Export Study and the even more recent data in AEO 2015 provide additional support for the conclusion that the proposed exports of LNG will yield significant local, regional, and national economic benefits, and will generate international benefits.

Sierra Club has argued that the requested export authority has not been shown to be consistent with the public interest. Sierra Club contends that the net economic benefits projected in the 2012 NERA Study will be limited to a relatively small, affluent segment of the population. It further argues that, independent of the distributional economic impacts of LNG exports, the proposed exports will likely have a negative impact on the United States economy by increasing the price of natural gas, limiting real wage growth, eliminating jobs in energy intensive industries, and reducing gross domestic product. Sierra Club asserts that while some regions may benefit from job growth because of additional gas production activity, the benefits will be temporary and will be overtaken by a boom-bust cycle characteristic of economies built on extractive industries. Sierra Club also maintains that the 2012 NERA Study attempted to downplay these negative impacts by incorrectly claiming that the benefits of additional natural gas production will be passed on to Americans that own stock in natural gas production companies. Moreover, Sierra Club rejects findings made by DOE/FE in other decisions to the effect that Sierra Club has not demonstrated the adverse distributional impacts of LNG exports because it has not conducted a quantitative analysis of the impacts at the household level.

On review of the non-environmental issues in this proceeding, DOE/FE finds that the evidence of record showing that the proposed exports would be in the public interest outweighs the concerns expressed by Sierra Club and the other commenters in this proceeding. DOE has considered and rejected each of Sierra Club's arguments that bear on the validity of the 2012 NERA Study in the preceding discussion of the Study in this Order. *See supra* § VIII. In regards to those arguments, Sierra Club has adduced no additional substantive support for its views in this proceeding. Even more recent data is consistent with the findings and conclusions contained in the 2012 LNG Export Study. Most significantly, EIA's most recent projections in

AEO 2015 provide independent support using the latest available data for the proposition that domestic supplies will be adequate both to meet domestic needs *and* to supply SPL's exports and other final non-FTA LNG exports previously authorized by DOE/FE. *See supra* § VIII.A. We find this most recent data from AEO 2015, in conjunction with the 2012 LNG Export Study, is determinative of the question of whether or not the proposed exports will be in the public interest. Based on this evidence, we find that the market will be capable of sustaining the level of exports proposed in SPL's Application over the term of the requested authorizations without significant negative price or other impacts and, in fact, the domestic economy is likely to experience net economic benefits. For these reasons, as further discussed below, we find that Sierra Club and the other commenters have not overcome the statutory presumption that the requested exports are consistent with the public interest.

1. Regional Impacts

SPL asserts that the proposed exports will stimulate local, regional, and national economies through direct and indirect job creation, increased economic activity, and tax revenues. As indicated above, however, Sierra Club challenges the sustainability of economic benefits in regions tied to resource extraction industries. In particular, Sierra Club contends that DOE/FE must consider a full range of counterfactual scenarios by evaluating whether the nation would be better off without LNG exports, or with lower export volumes. Sierra Club also challenges SPL's claimed regional economic benefits by focusing principally on the durability of economic benefits in producing regions in Pennsylvania and New York where Marcellus Shale drilling is occurring. Sierra Club asserts that any "boom" in economic activity will be followed by a bust, and that the prospect of such an event demonstrates that a grant of the requested authorization is inconsistent with the public interest.

On review, we do not agree with Sierra Club that SPL's proposed exports will not yield net economic benefits or that the proposed exports will produce deleterious economic and societal impacts. The 2012 NERA Study, bolstered by the more recent data in AEO 2015, shows that the proposed exports are likely to generate net economic benefits for the United States. The intervenors have not offered detailed analyses specific to the local and regional economic impacts of SPL's proposal to contradict this evidence.

Further, we reject the claims that exports will have a negative impact on employment. Sierra Club points to a study conducted by Weinstein and Partridge (the Weinstein study) to support its contrary position.[221] However, we have considered the analysis contained in the Weinstein study in several recent LNG export orders, and found that the Weinstein Study showed only a statistically insignificant decline in employment in the regions studied in the years before a drilling boom (2001 to 2005), compared to the years during the drilling boom (2005 to 2009).[222]

This small decline could have been the result of other factors, particularly since the years of the drilling boom coincided with a national economic recession. On the other hand, comparing the same time periods, we found that the Weinstein study showed substantial gains in economic growth rates in counties with drilling operations as opposed to those without. For the same reasons provided in those orders, we reject Sierra Club's arguments here.[223]

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[221] Sierra Club Mot. at 23 (discussing Weinstein and Partridge, *The Economic Value of Shale Natural Gas in Ohio*, Ohio State University, Swank Program in Rural-Urban Policy Summary & Report (Dec. 2010)).
[222] *See, e.g., LNG Develop. Co., LLC (d/b/a Oregon LNG)*, DOE/FE Order No. 3465, FE Docket No. 12-77-LNG, Order Conditionally Granting Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Oregon LNG Terminal in Warrenton, Clatsop County, Oregon, to Non-Free Trade Agreement Nations, at 135-36 (July 31, 2014).
[223] *Id*.

Sierra Club contends more broadly that extractive industries suffer from boom-bust cycles and therefore provide little lasting benefit to local communities. To the extent Sierra Club is claiming that the exports proposed by SPL will physically exhaust existing resources, we refer to Section VIII in which we conclude that record evidence indicates that there will be substantial supply into the foreseeable future. To the extent that the "bust" cycles Sierra Club envisions are brought on by price declines that render existing resources uneconomic to produce, we do not see compelling evidence that the exports will exacerbate this risk. If anything, it seems more likely that SPL's ability to export to non-FTA countries will deepen and diversify the market for U.S.-produced natural gas, making the potential for a precipitous price-driven downturn in production activities less likely, not more likely.

2. Price Impacts

As discussed above, the LNG Export Study projected the economic impacts of LNG exports in a range of scenarios, including scenarios that equaled and exceeded the current amount of LNG exports authorized in the final non-FTA export authorizations to date, including this Order (equivalent to a total of 11.38 Bcf/d of natural gas). *See infra* § XI.E. The LNG Export Study concluded that LNG exports at these levels (*e.g.*, 6 Bcf/d of natural gas and higher) 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. NERA's analysis in its 2012 Study indicates that, after five years of increasing LNG exports, wellhead natural gas price increases could range from $0.22 to $1.11 (2010$/Mcf) depending on the market-determined level of exports. However, even with these estimated price increases, NERA found that the United States would experience net economic benefits from increased LNG exports in all cases studied. *See supra* Section V.B.1, 8.

Furthermore, as discussed above, the AEO 2015 projections from EIA indicate domestic supply and demand conditions that are more favorable, not less favorable, to exports. Specifically, the most recent outlook in the AEO 2015 Reference Case for 2035 reflects LNG exports equivalent to 9.0 Bcf/d of natural gas, net natural gas pipeline exports of 5.2 Bcf/d, and market price $0.39/MMBtu below the AEO 2011 Reference Case price, in constant 2012 dollars. It should be noted that, for 2035, the AEO 2011 Reference Case forecast 0.5 Bcf/d of net imports of natural gas plus LNG. *See supra* § VIII.A. Accordingly, we reject Sierra Club's arguments and find that, as to the impact of these LNG exports on domestic gas prices, Sierra Club and the other commenters have not overcome the statutory presumption that the requested authorization is consistent with the public interest.

3. Significance of the LNG Export Study

For the reasons discussed above, DOE/FE commissioned the LNG Export Study and invited the submission of responsive comments. DOE/FE has analyzed this material and determined that the LNG Export Study provides substantial support for granting SPL's Application. The conclusion of the LNG Export Study is that the United States will experience net economic benefits from issuance of authorizations to export domestically produced LNG.

We have evaluated the initial and reply comments submitted in response to the LNG Export Study. Various commenters have criticized the data used as inputs to the LNG Export Study and numerous aspects of the models, assumptions, and design of the Study. As discussed above, however, EIA's most recent projections, set forth in AEO 2015, continue to show market conditions that will accommodate increased exports of natural gas. When compared to the AEO 2013 Reference Case, the AEO 2015 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 LNG Export Study is fundamentally sound and supports 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 LNG Export Study or the current data from AEO 2015 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."[224]

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 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,

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

authorizing U.S. exports may advance the public interest for reasons that are distinct from and additional to the economic benefits identified in the LNG Export Study.

C. Environmental Issues

In reviewing the potential environmental impacts of SPL'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

DOE/FE has reviewed the administrative records compiled at FERC in response to SPL's application to site, construct, and operate Trains 1-4 of the Liquefaction Project and SPL's subsequent application at FERC to increase the authorized production output of Trains 1-4 to align the authorized production with the maximum production capacity of the approved facilities. DOE/FE also has reviewed the complete record compiled in the present proceeding, including the Addendum.

Based on that review, DOE/FE concluded in its March 2016 FONSI that the proposed amendment of SPL's export authorization issued in Order No. 2961-A will not have a significant effect on the human environment. In particular, DOE/FE finds that FERC's environmental reviews examined the potential environmental impacts of the volumes covered by the Application in this proceeding and reasonably concluded that production of the maximum capacity of Trains 1-4 would not constitute a major federal action significantly affecting the quality of the human environment. Accordingly, DOE/FE concludes supplementation of the record is not warranted or necessary in order for DOE/FE to take final agency action and preparation of an environmental impact statement in this proceeding is not required.

2. Scope of NEPA Review

Sierra Club intervened in SPL's proceeding before FERC, and in the present proceedings. At the outset, we dismiss as moot Sierra Club's contention that DOE/FE may not act on the pending export Application until the environmental review of the proposed exports has been completed. Pursuant to the policy adopted by DOE on August 11, 2014,[225] DOE/FE has waited until the environmental review of the proposed Liquefaction Project was completed at FERC and until DOE/FE had an opportunity to complete its independent review of the EA before issuing a final decision herein.

Sierra Club asserted in the 2012 FERC proceeding that the EA failed to take the hard look required by NEPA, in that, among other things, it did not consider the indirect effects of induced natural gas production associated with the Liquefaction Project; failed to adequately analyze direct, cumulative, and indirect impacts on climate change from GHG emissions; and failed to consider and disclose the GHG emissions associated with the production, transport, and combustion of the natural gas. More generally, Sierra Club asserted in the 2012 FERC proceeding as it did in the present proceeding that FERC should have prepared an environmental impact statement (EIS) and not relied on an environmental assessment.

Provided that the 55 mitigation measures identified in the 2011 EA were adopted, FERC's April 16, 2012 order rejected Sierra Club's argument that the siting, construction, and operation of the Liquefaction Project constituted a major federal action significantly affecting the environment for which an EIS is warranted.[226] FERC also rejected the argument that its

[225] *Procedures for Liquefied Natural Gas Export Decisions, Final Revised Procedures*, 79 Fed. Reg. 48132 (Aug. 15, 2014).
[226] April 16 order at 39.

environmental review should include a cumulative impacts analysis of other liquefaction projects in the Gulf Coast.[227] FERC further concluded that a detailed environmental analysis of increased natural gas production would be too speculative for inclusion in the EA because the impact of such increased production cannot be described with sufficient specificity to make its consideration useful for reasoned decision-making. In the April 16, 2012 order, FERC found that such increased production is not "reasonably foreseeable" for purposes of NEPA analysis.[228]

We find that FERC's environmental review in the 2011 EA, the April 16 and July 26, 2012 orders, the 2014 EA, and the February 20 and September 18, 2014 orders addressed all reasonably foreseeable environmental impacts of the Liquefaction Project, and that NEPA does not require the review to include induced upstream natural gas production. As FERC indicated, fundamental uncertainties constrain our ability to foresee and analyze with any particularity the incremental natural gas production that may be induced by permitting exports of LNG to non-FTA countries.

However, we recognize as well that EIA's 2012 Study projected that incremental natural gas production in the United States would account for 63 percent of LNG export volumes and, of that amount, 93 percent would come from unconventional production.[229] For this reason, and because DOE/FE had received comments regarding the potential environmental impacts associated with unconventional production, DOE/FE produced the Addendum and made it available for public comment. The Addendum takes a broad look at unconventional natural gas

[227] April 16 order at 29, *et seq*.
[228] FERC Order at 31-32.
[229] *See* LNG Export Study – Related Documents, available at http://energy.gov/fe/services/natural-gas-regulation/lng-export-study (EIA 2012 Study) at 11.

production in the United States, with chapters covering water resources (including water quantity and quality), air quality, GHG emissions, induced seismicity, and land use.

The Addendum addresses unconventional natural gas production in the nation as a whole. But the Addendum does not attempt to identify or characterize the incremental environmental impacts that would result from LNG exports to non-FTA nations. Such impacts are not reasonably foreseeable and cannot be analyzed with any particularity. To begin, there is uncertainty as to the aggregate quantity of natural gas that ultimately may be exported to non-FTA countries. Receiving a non-FTA authorization from DOE/FE does not guarantee that a particular facility would be financed and built; nor does it guarantee that, if built, market conditions would continue to favor export once the facility is operational. To illustrate the point, of the more than 40 applications to build new LNG import facilities that were submitted to federal agencies between 2000 and 2010, only eight new facilities were built and those facilities have seen declining use in the past decade.[230]

There is also fundamental uncertainty as to where any additional production would occur and in what quantity. As the Addendum illustrates, nearly all of the environmental issues presented by unconventional natural gas production are local in nature, affecting local water resources, local air quality, and local land use patterns, all under the auspices of state and local regulatory authority. As DOE explained in *Sabine Pass*, Order No. 2961-A, without knowing where, in what quantity, and under what circumstances additional gas production will arise, the environmental impacts resulting from production activity induced by LNG exports to non-FTA

[230] *See Freeport LNG Expansion L.P., et al., LLC*, DOE/FE Order No. 3357, FE Docket No. 11-161-LNG, Order Conditionally 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, at 100-01 n.161 (Nov. 15, 2013) (FLEX II Conditional Order).

countries are not "reasonably foreseeable" within the meaning of the CEQ's NEPA regulations.[231]

3. Cumulative Environmental Impacts

Sierra Club has asserted in these proceedings that our environmental review must consider the environmental impacts from all proposed and previously approved export authorizations and that a programmatic EIS is legally required for these purposes. The environmental impact analysis in the EA examined cumulative impacts from other projects in the vicinity of the Liquefaction Project.[232] The types of impacts considered included potential impacts to water resources, wetlands, vegetation and wildlife, cultural resources, socioeconomics, air quality (including GHG emissions), and noise. The EA found:

> Most of the cumulative impacts identified would be short-term and minor, such as impacts on water resources, wildlife, and vegetation. Permanent wetlands impacts would be offset by compensatory mitigation, either through the purchase of credits from established mitigation banks or in-lieu mitigation.[233]

We find that the environmental review conducted by FERC took into account all reasonably foreseeable cumulative environmental impacts relating to the exports of LNG proposed in this proceeding. Moreover, in issuing the FONSI under NEPA in this proceeding, we have determined the proposed increase in authorized export volumes does not constitute a major federal action significantly affecting the human environment.

Furthermore, we find that Sierra Club is seeking a programmatic EIS when there was no "program" before FERC under CEQ guidelines.[234] The 2011 and 2014 EAs properly disclosed the environmental impacts of the Liquefaction Project while also setting forth measures that

[231] *Sabine Pass*, DOE/FE Order No. 2961-A, at 11 (quoting 40 C.F.R. § 1508.7).
[232] EA at 161-162.
[233] *Id.* at 171.
[234] 40 C.F.R. §§ 1508.7, 1508.8.

would mitigate, minimize, or eliminate any potential impacts. We, therefore, agree with FERC's reasoning and adopt its analysis concerning cumulative environmental impacts.

4. 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.[235] 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

[235] Addendum at 2.

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 reductions.[236] In 2013, EPA updated those regulations to include storage tanks,[237] 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.[238] More recently, 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."[239] Specifically, as part of the Administration's efforts to address climate change, EPA 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.[240] EPA issued a proposed rule in September 2015, with a final rule to follow in 2016.[241]

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[236] 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).
[237] U.S. Envtl. Prot. Agency, Oil and Natural Gas Sector: Reconsideration of Certain Provisions of New Source Performance Standards; Final Rule, 77 Fed. Reg. 58,416 (Sept. 23, 2013).
[238] 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), discussed *supra* § IX.C.
[239] 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.
[240] 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-climateaction-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.").
[241] U.S. Envtl. Prot. 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).

Regardless of the outcome of EPA's announced rulemaking proposals, we conclude Sierra Club has not demonstrated induced production will exacerbate public health impacts associated with elevated ozone levels in the regions where production occurs. The extent of ozone formation and its consequences for public health depends not only on VOCs and NOx formation but also on population exposure, spatial distribution, and sunlight. Therefore the formation of ozone and its impacts on population cannot be determined solely on an inventory of NOx and VOCs.

Furthermore, we reject Sierra Club's contention that for any given leak rate and volume of production, EPA conversion factors can be used to estimate the emissions of individual pollutants included in the leaked methane.[242] Sierra Club applies Table 4-2 from EPA's July 2011 oil and gas technical support document[243] incorrectly. The table represents uncontrolled completion emissions only and is not representative of the rest of the natural gas supply chain. Further, it is not representative of current completion practices. The New Source Performance Standards (NSPS) require that all wells drilled after August 23, 2011, have VOC controls; and as of January 2015, all newly drilled wells must use green completions that capture VOC and associated CH_4 and make it available for use or sale.[244] Using Table 4-2 from EPA's July 2011 technical support document extrapolates one type of production activity to the entire supply chain and overlooks the effect of NSPS VOC reduction strategies. Therefore, Table 4-2 cannot be used to calculate life cycle CH_4, VOC, or HAP emissions.

[242] Sierra Club Mot. at 19.
[243] EPA (2011). Oil and Natural Gas Sector: Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution. EPA-453/R-11-002. Retrieved March 3, 2016 from https://www3.epa.gov/airquality/oilandgas/pdfs/20110728tsd.pdf.
[244] EPA (2011). EPA's Air Rules for the Oil & Natural Gas Industry: Summary of Requirements for Processes and Equipment at Natural Gas Well Sites.

In sum, 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. 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.

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

Sierra Club and other commenters on the LCA GHG Report and the Addendum 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. Those objections are largely addressed in sections IX and X of this Order. Additional consideration of arguments raised in this proceeding by Sierra Club is provided in the following discussion.

a. Domestic 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)."[245] 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."[246] 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."[247] 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.[248] 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

[245] 2012 EIA Study at 18.
[246] *Id*.
[247] *Id*.
[248] *Id*.

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 2012 Study assumed the continuation of regulations in effect at the time the AEO 2011 was prepared.[249] Therefore, EIA's analysis did not include the impacts that EPA's Mercury and Air Toxics Standard[250] and its Transport Rule[251] may have on the extent to which the U.S. coal fleet would compensate for reduced use of natural gas. Nor did EIA's analysis capture the potential for broad regulation of carbon dioxide emissions from the electric power sector. After publication of the EIA Study in early 2012, EPA proposed two rules that, if finalized, would likely reduce the extent to which increased use of coal would compensate for reduced use of natural gas. Effective October 23, 2015, EPA implemented a final rule that limits carbon dioxide emissions from new coal-fired electric-generating units.[252] EPA also issued a final rule to take effect on Dec. 22, 2015 to limit carbon dioxide emissions from existing coal-fired electric generating units.[253] However, the United States Supreme Court issued a stay of the effectiveness of the latter rule on February 9, 2016 pending disposition of an appeal of the rule.[254]

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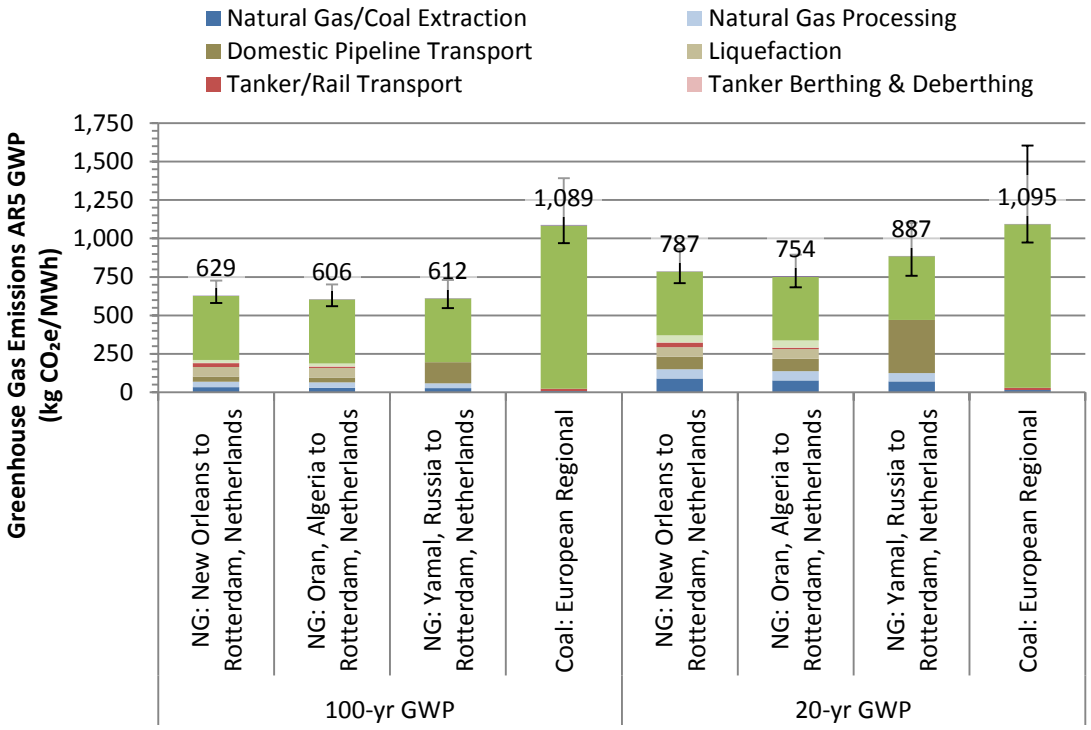
[249] 2012 EIA Study at 12 n.7 ("The degree to which coal might be used in lieu of natural gas depends on what regulations are in-place that might restrict coal use. These scenarios reflect current laws and regulations in place at the time [AEO 2011] was produced.").
[250] U.S. Envtl. Prot. Agency, National 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 Rule, 77 Fed. Reg. 9,304 (Feb. 16, 2012).
[251] 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).
[252] U.S. Envtl. Prot. 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).
[253] U.S. Envtl. Prot. 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).
[254] *Chamber of Commerce, et al. v. EPA*, et al., Order in Pending Case, 577 U.S. ___ (2016), http://www.supremecourt.gov/orders/courtorders/020916zr3_hf5m.pdf.

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. 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.

b. International Impacts Associated with Energy Consumption in Foreign Nations

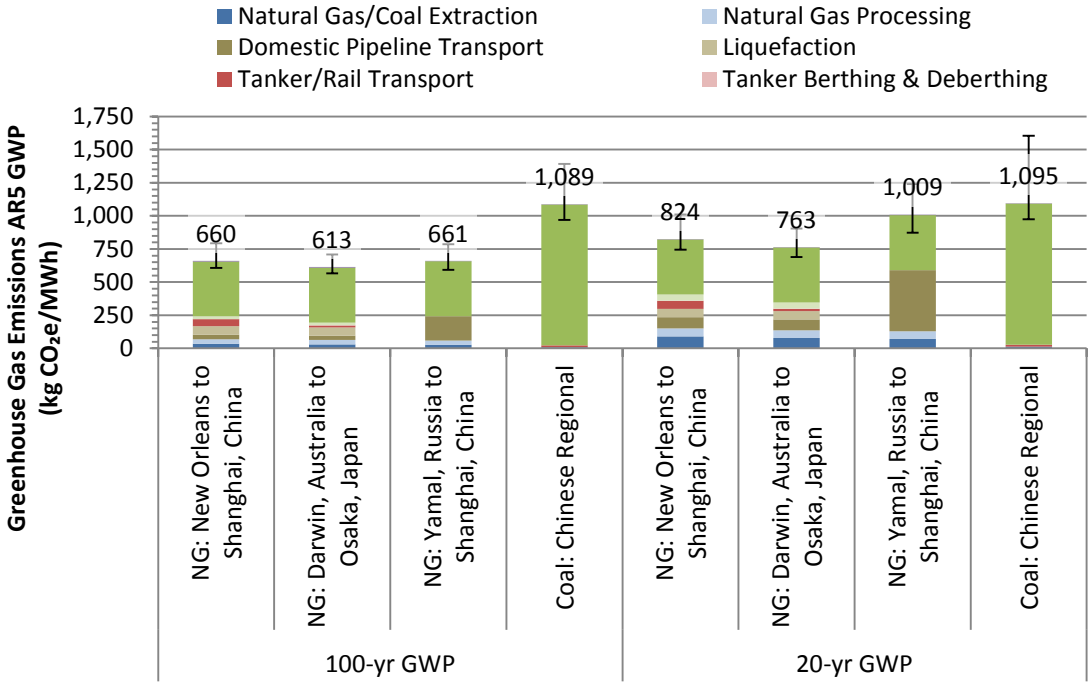
The LCA GHG Report estimated the life cycle GHG emissions of U.S. LNG exports to Europe and Asia, compared with certain other fuels used to produce electric power in those importing countries. The key findings for U.S. LNG exports to Europe and Asia are summarized in the following two figures (also presented above in Section XI.A):

Table 15: Life Cycle GHG Emissions for Natural Gas and Coal Power in Europe[255]



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

Table 16: Life Cycle GHG Emissions for Natural Gas and Coal Power in Asia[256]



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.[257]

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

[256] LCA GHG Report at 10 (Figure 6-2).
[257] *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.[258]

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 66% coal and 3% natural gas in 2012.[259] For India, installed electric generation capacity in 2014 is 59% coal and 9% natural gas.[260] In both China and India, electric generation 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 89 percent in 2012

[258] Sierra Club observes in its protest in FE Docket No. 13-121-LNG that renewable energy has experienced significant growth in key LNG-importing countries such as India and China. Sierra Club does not, however, place the growth of renewable energy in the context of the aggregate use of fossil energy projects in those countries. Nor does Sierra Club 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.

[259] U.S. Energy Information Administration, China Analysis Brief (last updated Feb. 4, 2014), *available at:* http://www.eia.gov/countries/cab.cfm?fips=CH.

[260] U.S. Energy Information Administration, India Analysis Brief (last updated June 26, 2014), *available at* http://www.eia.gov/beta/international/analysis.cfm?iso=IND.

after the Fukushima disaster.[261] In Europe, use of fossil fuels is slightly less than in the Asian nations noted above but still significant, comprising 68 percent and 49 percent of electric generation in the United Kingdom and Spain for 2012, respectively.[262]

The comparison cases used in the LCA GHG Report were well-chosen. When U.S.-exported LNG enters the marketplace, it will compete with LNG sourced from other countries. Therefore, the comparison of U.S.-sourced LNG to foreign-sourced LNG is clearly instructive. U.S.-exported LNG also will compete directly with pipeline deliveries from Russia in some markets, another form of "gas-on-gas" competition. Because the availability of U.S.-exported LNG may affect the electric power generation mix in importing countries, the LCA GHG Report also compared U.S.-exported LNG to coal produced domestically in both Europe and Asia. This comparison is likewise instructive because, as we explain herein, coal remains a prevalent choice for electric power generation in LNG-importing countries and competes with natural gas as a source of baseload power.

It is important, however, to recognize DOE/FE's limited aims in making these comparisons. We emphasize that the comparisons to coal and foreign-sourced gas in the LCA GHG Report do not themselves answer how U.S. LNG exports may affect the global GHG balance because U.S. LNG may compete with other resources as well. Nonetheless, given the

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[261] U.S. Energy Information Administration, Japan Analysis Brief (last updated Jan. 30, 2015), *available at* http://www.eia.gov/countries/cab.cfm?fips=JA. In this updated Brief, EIA observed that, "[o]nce Japan removed its nuclear generation capacity from operation starting in 2011, other fuels such as LNG, oil, and coal displaced it. This shift has markedly altered the generation portfolio," with reports that "LNG, oil, and coal shares rose to 43%, 14%, and 30%, respectively, in 2013." *Id*.

[262] EIA, International Energy Statistics, *available at:* http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=2&pid=alltypes&aid=12&cid=SP,UK,&syid=2008&eyid=2012&unit=BKWH. 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.

prevalence of coal and natural gas as sources of electric generation in LNG-importing countries, the comparison provides valuable information.

Additionally, as noted above, DOE/FE has not attempted to calculate a more precise prediction regarding global GHG impacts because the compounded uncertainties in estimating how the availability of U.S. LNG exports would affect the market for every potential energy source in every importing country—together with the interventions of foreign governments in those markets—would render such an analysis too speculative to inform our public interest determination. For example, even in the unlikely scenario that *all* U.S. LNG were exported to Japan, those exports would affect the global price of LNG, which in turn would affect energy systems in numerous countries besides Japan. To the extent that U.S.-exported LNG lowers the price of natural gas in a given country, that price change could affect dispatch and retirement decisions facing existing units as well as decisions of what new units to build. Even with respect to new capacity, it may not be valid to assume that natural gas would compete directly with renewables in all nations given the potential intervention of public policy and the different role these resources play in an integrated electric system.

In sum, 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.

D. Other Considerations

Our decision is not premised on an uncritical acceptance of the general conclusion of the LNG Export Study of net economic benefits from LNG exports. Both the LNG Export Study 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 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 SPL'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[263] 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.[264] Given

[263] 49 Fed. Reg. at 6684.

[264] Some commenters on the LNG Export Study 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,

these possibilities, DOE/FE recognizes the need to monitor market developments closely as the impact of successive authorizations of LNG exports unfolds.

E. Conclusion

We have reviewed the evidence in the record and have not found an adequate basis to conclude SPL's proposed export of LNG to non-FTA countries will be inconsistent with the public interest. We find the intervenors, commenters, and protestors in this proceeding have failed to overcome the statutory presumption that the proposed export authorization is consistent with the public interest. For that reason, we are authorizing SPL'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 11.38 Bcf/d of natural gas, or 3.949 Tcf/yr, for the 15 final authorizations issued to date—Sabine Pass (Trains 1-4) (2.2 Bcf/d); Carib Energy (USA) LLC (0.04 Bcf/d);[265] Cameron LNG, LLC (1.7 Bcf/d);[266] FLEX I (1.4 Bcf/d);[267] FLEX II (0.4

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).

[265] *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).

[266] *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).

[267] *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).

Bcf/d);[268] Dominion Cove Point LNG, LP (0.77 Bcf/d);[269] Cheniere Marketing, LLC and Corpus Christi Liquefaction, LLC (2.1 Bcf/d);[270] Sabine Pass Liquefaction, LLC Expansion Project (1.38 Bcf/d),[271] American Marketing LLC (0.008 Bcf/d),[272] Emera CNG, LLC (0.008 Bcf/d),[273] Floridian Natural Gas Storage Company, LLC, [274] Air Flow North American Corp. (0.002 Bcf/d),[275] Bear Head LNG Corporation and Bear Head LNG (USA), LLC (0.81 Bcf/d),[276]

[268] *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).
[269] *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).
[270] *Cheniere Marketing, LLC, and Corpus Christi, LLC*, DOE/FE Order No. 3638, FE Docket No. 12-97-LNG, Final Opinion and Order 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).
[271] *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 Free Trade Agreement Nations (June 26, 2015).
[272] *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).
[273] *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).
[274] *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).
[275] *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).
[276] *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).

Pieridae Energy (USA) Ltd.;[277] and this Order (0.56 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 source of LNG approved under both orders is from the Floridian Facility.[278] 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.[279] In sum, the total export volume is within the range of scenarios analyzed in the 2012 EIA and NERA studies. NERA found that in all such scenarios—assuming either 6 Bcf/d or 12 Bcf/d of export volumes—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

[277] *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).

[278] *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 "will be reduced by the portion of the total approved export 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").

[279] *See Bear Head LNG Corporation and Bear Head LNG (USA)*, DOE/FE Order No. 3770, at 178 (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).

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 LNG Export Study, like any study based on assumptions and economic projections, is inherently limited in its predictive accuracy; (2) applications to export significant quantities of 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.

XII. 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. SPL must abide by each Term and Condition or may face rescission of the authorization or other appropriate sanction.

A. Term of the Authorization

SPL requests a 20-year term for the authorization commencing from the date of first commercial exports. This term is consistent with our practice in the final and conditional non-

FTA export authorizations issued to date.[280] 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 date when SPL commences commercial export of domestically sourced LNG from any of Trains 1 through 4 of the Sabine Pass LNG Terminal, but not before.

B. Commencement of Operations Within Seven Years

Consistent with the final and conditional non-FTA authorizations issued to date,[281] DOE/FE will add as a condition of the authorization that SPL must commence commercial LNG export operations 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

SPL 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 Trains 1 through 4 of the Sabine Pass LNG Terminal. "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 Sabine Pass's

[280] *See, e.g., Freeport LNG Expansion, L.P., et al.*, DOE/FE Order No. 3357-B, at 100-01.
[281] *See, e.g., Freeport LNG Expansion, L.P., et al.*, DOE/FE Order No. 3357-B, at 100-01.

long-term contracts.[282] The Commissioning Volumes will not be counted against the maximum level of volumes previously authorized in any of SPL's blanket short-term or long-term FTA and non-FTA authorizations, including this Order.

D. Make-Up Period

SPL 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 SPL's FTA and non-FTA orders, including this Order. Insofar as SPL 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.[283] As a condition of the similar authorization issued to SPL in 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,

[282] 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).
[283] 10 C.F.R. § 590.405.

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 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.[284]

F. Agency Rights

As noted above, SPL requests authorization to export LNG in a volume equivalent to 203 Bcf/yr of natural gas from Trains 1 through 4 of the Sabine Pass LNG Terminal. SPL expressly requests this authorization both on its own behalf and as agent for other entities that hold title to the LNG at the time of export.[285]

DOE/FE previously addressed the issue of Agency Rights in Order No. 2913,[286] which granted FLEX authority to export LNG to FTA countries. In that order, DOE/FE approved a proposal by FLEX to register each LNG title holder for whom FLEX sought to export LNG as

[284] 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).
[285] App. 3 at 4.
[286] *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*].

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.[287] 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, LLC*.[288] 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.[289]

To ensure that the public interest is served, this authorization shall be conditioned to require that where SPL proposes to export this volume of LNG from Trains 1 through 4 (equivalent to 203 Bcf/yr of natural gas) 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."[290] Additionally, DOE/FE regulations allow confidential

[287] *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.
[288] *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).
[289] *See id*. at 7-8.
[290] 10 C.F.R. § 590.202(b).

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.[291]

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

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 Sabine Pass LNG 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[292] requires that SPL file, or cause to be filed, all long-term contracts associated with the long-term supply of natural gas to the Sabine Pass LNG Terminal, whether signed by SPL or the Registrant, within 30 days of their execution.

DOE/FE recognizes that some information in SPL'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 Sabine Pass LNG Terminal, may be

[291] *Id*. § 590.202(e).
[292] *Id*. § 590.202(c).

commercially sensitive. DOE/FE therefore will provide SPL the option to file or cause to be filed either unredacted contracts, or in the alternative (A) SPL 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.

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 and Operational Flexibility

SPL has sought authorization in this proceeding to export up to the equivalent of 203 Bcf/yr of natural gas to non-FTA countries from Trains 1 through 4 at the Sabine Pass LNG Terminal. This Order authorizes the export of LNG in the full amount requested, up to the equivalent of 203 Bcf/yr of natural gas, pursuant to Ordering Paragraph A below. This export volume of 203 Bcf/yr is in addition to 803 Bcf/yr previously authorized for export to non-FTA countries from Trains 1 through 4 in Order No. 2961-A. However, it is not additive to volumes authorized for export from the Sabine Pass LNG Terminal to FTA countries; volumes authorized under short-term blanket authorizations; or volumes authorized for export using other trains, e.g. Trains 5 and 6, at the Sabine Pass LNG Terminal.

XIII. 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 SPL's Application should be granted subject to the Terms and Conditions set forth herein. The following Ordering Paragraphs reflect current DOE/FE practice.

XIV. ORDER

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

A. Sabine Pass Liquefaction, LLC is authorized to export domestically produced LNG by vessel from the Sabine Pass LNG Terminal located in Cameron Parish, Louisiana, using Trains 1 through 4, in a volume up to the equivalent of 203 Bcf/yr of natural gas for a term of 20 years to commence when SPL commences commercial export of domestically sourced LNG, but not before. SPL is authorized to export this LNG on its own behalf and as agent for other entities who hold title to the LNG, pursuant to one or more long-term contracts (a contract greater than two years).

B. SPL 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 SPL's FTA and non-FTA orders, including this Order.

C. SPL 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 previously authorized for export in any of SPL's FTA and non-FTA orders, including this Order. Insofar as SPL may seek to export

additional volumes not previously authorized for export, it will be required to obtain appropriate authorization from DOE/FE.

D. SPL 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 203 Bcf/yr of natural gas. This export volume is in addition to 803 Bcf/yr previously authorized for export to non-FTA countries from Trains 1 through 4 in DOE/FE Order No. 2961-A. However, it is not additive to volumes authorized for export from the Sabine Pass LNG Terminal to FTA countries or to volumes authorized under short-term blanket export authorizations.

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. SPL 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. SPL shall ensure compliance with all terms and conditions established by FERC in the 2011 EA, the 55 environmental conditions adopted in the FERC's April 16, 2012 order, and the 2014 EA. Additionally, this authorization is conditioned on SPL's on-going compliance with any other preventative and mitigative measures at the Sabine Pass LNG Terminal imposed by federal or state agencies.

I. (i) SPL 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 export of LNG as agent for other entities from Trains 1 through 4 of the Sabine Pass LNG Terminal. The non-redacted copies may be filed under seal and must be filed within 30 days of their execution. Additionally, if SPL 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, SPL 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, SPL shall state why the redacted or non-disclosed information should be exempted from public disclosure.

(ii) SPL 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 Sabine Pass LNG Terminal. The non-redacted copies may be filed under seal and must be filed within 30 days of their execution. Additionally, if SPL 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, SPL 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, SPL shall state why the redacted or non-disclosed information should be exempted from public disclosure.

J. SPL, or others for whom SPL 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. 3792, issued March 11, 2016, in FE Docket No. 15-63-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 Sabine Pass Liquefaction, LLC that identifies the country (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 Sabine Pass Liquefaction, LLC is made aware of all such countries.

K. SPL is permitted to use its authorization in order to export LNG as agent for other entities, after registering the other parties with DOE/FE. Registration materials shall include an acknowledgement and agreement by the Registrant to supply SPL with all information necessary to permit SPL 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, SPL shall ensure that all persons required by this Order to register with DOE/FE have done so. Any failure by SPL 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 any of Trains 1 through 4 of the Sabine Pass LNG Terminal, SPL shall provide written notification of the date that the first export of LNG authorized in Ordering Paragraph A above occurred.

O. SPL shall file with the Office of Regulation and International Engagement, on a semi-annual basis, written reports describing the progress of Trains 1 through 4 of the Sabine Pass LNG Terminal. The reports shall be filed on or by April 1 and October 1 of each year, and shall include information on the progress of Trains 1 through 4, the date these LNG trains are expected to be operational, and 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, SPL must obtain the approval of the Assistant Secretary for Fossil Energy. 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 SPL, 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.[293]

Q. Monthly Reports: With respect to the LNG exports authorized by this Order, SPL 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 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.

[293] *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).

S. The motions to intervene submitted by Sierra Club and API are granted.

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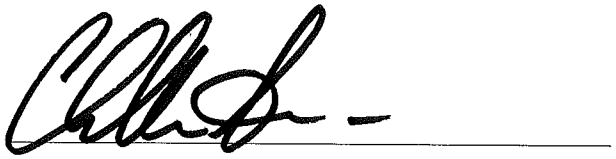

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