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UNITED STATES OF AMERICA
DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

IN THE MATTER OF	**)**	
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EOS LNG LLC	**)**	**FE DOCKET NO. 13-116-LNG**
	)	

SIERRA CLUB'S MOTION TO INTERVENE, PROTEST, AND COMMENTS

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In the above-captioned docket, Eos LNG LLC ("EOS") requests authorization to export approximately 584 billion cubic feet per year (bcf/y), or roughly 1.6 bcf/day, of natural gas as liquefied natural gas (LNG) from a proposed floating LNG liquefaction facility and export terminal located at the Port of Brownsville in Brownsville, Texas ("FLNG Project"). This proposal cannot move forward without extensive environmental and economic analyses that EOS has not provided to the Department of Energy Office of Fossil Energy (DOE/FE). EOS's application makes sweeping claims without any supporting material and with scant citation; producing a record upon which DOE/FE cannot credit EOS's assertions. The available evidence, on the other hand, demonstrates that this proposal is inconsistent with the public interest.

One of EOS's primary claims isthat the proposed project would "provide the Gulf Coast region, and the United States with significant economic benefits by increasing domestic natural gas production." EOS App. at 13; *see also id.* at 14, 16. While Sierra Club agrees that the proposed exports would stimulate additional gas production, DOE/FE cannot authorize exports without fairly weighing significant environmental and economic impacts of this production. *See NAACP v. Federal Power Comm'n*, 425 U.S. 662, 670 n.4 (1976). Exports will also harm the public interest by increasing domestic gas prices, likely increasing global greenhouse gas emissions, and through other adverse effects.

Because Sierra Club's members have a direct interest in ensuring that environmental harms resulting from domestic natural gas production are minimized, and that any exports do not adversely affect domestic consumers, Sierra Club moves to intervene in FE Docket No. 13-116-LNG and protests EOS's application.

I. Sierra Club Should be Granted Intervention

Sierra Club members live and work throughout the area that will be affected by EOS's export proposal, including in the regions of Texas that will be affected by supporting infrastructure. Sierra Club members also live in the domestic gas fields that will likely see increased production as a result of the proposed exports. Sierra Club members everywhere will also be affected by the increased gas prices that would result from completion of proposed LNG export facilities like the EOS FLNG Project. As of February 2014, Sierra Club had 22,239 members in Texas and 610,667 members overall.[1]

To protect our members' interests, Sierra Club moves to intervene in FE Docket No. 13-116-LNG, pursuant to 10 C.F.R. § 590.303. Consistent with that rule, Sierra Club states that its rights and interests in these matters include, but are not limited to, the following:

- The environmental consequences of any gas exports from the EOS FLNG Project, including emissions and other pollution associated with the liquefaction process, environmental damage associated with construction and operation of the facility and associated infrastructure, environmental impacts caused by shipping traffic, and the emissions associated with all phases of the process from production to combustion.
- The environmental and economic consequences of any expansion or change in natural gas production, especially in shale gas plays, as a result of increased gas exports. Members living in these regions will be affected by the damage to air, land, and water resources caused by the increasing development of these plays, and the public health risks caused by these harms.
- The economic impacts of any gas exports from the EOS FLNG Project, whether individually or in concert with exports from other such facilities, including the consequences of price changes upon members' finances, consumer behavior generally, and industrial and electrical generating facilities whose fuel choices may be affected by price changes. Sierra Club, in particular, works to reduce U.S. and global dependence on fossil fuels, including coal, gas, and oil, and to promote clean energy and efficiency in order to protect public health and the environment. To the extent changes in gas prices increase the use and production of coal and oil, Sierra Club's interests in this proceeding are directly implicated.
- The public disclosure, in National Environmental Protection Act and other documents, of all environmental, cultural, social, and economic consequences of EOS's proposal, and of all alternatives to that proposal.

In short, Sierra Club's members have vital economic, aesthetic, spiritual, personal, and professional interests in the expansion project.

The Club has demonstrated the vitality of these interests in many ways. Sierra Club runs national advocacy and organizing campaigns dedicated to reducing American dependence on fossil fuels, including natural gas, and to protecting public health. These

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[1] Attached Declaration of Yolanda Andersen at ¶ 7, attached as Exhibit 1.

campaigns, including its Beyond Coal campaign and its Beyond Natural Gas campaign, are dedicated towards promoting a swift transition away from fossil fuels and to reducing the impacts of any remaining natural gas extraction.

Thus, although 10 C.F.R. § 590.303 states no particular standard for intervention, Sierra Club has interests in these proceedings that would be sufficient to support intervention on any standard. This motion to intervene must be granted.[2]

II. Service

Pursuant to 10 C.F.R. § 590.303, Sierra Club identifies the following persons for service of correspondence and communications regarding these applications.

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III. Sierra Club Protests this Application Because It Is Not In the Public Interest and Is Not Supported by Adequate Environmental and Economic Analysis

Section 3 of the Natural Gas Act provides that DOE/FE cannot authorize exports unless it finds the exports to be in the public interest. 15 U.S.C. § 717b. DOE/FE must consider environmental factors in the course of this public interest analysis. Accordingly, DOE/FE cannot proceed with EOS's application without fully evaluating the environmental impacts of EOS's proposal. The National Environmental Policy Act ("NEPA"), 42 U.S.C. § 4332 *et seq*., provides the congressionally mandated procedure for assessment of these impacts, and NEPA requires that these procedures be completed "at the earliest possible time," *i.e.*, "*before* decisions are made and *before* actions are taken." 40 C.F.R. §§ 1501.2, 1500.1(b) (emphases added). Accordingly, DOE/FE cannot proceed with EOS's request for export authorization until the NEPA process is completed, including preparation of an Environmental Impact Statement.

EOS's application is silent as to important environmental impacts of the proposal. As we explain below, the proposal will cause three categories of significant environmental

[2] If any other party opposes this motion, we respectfully request leave to reply. *Cf.* 10 C.F.R. §§ 590.302, 590.310 (allowing for procedural motions and briefing in these cases).

harm, and these harms must be considered as part of DOE/FE's public interest analysis. First, the construction and operation of the EOS FLNG Project and any other associated infrastructure will directly impact local water quality, habitats, and air quality. Second, the project will induce additional natural gas production in the United States, primarily hydraulic fracturing (fracking) of unconventional gas sources, thus causing the myriad environmental harms associated with such production. Third, the project will increase domestic gas prices, likely causing an increase in coal-fired electricity generation and thus increasing emissions of greenhouse gases, conventional, and toxic air pollutants.

Moreover, DOE/FE must reject EOS's threadbare and wholly unsupported economic arguments in support of its proposal. Contrary to EOS's contentions, the increase in domestic gas prices resulting from LNG export will have adverse and wide-ranging effects on the domestic economy, harming domestic consumers and, as noted above, increasing coal-fired electricity generation. Communities where increased gas production occurs will likely suffer from the "resource curse" and end up worse off than they would have been otherwise. LNG exports will result in net domestic job losses and economic harm to most Americans, overwhelming the purported economic benefits EOS asserts.

For these reasons, the reasons stated in Sierra Club's initial and reply comments on the NERA LNG study,[3] and the other reasons set forth below, Sierra Club files this protest, pursuant to 10 C.F.R. § 590.304.

A. Legal Standards

DOE/FE has significant substantive and procedural obligations to fulfill before it can authorize EOS's export application. Here, we discuss some of these obligations created by the Natural Gas Act, National Environmental Policy Act, Endangered Species Act, and the National Historic Preservation Act before explaining why these obligations preclude EOS's request for authorization.

1. Natural Gas Act

Pursuant to the Natural Gas Act and subsequent delegation orders, DOE/FE must determine whether EOS's proposal to export LNG to nations which have not signed a

[3] DOE/FE has commissioned a two part study of the economic impacts of LNG exports. Energy Information Administration, *Effect of Increased Natural Gas Exports on Domestic Energy Markets*, (2012) ("EIA Export Study"), attached as Exhibit 2; NERA Economic Consulting, *Macroeconomic Impacts of LNG Exports from the United States* (2012) ("NERA Study"), attached as Exhibit 3. Sierra Club and others submitted extensive comments on these studies. Sierra Club Initial NERA Comment, attached as Exhibit 4; Synapse Analysis of NERA Study, attached as Exhibit 5; Sierra Club Reply NERA Comment, attached as Exhibit 6.

free trade agreement (FTA) with the United States is in the public interest.[4] Courts, DOE/FE, and the Federal Energy Regulatory Commission (FERC) all agree that the "public interest" at issue in this provision includes environmental impacts as well as economic impacts.

Section 3 of the Act provides:

> [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 [DOE/FE] authorizing it do so. [DOE/FE] shall issue such order upon application unless, after opportunity for hearing, it finds that the proposed exportation or importation will not be consistent with the public interest.

15 U.S.C. § 717b(a).[5]

Courts interpreting this provision have long held that the "public interest" encompasses the environment. Although the public interest inquiry is rooted in the Natural Gas Act's "fundamental purpose [of] assur[ing] the public a reliable supply of gas at reasonable prices," *United Gas Pipe Line Co v. McCombs*, 442 U.S. 529 (1979), the Natural Gas Act also grants DOE/FE "authority to consider conservation, environmental, and antitrust questions." *NAACP v. Federal Power Comm'n*, 425 U.S. 662, 666 n.4, 670 n.6 (1976).[6] Subsequent cases have explicitly confirmed *NAACP*'s holding that the purposes of the Natural Gas Act include environmental issues. *See, e.g. Pub. Utilities Comm'n of State of Cal. v. F.E.R.C.*, 900 F.2d 269, 281 (D.C. Cir. 1990). In interpreting an analogous public interest provision applicable to hydroelectric power and dams, the Court has explained that the public interest determination "can be made only after an exploration of all issues relevant to the 'public interest,' including future power demand and supply, alternate sources of power, the public interest in preserving reaches of wild rivers and wilderness areas, the preservation of anadromous fish for commercial and recreational purposes, and the protection of wildlife." *Udall v. Fed. Power Comm'n*, 387 U.S. 428, 450 (1967) (interpreting § 7(b) of the Federal Water Power Act of 1920, as amended by the Federal Power Act, 49 Stat. 842, 16 U.S.C. § 800(b)). Other courts have applied *Udall*'s

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[4] The Natural Gas Act separately provides that DOE/FE must approve exports to nations that have signed a free trade agreement requiring national treatment for trade in natural gas "without modification or delay." 15 U.S.C. § 717b(c).

[5] The statute vests authority in the "Federal Power Commission," which has been dissolved. DOE/FE has been delegated the former Federal Power Commission's authority to authorize natural gas exports. Department of Energy Redelegation Order No. 00-002.04E (Apr. 29, 2011). *See also* Executive Orders 12038 & 10485 (vesting any executive authority to allow construction of export facility in the Federal Power Commission and its successors).

holding to the Natural Gas Act. *See, e.g.*, *N. Natural Gas Co. v. Fed. Power Comm'n*, 399 F.2d 953, 973 (D.C. Cir. 1968) (interpreting section 7 of the Natural Gas Act).[7]

DOE and FERC have also acknowledged the breadth of the public interest inquiry and recognized that it encompasses environmental concerns. DOE recently explained that factors weighing on the public interest "include economic impacts, international impacts, security of natural gas supply, and environmental impacts, among others."[8] DOE rules require export applicants to provide information documenting "[t]he potential environmental impact of the project." 10 C.F.R. § 590.202(b)(7). DOE Delegation Order No. 0204-111 interpreted the NGA's public interest standard to require consideration of matters beyond the mere "domestic need for the gas to be exported."[9] Similarly, in FERC's recent order approving siting, construction, and operation of LNG export facilities in Sabine Pass, Louisiana, FERC considered potential environmental impacts of the terminal as part of its public interest assessment, which is analogous to DOE/FE's.[10]

DOE/FE must also reject EOS's invocation of DOE/FE's outdated *import* guidance. EOS refers without citation to DOE/FE's "Policy Guidelines," presumably in reference to *Policy Guidelines and Delegation Orders Relating to the Regulation of Imported Natural Gas*, 49 Fed. Reg. 6,684 (Feb. 22, 1984). EOS App. at 12. These outdated guidelines are inapplicable to export proposals. The primary issue confronted therein was whether to directly regulate prices at which gas could be imported from Canada.[11] DOE/FE determined that, if U.S. buyers were willing to pay market rates for imported gas, this would generally demonstrate a need for that gas.[12] This reasoning does not apply to exports. It would be nonsensical to assume that a foreign purchaser's willingness to pay for gas exported from the United States provides a presumptive indication that there was not a domestic need for that gas. Similarly, a foreign purchaser's willingness to pay for U.S. exports is independent of the environmental impacts that will result from

[7] Further support for the inclusion of environmental factors in the public interest analysis is provided by NEPA, which declares that all federal agencies must seek to protect the environment and avoid "undesirable and unintended consequences." 42 U.S.C. § 4331(b)(3).

[8] 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, 6 (May 17, 2013) (hereinafter "Freeport Conditional Authorization"); accord *Phillips Alaska Natural Gas Corporation and Marathon Oil Company*, 2 FE ¶ 70,317, DOE FE Order No. 1473, 1999 WL 33714706, *22 (April 2, 1999) (specifically enumerating environmental concerns as a factor in the public interest analysis).

[9] DOE Delegation Order No. 0204-111, at 1, 49 Fed. Reg. 6686, 6690 (Feb. 22, 1984). This order has been rescinded, but DOE/FE continues to cite it in discussing export applications. *See, e.g.,* Freeport Conditional Authorization, DOE/FE Order 3282, at 7.

[10] 139 FERC ¶ 61,039, PP 29-30 (Apr. 14, 2012). Sierra Club contends that other aspects of this order were wrongly decided, as was FERC's subsequent denial of Sierra Club's petition for rehearing, as we explain below.

[11] 49 Fed. Reg. at 6,684-85.

[12] *Id.*

producing that gas: because DOE/FE must consider the latter as part of its public interest analysis, DOE/FE cannot simply presume that the market will reflect the public interest. Sierra Club recognizes that DOE/FE has referred to this guidance in prior export proceedings, but in those proceedings, DOE/FE neither acknowledged nor discussed these differences between imports and exports.[13]

Finally, although DOE/FE has adopted a presumption that LNG export applications are consistent with the public interest, this presumption is rebuttable and not determinative. The D.C. Circuit has explained to DOE/FE that this presumption is "highly flexible, creating *only* rebuttable presumptions and leaving parties free to assert other factors." *Panhandle Producers & Royalty Owners Ass'n v. Economic Regulatory Admin.*, 822 F.2d 1105, 1110-11, 1113 (D.C. Cir. 1987) (emphasis added) (internal quotation marks omitted). Put differently, although DOE/FE may "presume" that an application should be granted, this presumption is not determinative, and DOE/FE retains an independent duty to determine whether an application is, in fact, in the public interest. *See* 10 C.F.R. § 590.404.

2. National Environmental Policy Act

NEPA requires federal agencies to consider and disclose the "environmental impacts" of proposed agency actions. 42 U.S.C. § 4332(C)(i). Agencies must "carefully consider [ ] detailed information concerning significant environmental impacts" and NEPA "guarantees that the relevant information will be made available" to the public. *Dep't of Transp. v. Public Citizen*, 541 U.S. 752, 768 (2004) (quoting *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349 (1989)). This requirement is implemented via a set of procedures that "insure that environmental information is available to public officials and citizens *before* decisions are made and *before* actions are taken." 40 C.F.R. § 1500.1(b) (emphases added). The Council on Environmental Quality (CEQ) directs agencies to "integrate the NEPA process with other planning at the earliest possible time to insure that planning and decisions reflect environmental values." 40 C.F.R. § 1501.2. "It is DOE's policy to follow the letter and spirit of NEPA; comply fully with the [CEQ] Regulations and apply the NEPA review process early in the planning stages for DOE proposals." 10 C.F.R. § 1021.100. DOE has adopted CEQ's NEPA regulations in full. *Id.* § 1021.103. The NEPA rules apply to "any DOE action affecting the quality of the environment of the United States, its territories or possessions." *Id.* § 1021.102.

For purposes of the intersection of NEPA and the NGA, the NGA designated the former Federal Power Commission as the "lead agency" for NEPA purposes. 15 U.S.C. § 717n. The lead agency prepares NEPA documents for an action that falls within the jurisdiction of multiple federal agencies. FERC has since generally filled that role for LNG export and

[13] *See, e.g.*, Freeport Conditional Authorization, Order 3282 at 112, Phillips Alaska, Order 1472, Sabine Pass, Order 2961.

import decisions. *See* 10 C.F.R. § 1021.342 (providing for interagency cooperation). Whether or not FERC takes a lead role, however, DOE's ultimate NEPA obligations are the same: DOE may not move forward until the full scope of the action *it* is considering – here, the approval of LNG export – has been properly considered. Thus, if the NEPA analysis FERC prepares in its capacity as lead agency is inadequate to fully inform DOE/FE's decision or discharge DOE/FE's NEPA obligations, DOE/FE must prepare a separate EIS.[14]

NEPA requires preparation of an "environmental impact statement" (EIS) where, as here, the proposed major federal action would "significantly affect[] the quality of the human environment." 42 U.S.C. § 4332(C). DOE/FE regulations similarly provide that "[a]pprovals or disapprovals of authorizations to import or export natural gas . . . involving major operational changes (such as a major increase in the quantity of liquefied natural gas imported or exported)" will "normally require [an] EIS." 10 C.F.R. Part 1021, Appendix D, D9. As we explain below, an EIS is required here.

An EIS must describe:

i. the environmental impact of the proposed action,

ii. any adverse environmental effects which cannot be avoided should the proposal be implemented,

iii. alternatives to the proposed action,

iv. the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

v. any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

42 U.S.C. § 4332(C). The alternatives analysis "is the heart of the environmental impact statement." 40 C.F.R. § 1502.14. Here, the proposed action is to export additional LNG from the proposed expanded facility; DOE/FE must consider alternatives to this action. DOE/FE must take care not to define the project purpose so narrowly as to prevent the consideration of a reasonable range of alternatives. *See, e.g.*, *Simmons v. U.S. Army*

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[14] *See Sabine Pass LNG*, FERC Dkt. CP11-72-001, 140 FERC ¶ 61,076 P 32 (July 26, 2012) ("DOE has separate statutory responsibilities with respect to authorizing the export of LNG from Sabine Pass; thus it has an independent legal obligation to comply with NEPA."), DOE/FE Dkt. 10-111-LNG, Order 2961-A, 27 (Aug. 7, 2012) (DOE/FE recognizes that it is "responsible for conducting an independent review" of FERC's analysis and determining whether "the record needs to be supplemented in order for DOE/FE to meets its statutory responsibilities under section 3 of the NGA and under NEPA.").

Corps of Eng'rs, 120 F.3d 664, 666 (7th Cir. 1997). If it did otherwise, it would lack "a clear basis for choice among options by the decisionmaker and the public." *See* 40 C.F.R. § 1502.14.

An EIS must also describe the direct and indirect effects and the cumulative impacts of a proposed action. 40 C.F.R §§ 1502.16, 1508.7, 1508.8; *N. Plains Resource Council v. Surface Transp. Bd.*, 668 F.3d 1067, 1072-73 (9th Cir. 2011). These terms are distinct from one another: Direct effects are "caused by the action and occur at the same time and place." 40 C.F.R. § 1508.8(a). Indirect effects are also "caused by the action" but:

> are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effect on air and water and other natural systems, including ecosystems.

40 C.F.R. § 1508.8(b). Cumulative impacts, finally, are not causally related to the action. Instead, they are:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

40 C.F.R. § 1508.7. The EIS must give each of these categories of effect fair emphasis.

Agencies may also prepare "programmatic" EISs, which address "a group of concerted actions to implement a specific policy or plan; [or] systematic and connected agency decisions allocating agency resources to implement a specific statutory program or executive directive." 40 C.F.R. § 1508.17(b)(3); *see also* 10 C.F.R. § 1021.330 (DOE regulations discussing programmatic EISs). As we discuss below, such an EIS is appropriate here.

Finally, while an EIS is being prepared "DOE shall take no action concerning the proposal that is the subject of the EIS" until the EIS is complete and a formal Record of Decision has been issued. 10 C.F.R. § 1021.211. During this time, DOE may take no action which would tend to "limit the choice of reasonable alternatives," or "tend[] to determine subsequent development." 40 C.F.R. § 1506.1.

3. Endangered Species Act

The Endangered Species Act (ESA) directs that all agencies "shall seek to conserve endangered species." 16 U.S.C. § 1531(c)(1). Consistent with this mandate, DOE/FE must ensure that its approval of EOS's proposal "is not likely to jeopardize the continued existence of any endangered species . . . or result in the destruction or adverse modification of [critical] habitat of such species." 16 U.S.C. § 1536(a)(2). "Each Federal agency shall review its actions at the earliest possible time to determine whether any action may affect listed species or critical habitat." 50 C.F.R. § 402.14(a); *see also* 16 U.S.C. § 1536(a)(2).

Here, DOE/FE's section 1536 inquiry must be wide-ranging, because EOS's export proposal will increase gas production across the Gulf region, if not nationwide. Thus, DOE/FE must consider not just species impacts at the proposed project site (although it must at least do that), but the effects of increased gas production across the full region the terminal affects.

To make this determination, DOE/FE should, first, conduct a biological assessment, including the "results of an on-site inspection of the area affected," "[t]he views of recognized experts on the species at issue," a review of relevant literature, "[a]n analysis of the effects of the action on the species and habitat, including consideration of cumulative effects, and the results of any related studies," and "[a]n analysis of alternate actions considered by the Federal agency for the proposed action." *See* 50 C.F.R. § 402.12(f). If that assessment determines that impacts are possible, DOE/FE must enter into formal consultation with the Fish and Wildlife Service and the National Marine Fisheries Service, as appropriate, to avoid jeopardy to endangered species or adverse modification of critical habitat as a result of its approval of EOS's proposal. 16 U.S.C. § 1536(a), (b).

4. National Historic Preservation Act

DOE/FE must also fulfill its obligations under the National Historic Preservation Act (NHPA) to "take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register." 16 U.S.C. § 470f; *see also Pit River Tribe v. U.S. Forest Serv.*, 469 F.3d 768, 787 (9th Cir. 2006) (discussing the requirements of the NHPA). Because "the preservation of this irreplaceable heritage is in the public interest," 16 U.S.C. § 470(b)(4), it behooves DOE/FE to proceed with caution.

DOE/FE must, therefore, initiate the NHPA section 106 consultation and analysis process in order to "identify historic properties potentially affected by the undertaking, assess its effects and seek ways to avoid, minimize or mitigate any adverse effects on historic properties." 36 C.F.R. § 800.1(a). NHPA regulations make clear that the scope of a proper analysis is defined by the project's area of potential effects, *see* 36 C.F.R. § 800.4, which in turn is defined as “the geographic area . . . within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties,” 36 C.F.R. § 800.16(d). This area is “influenced by the scale and nature of an undertaking.” *Id.* The area of potential effects should sweep quite broadly here because, as in the ESA and NEPA contexts, the reach of EOS’s proposal extends to the entire area in which it will increase gas production. Thus, to approve EOS’s proposal, DOE/FE must first understand and mitigate its impacts on any historic properties which it may affect. *See also* DOE Policy P.141.1 (May 2001) (providing that DOE will fully comply with the NHPA and many other cultural resources preservation statutes).

The regulations governing this process provide that “[c]ertain individuals and organizations with a demonstrated interest in the undertaking may participate as consulting parties” either “due to the nature of their legal or economic relation to the undertaking or affected properties, or their concern with the undertaking’s effects on historic properties.” 36 C.F.R. § 800.2(c)(5). Sierra Club meets that test, because the organization and its members are interested in preserving intact historic landscapes for their ecological and social value, and reside through the regions affected by the EOS’s proposal. Our members have worked for years to protect and preserve the rich human and natural fabric of these regions, and would be harmed by any damage to those resources. Sierra Club must therefore be given consulting party status under the NHPA for this application.

B. DOE/FE’s NEPA, NGA, and Other Analyses Must Consider the Broad Context of All Pending Export Applications, Pipelines, and Studies

As explained above, the NGA, NEPA, ESA and NHPA all require DOE/FE’s determination to be informed by the context in which the proposed project would occur. DOE/FE’s analysis must not be confined to local, direct effects of the particular applications; DOE/FE must consider the broader constellation of indirect and cumulative effects. Here, to accurately analyze EOS’s application in context, DOE/FE must also take into account the other LNG export proposals pending before DOE/FE and FERC. This broader backdrop of related and similar projects must inform the NEPA alternatives analysis. Finally, DOE/FE must not grant any authorization (final or conditional) prior to completion of the NEPA process, including the above analyses.[15]

1. A Full EIS Is Required

The proposed EOS FLNG Project would have severe adverse environmental impacts, plainly surpassing the threshold of “significance” that mandates preparation of a full EIS, rather than an Environmental Assessment. NEPA requires an EIS where a proposed

[15] Similarly, Sierra Club protests any request for final, rather than conditional, authorizations prior to completion of NEPA review.

major federal action would "significantly affect[] the quality of the human environment." 42 U.S.C. § 4332(C). The effects that must be considered as part of the NEPA analysis, including the significance determination, include the project's direct, indirect, and cumulative environmental impacts, including "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, [and] economical" impacts. 40 C.F.R. § 1508.8. The agency must assess the significance of those impacts in light of "considerations of both context and intensity." *Id.* § 1508.27. The pertinent contexts range from short-term local impacts to regional and global impacts. 40 C.F.R. § 1508.27(a); *The Mountaineers v. U.S. Forest Serv.*, 445 F. Supp. 2d 1235, 1245 (W.D. Wash. 2006) (noting the mandate to consider both local and regional impacts). Intensity "refers to the severity of the impact" and involves factoring in ten considerations, enumerated in 40 C.F.R. § 1508.27(b), including effects on public health and safety, controversy or uncertainty regarding effects on the environment, and the cumulative effects of the action and other related actions. If there is a "substantial question" as to the severity of impacts, an EIS must be prepared. *See Klamath Siskiyou Wildlands Ctr. v. Boody*, 468 F.3d 549, 561-62 (9th Cir. 2006) (holding that the "substantial question" test sets a "low standard" for plaintiffs to meet). Considerations of both context and intensity militate in favor of preparing an EIS for the Project.

Here, the proposed exports and the EOS FLNG Project would have severe adverse environmental impacts, plainly surpassing the threshold of "significance" that mandates preparation of a full EIS. As we explain elsewhere, LNG exports will induce additional gas production that, every year, will potentially emit millions of tons of methane pollution, emit tens of thousands of tons of VOC and hazardous air pollutants, and require of hundreds of millions of tons of fresh water.[16] DOE/FE regulations categorically state that "[a]pprovals or disapprovals of authorizations to import or export natural gas . . . involving major operational changes (such as a major increase in the quantity of liquefied natural gas imported or exported)" will "normally require [an] EIS." 10 C.F.R. Part 1021, Appendix D, D9. We further note that for all greenfield LNG export projects, such as this one, where FERC has issued a notice of intent regarding NEPA review, FERC is undertaking a full EIS.

2. DOE/FE Must Consider the Cumulative Effect of All Pending Export Proposals, and DOE/FE Should Do So with a Programmatic EIS

EOS's export proposal is only one of many export applications recently approved or currently pending before DOE/FE. Because the effects of these projects are cumulative, and because each approval alters the price and production effects of exports, DOE/FE must consider these projects' cumulative impacts. The public, after all, will not experience each proposed terminal as an individual project: It will experience them

[16] Sierra Club, *et al.*, comment on NERA Macroeconomic Study at 32, 40.

cumulatively, through the gas and electricity prices that they will raise and the environmental damage that they will cause. All analysts and observers have agreed, for example, that higher volumes of exports will cause greater gas price increases. Indeed, several models indicate that prices increase non-linearly with export volumes. That is, going from 4 to 6 bcf/d in exports, for example, may impact domestic prices more than going from 0 to 2 bcf/d.[17]

Accordingly, as DOE/FE and EPA have acknowledged, DOE/FE's NGA, NEPA, and other analyses must consider the full range of pending export proposals, and the cumulative impacts thereof. This must include the full 35.58 bcf/d of exports to non-free trade agreement nations for which applications have been filed with DOE/FE,[18] and rather than merely a subset of exports that DOE/FE determines to be most likely to occur. Indeed, there are 23.21 bcf/d of other nFTA export applications that will be reviewed by DOE/FE *prior to* EOS's pending application.[19] NEPA requires consideration of this full export volume, prohibiting DOE/FE from granting this application or others on the assumption that the authorized activity will not actually occur. Under NEPA, an agency may only exclude analysis of an event and its consequences when the event "is so 'remote and speculative' as to reduce the effective probability of its occurrence to zero." *See New York v. NRC*, 681 F.3d 471, 482 (D.C. Cir. 2012); *see also San Luis Obispo Mothers for Peace v. Nuclear Regulatory Comm'n*, 449 F.3d 1016, 1031 (9th Cir. 2006) (same). Here, DOE/FE cannot rule out as speculative the possibility of all proposed exports occurring. We note that in similar proceedings EPA has explicitly requested consideration of this broader context. EPA, *Scoping Comments – The Jordan Cove Energy Project LP*, FERC Dkts. PF12-7 and PF12-17, at 3 (Oct. 29, 2012) ("[W]e recommend discussing the proposed project in the context of the larger energy market, including existing export capacity *and export capacity under application to the Department of*

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[17] Robert Brooks, *Using GPCM to Model LNG Exports from the US Gulf Coast* 5 (2012), available at http://www.rbac.com/press/LNG%20Exports%20from%20the%20US.pdf, attached as **Exhibit 7**. Deloitte Marketpoint LLC has similarly predicted that doubling exports will more than double price impacts thereof. Deloitte MarketPoint, *Analysis of Economic Impact of LNG Exports from the United States*, at 3, 24 ("Deloitte Study"), attached as Exhibit 8 (originally filed as Appendix F to Excelerate Liquefaction Solutions I, LLC, *Application for Long-Term, Multi-Contract Authorization to Export Liquefied Natural Gas to Non-Free Trade Agreement Countries*, DOE/FE Dkt. 12-146-LNG (Oct. 5, 2012)). One reason prices may increase this way is that domestic gas consumers differ in their ability to reduce gas consumption. Robert Brooks, *Using GPCM to Model LNG Exports from the US Gulf Coast*, 7 (2012). As export volumes increase, increasing numbers of inflexible domestic consumers are forced to compete with exports, further driving up prices. When export volumes are lower, by contrast, price-sensitive domestic consumers can respond to price increases by reducing their consumption, freeing gas supplies for exports and limiting price impacts. The Brooks study predicts significantly higher price increases than the EIA study. *Id.* at 5, 7.

[18] Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of Jan. 22, 2014) attached as Exhibit 9.

[19] *See* "Pending Long-Term Applications to Export LNG to Non-FTA Countries - Listed in Order DOE Will Commence Processing – last revised 12/6/13," available at http://energy.gov/sites/prod/files/2013/09/f2/Pending%20LT%20LNG%20Export%20Apps%20%289-10-13%29.pdf, attached as Exhibit 10.

Energy, and clearly describe how the need for the proposed action has been determined.”),[20] EPA, *Scoping Comments – Cove Point Liquefaction Project*, FERC Dkt. PF12-16-000, at 2 (Nov. 15, 2012) (“We recommend discussing the proposed project in the context of the broader energy market, *including existing and proposed LNG export capacity*.”),[21] EPA, *Scoping Comments – The Oregon LNG Export Project and Washington Expansion Project*, FERC Dkts. PF12-18 and PF12-20, at 3 (Dec. 26, 2012).[22]

Although it is not certain that all proposed projects will be approved or that all approved projects actually will be completed, these uncertainties do not justify excluding pending proposals from cumulative impacts review. On the first issue, DOE’s obligation is to understand the impacts of proposed projects and decide whether to approve them all in light of these impacts. Analyzing the proposals’ cumulative impacts does not require DOE to assume that all proposed projects will be approved; instead, it informs DOE of potential consequences so that it can decide *whether* to approve all proposals or only a subset. A number of courts have held that agencies must consider the cumulative impacts of proposed projects together with other pending proposals. *See NRDC v. Callaway*, 524 F.2d 79, 87 (2d Cir. 1975) (holding that the cumulative impacts analysis for a proposed dredge spoil dumping project should have included another dredge spoil project that was still “subject to approval and funding by Congress”); *People ex rel. Van de Kamp v. Marsh*, 687 F. Supp. 495, 500 (N.D. Cal. 1988) (stating that, in cumulative impacts analysis, “[t]he agency must consider other proposals” and even “contemplated actions that are not yet formalized proposals”); *see also Kleppe v. Sierra Club*, 427 U.S. 390, 410 (1976) (holding, in a related context, that “when several *proposals* for . . . related actions that will have cumulative or synergistic environmental impact . . . are pending concurrently before an agency, their environmental consequences must be considered together”) (emphasis added).

Second, even though it is not certain that all exports DOE approves will occur, this uncertainty does not excuse the obligation to analyze pending projects’ cumulative impacts. If it did, agencies could avoid analysis of future projects in almost every case, by reasoning that market factors out of their control could prevent them from being constructed. Here, every good faith export applicant believes that its proposed project is feasible. DOE therefore must analyze the cumulative impact of all proposals together.

If DOE/FE looks—wrongly—only at the range of exports it deems likely to occur, DOE/FE must not underestimate this likelihood. The NERA study, for example, understates the market for likely exports. NERA concluded that exports would only occur when the spread between US gas prices and prices in potential foreign markets exceeded the cost of liquefying, transporting, and regassifying US produced gas. But NERA overstates these

[20] Attached as Exhibit 11 (emphasis added).
[21] Attached as Exhibit 12 (emphasis added).
[22] Attached as Exhibit 13.

transaction costs and ignores the ways in which "take-or-pay" contracts that appear likely to dominate this industry will distort this market.

As to transaction costs, proposed West Coast terminals will have significantly lower costs for export to Asia than will the Gulf Coast facilities NERA considered. The proposed Jordan Cove Energy Project explained that its transportation costs to Japan were significantly lower than those assumed by the NERA Study. Although Jordan Cove Energy Project would face higher facility construction and thus liquefaction costs than Gulf Coast facilities, Jordan Cove asserts that, in aggregate, its total processing and transportation costs will be $0.44/MMBtu lower than the estimates used by NERA.[23] Accordingly, insofar as the cost of processing and transporting LNG sets the ceiling on price increases resulting from exports, that ceiling could be $0.44/MMBtu higher than the NERA Study estimates. $0.44/MMBtu represents roughly 5 to 10% of NERA's predicted 2035 wellhead gas prices, meaning NERA may have significantly underestimated the price range within which exports will occur.[24] Although Sierra Club raised this argument in its initial and reply comments on the NERA study,[25] DOE/FE did not address it in the Freeport Conditional Authorization.[26]

As to contract structure, previous export applicants have adopted "take or pay" liquefaction services arrangements, wherein would-be importers will be required to pay a fee to reserve terminal capacity, regardless of whether that capacity is actually used to liquefy and export gas.[27] The "pay" provision constitutes a sunk cost that will effectively raise the price ceiling under which exports will occur. For example, if the cost to liquefy, transport, and regassify gas is $4/MMBtu, but an importer has entered a "take or pay" contract reserving terminal capacity but requiring payment of $1.50/MMBtu[28] for unused capacity, the importer will have an incentive to import gas so long as the spread between US and foreign prices exceeds $2.50/MMBtu, whereas NERA predicts that no exports will occur once the price spread falls below $4/MMBtu. Exports may continue to occur – and domestic prices may therefore continue to rise – even where NERA predicts that exports will cease.[29]

The pending export proposals' cumulative impacts would be best examined through a programmatic EIS. Such a programmatic EIS would allow DOE and the public to

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[23] Comment of Jordan Cove Energy Project at 2.
[24] NERA Study, *supra* n.3 at 50.
[25] Sierra Club Initial NERA Comment, *supra* n.3, at 12-13, Sierra Club Reply NERA Comment, *supra* n.3, at 11-12.
[26] Freeport Conditional Authorization at 95.
[27] *See Sabine Pass* DOE Order No. 2961, at 4 (May 20, 2011); Cheniere Energy April 2011 Marketing Materials, *available at* http://tinyurl.com/cqpp2h8 (last visited Jan. 13, 2013), at 14.
[28] Within the $1.40 to $1.75/MMBtu range of "capacity fees" contemplated by Sabine Pass's parent company, Cheniere Energy April 2011 Marketing Materials at 14.
[29] *See* NERA Study, *supra* n.3, at 37-46.

understand these proposals' relationship and their cumulative environmental and economic impacts, thus improving DOE's ability to make informed decisions on export terminal applications and allowing DOE, the public, and industry to identify prudent alternatives to serve the public interest and minimize environmental impacts. In acting on the many pending LNG export applications, DOE/FE is making what is functionally a programmatic decision to radically alter the U.S. natural gas market by allowing for large-scale LNG export. DOE/FE has already acknowledged that a programmatic approach is appropriate for discussion of the economic impacts of exports, commissioning nationwide studies of the impacts of exports from EIA and NERA. Environmental impacts should be similarly analyzed.

In summary, to determine whether EOS's export proposal is consistent with the public interest, DOE/FE must consider not only the effect of the particular proposal, but the effect of that proposal in conjunction with all proposals so far approved and all reasonably foreseeable future proposals. Moreover, this analysis must examine the possibility that all proposals that receive approval will export to the fully authorized extent.

3. The Alternatives Analysis Must Consider This Broader Context

Both NEPA and the NGA require DOE/FE to fully consider alternatives to EOS's proposal. Specifically, the NGA public interest analysis requires an "exploration of all issues relevant to the 'public interest'," an inquiry which the Supreme Court held in *Udall* must be wide-ranging. In that case, which concerned hydropower, the regulatory agency was required to consider, for instance, "alternate sources of power," the state of the power market generally, and options to mitigate impacts on wildlife. 387 U.S. at 450. Here, likewise, DOE/FE must consider alternatives to EOS's export proposal that would better serve the public interest, broadly analyzing other approaches to structuring LNG exports and gas use generally, given exports' sweeping effects on the economy.

NEPA is designed to support this sort of broad consideration. As mentioned, the alternatives analysis is "the heart of the environmental impact statement," designed to offer "clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. § 1502.14. Crucially, the alternatives must include "reasonable alternatives not within the jurisdiction of the lead agency," and must include "appropriate mitigation measures not already included in the proposed action or alternatives." *Id.* Because alternatives are so central to decisionmaking and mitigation, "the existence of a viable but unexamined alternative renders an environmental impact statement inadequate." *Oregon Natural Desert Ass'n*, 625 F.3d at 1122 (internal alterations and citations omitted).

Here, DOE/FE must consider a broad range of alternatives to EOS's proposal, including alternatives that would alter or minimize the economy-wide impacts of the many pending export proposals. Even if DOE/FE does not have jurisdiction to directly order implementation of some of these alternatives, it must include them nonetheless.

DOE/FE should consider, at a minimum and without limitation, the following alternatives:

(1) Whether, consistent with the EIA Export Study, exports, if allowed, should move forward in smaller quantities or on a slower time table to mitigate the domestic economic and environmental impacts associated with large export volumes or rapid export schedules;

(2) Whether export from other locations would better serve the public interest by mitigating or better distributing economic or environmental impacts;

(3) 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;

(4) 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;

(5) 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);

(6) 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 Subcommittee);

(7) Whether to permit exports only if the export facilities are designed and operated so as to minimize their environmental impacts, including, for example, using electric motors to drive liquefaction compressors;

(8) Whether to deny export proposals altogether as contrary to the public interest.

Other alternatives are no doubt also available, but DOE/FE must at a minimum consider the possibilities listed above, as they are reasonable and bear directly on the public interest determination before it.

4. DOE/FE May Not Conditionally Approve EOS's Proposal Prior to NEPA Review

DOE/FE must reject EOS's request for a conditional order prior to NEPA review. EOS App. at 9. As we have discussed at length above, DOE/FE cannot complete a public interest determination without weighing environmental factors. Because these factors are integral to DOE/FE's decision, DOE/FE must weigh environmental interests at the same time that it weighs all other interests. It may not parcel them into a separate process without irrationally ignoring important aspects of the problem before it. Thus, although DOE regulations permit "conditional" orders in general, *see* 10 C.F.R. § 590.402, this authority cannot extend to the specific context of LNG export authorizations. Indeed, because an EIS is required here, *see supra*, section III.B.1, DOE regulations specifically prohibit taking any action prior to completion of the EIS. 10 C.F.R. § 1021.211. Although DOE has granted conditional authorization in four recent LNG export proceedings, DOE did so without considering section 1021.211's prohibition on action pending completion of an EIS.

Section 1021.211 explicitly provides that DOE "*shall take no action*" concerning a proposal that is the subject of an EIS until the EIS is completed. 10 C.F.R. § 1021.211 (emphasis added).[30] Similarly, CEQ's generally applicable NEPA regulations prohibit agencies from taking any action on a proposal prior to completion of NEPA review if that action if that action tends to "limit the choice of reasonable alternatives," or "determine subsequent development." 40 C.F.R. § 1506.1. Here, because an EIS is required but has not yet been completed, DOE/FE cannot issue a conditional authorization now. A conditional approval would limit alternatives, and determine subsequent choices, in precisely the manner the regulations forbid.

DOE/FE has not addressed this regulation in its recent conditional authorizations in other proceedings. Most recently, DOE/FE conditionally authorized exports to nFTA countries pursuant to Freeport LNG Expansion's application in docket 11-161-LNG. Order 3357. There, as here, Sierra Club intervened and argued that conditional authorization prior to NEPA review was improper. DOE/FE rejected this argument without considering 10 C.F.R. § 1021.211's specific prohibition on "any action" pending completion of an EIS.

Issuing a conditional authorization now would similarly violate 40 C.F.R. § 1506.1's prohibition on actions that tend to limit the choice of reasonable alternatives, as demonstrated by the narrow scope of alternatives FERC reviewed in the original Sabine Pass proceeding. There, DOE/FE's approval, even if nominally "conditional," plainly influenced the NEPA process. In the Sabine Pass Environmental Assessment, although

[30] Although this regulation states that it applies when "DOE is preparing an EIS that is required" under NEPA, it should be interpreted as applying to any proposed DOE action that is a "major action" requiring preparation of an EIS, regardless of whether the EIS is authored by DOE or another agency.

FERC acknowledged that DOE/FE was making a broad public interest determination, FERC functionally treated DOE/FE's decision as already made. As such, in its alternatives analysis, FERC summarily rejected the "no-action" alternative because "the no-action alternative could not meet the purpose and need for the Project."[31] This statement reveals FERC's belief that DOE/FE had already made its decision, and thus that the EA was not truly designed assist DOE/FE in deciding *whether* to allow gas exports. An analysis premised on the understanding that the decision had *not* been made after the conditional approval would not have summarily ruled out the no-action alternative. The fact that FERC felt that it was not free to give the no-action alternative serious consideration indicates that conditional approvals in fact tend to limit alternatives and influence decisionmaking.

To avoid placing premature and illegal restrictions on its decisionmaking, DOE/FE may not approve EOS's export proposal, conditionally or finally, until it has considered the effects of the proposal and the alternatives to it through the NEPA and NGA processes.

C. EOS's Proposal Will Have Numerous Harmful Environmental and Other Effects and Is Contrary to The Public Interest

EOS's proposal is inconsistent with the public interest. Environmentally, the proposal will harm the environment around the LNG liquefaction facility and export terminal site, in the gas plays where additional production occurs, nationwide as it induces additional coal use, and globally as it increases greenhouse gas emissions. These environmental injuries all cause economic damage as well. In terms of more purely economic impact, the proposal will raise domestic gas prices, eliminate jobs in manufacturing and other domestic industries, disrupt communities, and regressively transfer wealth from working class families to large corporations. Available evidence indicates that even when these environmental and intra-US distributional effects are ignored (although they must not be), LNG exports will likely have a negative impact on GDP and other measures of aggregate welfare.[32] Each of these adverse impacts requires additional consideration in the NEPA process and in DOE/FE's ongoing review of the economic impacts of gas exports. Even the evidence of adverse impacts available now, however, greatly overwhelms EOS's cursory assertion that its proposal will provide economic benefits.

The environmental harms caused by EOS's proposal can be divided into three categories: direct effects of the LNG liquefaction facility, export terminal and associated infrastructure; indirect effects of the additional gas production the project will induce;

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[31] FERC, *Environmental Assessment for the Sabine Pass Liquefaction Project*, Dkt. CP11-72, at 3-1 (2011) ("Sabine Pass EA").

[32] *See* Kemal Sarica & Wallace E. Tyner, *Economic and Environmental Impacts of Increased US Exports of Natural Gas* (Purdue Univ., Working Paper, 2013) (available from the authors); *see also* Wallace Tyner, Initial Comment on NERA Study (Jan. 14, 2013) (summarizing the results of the above study), attached as Exhibit 14.

and non-localized indirect effects resulting from increased domestic gas prices, increases in coal combustion, and possible increases in global fossil fuel consumption. As we explain below, each of these categories of effects must be considered in DOE/FE's NEPA and NGA analyses, and each weighs against finding that the proposed project is consistent with the public interest.[33] Somewhat separate from these environmental impacts are the harms to US communities and employees as a result of the proposed exports.

We note that impacts caused by increased gas production are, in a sense, inversely related to impacts related to increased domestic coal consumption and increased domestic gas prices. Gas exported as LNG must come from somewhere. To the extent that exported gas does not come from increased domestic production, it must come from decreased domestic consumption. EIA has determined that the primary reduction in consumption would come from the electricity generating sector, and that this sector will primarily reduce its gas use by switching to coal. Thus, the consequence of LNG exports will primarily be increased gas production or increased coal consumption.

In light of these costs and a more sober assessment of the project's benefits, if DOE/FE were to make a decision on the available record, DOE/FE would have to conclude that these impacts outweigh any possible benefit of the project.

1. Local Environmental Impacts

EOS proposes to construct a LNG liquefaction facility and export terminal at the Port of Brownsville in Brownsville, Texas. EOS App. at 7. Facilities at the proposed site include a floating LNG liquefaction unit, an existing LNG tanker to be used for storage, mooring hooks, high pressure gas and LNG transfer arms, and cable connections for electrical power, communications and emergency responses. *Id.* Construction and operation of these liquefaction and export facilities and related infrastructure will have a range of adverse environmental effects. Sierra Club cannot provide a thorough discussion of local impacts in this filing, because the precise nature and extent of these impacts will depend on the final site design and plan, which EOS has not yet provided. However, these effects undoubtedly impact the public interest; DOE/FE must consider these impacts in its public interest analysis; and Sierra Club, together with the broader public, must be given an opportunity to comment on these issues once additional information is available. At this time, we identify the types of issues that the facility is likely to have, informed by the designs of other facilities and the permitted but not yet complete liquefaction trains, export terminals and related infrastructure currently under construction at other LNG export terminals. Adverse environmental effects include (but

[33] Sierra Club anticipates providing additional information regarding these impacts as part of the NEPA process, when additional information regarding the proposal, and FERC's assessment thereof, is made available.

are not limited to) air pollution, disruption of aquatic habitat, increased noise and light pollution, and impacts on fish and wildlife related to the preceding impacts. These impacts must be considered in both the NEPA analysis and in DOE/FE's public interest determination.

a. Local Air Emissions

Whatever design is ultimately used, both construction[34] and operation of the floating liquefaction unit, export terminal and associated infrastructure will emit harmful quantities of carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic chemicals (VOC), and greenhouse gases (GHGs), and will likely emit harmful sulfur dioxides (SO_x) and particulate matter (PM_{10} and $PM_{2.5}$).

VOC and NO_x

Liquefaction and export equipment will emit harmful amounts of VOC and NOx. Sources of these pollutants include the liquefaction trains, ships, and other equipment. Liquefaction trains in particular can emit many thousands of tons per year of NOx when powered by simple-cycle gas turbines, as has been proposed for the Sabine Pass, Louisiana and Corpus Christi, Texas LNG export terminals.[35] EOS has yet to provide emission estimates for its proposed FLNG Project, but a rough calculation of the potential emissions from the project based on other LNG export proposals is possible. For instance, according to Sabine Pass, expanding its export facility to include two new liquefaction trains and related infrastructure to produce an additional 1.4 bcf/d of LNG for export has the potential to emit 90.4 tons per year ("tpy") of VOCs and 1,820.83 tpy of NOx.[36] Assuming similar emission rates from its liquefaction trains and related infrastructure, EOS has the potential to emit 103.3 tpy of VOCs and 2,080.95 tpy for NOx to produce 1.6 bcf/d of LNG for export.

These emissions will harm the environment because VOC and NOx contribute to the formation of ground-level ozone (also called smog). Smog pollution harms human respiratory systems and has been linked to premature death, heart failure, chronic respiratory damage, and premature aging of the lungs.[37] Smog may also exacerbate

[34] Although EOS indicates that its anticipated design will incorporate a floating component constructed in a shipyard, EOS will construct an export terminal and related infrastructure at the Port of Brownsville. EOS App. at 7.

[35] Sabine Pass EA, *supra* n.31, at 2-56, t.2.7-7; Corpus Christi Liquefaction *et al.*, FERC Dkt. CP12-507, Resource Report 9, 9-7 to 9-9 (Aug. 31, 2012).

[36] Sabine Pass Liquefaction LLC *et al.*, FERC DKT. PF13-8, Draft Resource Report 9 at 11-12, Table 9.2-10.

[37] EPA, *Proposed New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry: Regulatory Impact Analysis*, 4-25 (July 2011) ("O&G NSPS RIA"), *available at* http://www.epa.gov/ttnecas1/regdata/RIAs/oilnaturalgasfinalria.pdf, attached as Exhibit 15; Jerrett *et al.*, *Long-Term Ozone Exposure and Mortality*, New England Journal of Medicine (Mar. 12, 2009), *available at* http://www.nejm.org/doi/full/10.1056/NEJMoa0803894#t=articleTop, attached as Exhibit 16.

existing respiratory illnesses, such as asthma and emphysema, or cause chest pain, coughing, throat irritation and congestion. Children, the elderly, and people with existing respiratory conditions are the most at risk from ozone pollution.[38] Significant ozone pollution also damages plants and ecosystems.[39]

Ozone also contributes substantially to global climate change over the short term. According to a recent study by the United Nations Environment Program (UNEP), behind carbon dioxide and methane, ozone is now the third most significant contributor to human-caused climate change.[40]

CO

Operation of LNG export terminals such as the proposed project also causes emissions of CO. For instance, the Sabine Pass expansion project has the potential to emit 2,800.6 tpy of CO from liquefaction activities.[41] Once again, using the potential emissions from Sabine Pass's expansion as a guide, EOS has the potential to emit 3,200.69 tpy of CO emissions.

CO can cause harmful health effects by reducing oxygen delivery to the body's organs and tissues.[42] CO can be particularly harmful to persons with various types of heart disease, who already have a reduced capacity for pumping oxygenated blood to the heart. "For these people, short-term CO exposure further affects their body's already compromised ability to respond to the increased oxygen demands of exercise or exertion."[43]

GHGs

Operation of LNG export terminals such as the proposed project also results in emission of greenhouse gases. To again use the Sabine Pass expansion project as an example, the two new liquefaction trains alone are expected to emit over 2.5 million tpy of carbon dioxide equivalent in greenhouse gases each year.[44] Working off of Sabine Pass's calculations, EOS can expect to emit over 2.9 million tpy of carbon dioxide equivalent in

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[38] *See* EPA, *Ground-Level Ozone, Health Effects*, *available at* http://www.epa.gov/glo/health.html attached as Exhibit 17. EPA, Nitrogen Dioxide, Health, available at http://www.epa.gov/air/nitrogenoxides/health.html, attached as Exhibit 18.

[39] O&G NSPS RIA, *supra* n.37, at 4-26.

[40] *Id. See also* United Nations Environment Programme and World Meteorological Organization, (2011): *Integrated Assessment of Black Carbon and Tropospheric Ozone: Summary for Decision Makers* (hereinafter "UNEP Report,") available at http:// www.unep.org/dewa/Portals/67/pdf/Black_Carbon.pdf, at 7, attached as Exhibit 19.

[41] Sabine Pass Liquefaction LLC *et al.*, FERC DKT. PF13-8, Draft Resource Report 9 at 11, Table 9.2-10.

[42] EPA, Carbon Monoxide, Health, http://www.epa.gov/air/carbonmonoxide/health.html, last visited Jan. 16, 2014, attached as Exhibit 20.

[43] *Id.*

[44] Sabine Pass Liquefaction LLC *et al.*, FERC DKT. PF13-8, Draft Resource Report 9 at 11, Table 9.2-10 (2,543,099 CO2e).

greenhouse gasses per year. These greenhouse gas emissions will increase global warming, harming both the local and global environments. The impacts of global warming include "increased air and ocean temperatures, changes in precipitation patterns, melting and thawing of global glaciers and ice, increasingly severe weather events, such as hurricanes of greater intensity, and sea level rise."[45] A warming climate will also lead to loss of coastal land in densely populated areas, shrinking snowpack in Western states, increased wildfires, and reduced crop yields.[46] More frequent heat waves as a result of global warming have already affected public health, leading to premature deaths, and threats to public health are only expected to increase as global warming intensifies. For example, a warming climate will lead to increased incidence of respiratory and infectious disease, greater air and water pollution, increased malnutrition, and greater casualties from fire, storms, and floods.[47] Vulnerable populations—such as children, the elderly, and those with existing health problems—are the most at risk from these threats.

Sulfur Dioxide

Operation of LNG export terminals such as the proposed project also results in emission of sulfur dioxide. For example, the Sabine Pass expansion has the potential to emit an estimated 6.2 tpy of SO_2.[48] EOS can expect potentially to emit an estimated 7.1 tpy of SO2. Sulfur dioxide causes respiratory problems, including increased asthma symptoms. Short-term exposure to sulfur dioxide has been linked to increased emergency room visits and hospital admissions. Sulfur dioxide reacts in the atmosphere to form particulate matter (PM), an air pollutant which causes a great deal of harm to human health.[49] PM is discussed separately below. Sulfur dioxide can also cause haze, or decreased visibility.

Particulate Matter/Fugitive Dust

Operation of LNG export terminals such as the proposed project also results in emission of particulate matter. The Sabine Pass expansion has the potential to emit an estimated 117.8 tpy of PM10/ PM2.5.[50] Once again, using the Sabine Pass expansion's potential emissions as a guide, EOS has the potential to emit 134.6 tpy of PM10/ PM2.5. PM consists of tiny particles of a range of sizes suspended in air. Small particles pose the greatest health risk. These small particles include "inhalable coarse particles," which are

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[45] Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 76 Fed. Reg. at 52,738, 52,791-22 (citing U.S. EPA, 2011 U.S. GREENHOUSE GAS INVENTORY REPORT EXECUTIVE SUMMARY (2011)), attached as Exhibit 21.

[46] *Id.* at 66,532–33.

[47] EPA, *Climate Change, Health and Environmental Effects*, *available at* http://epa.gov/climatechange/effects/health.html, attached as Exhibit 22.

[48] Sabine Pass Expansion Draft Resource Report 9, *supra* n.44, at 11, Table 9.2-10.

[49] EPA, Sulfur Dioxide, Health, *available at* http://www.epa.gov/air/sulfurdioxide/health.html, attached as Exhibit 23.

[50] Sabine Pass Expansion Draft Resource Report 9, *supra* n.44, at 11, Table 9.2-10.

smaller than 10 micrometers in diameter (PM_{10}), and "fine particles" which are less than 2.5 micrometers in diameter ($PM_{2.5}$). PM_{10} is primarily formed from crushing, grinding or abrasion of surfaces. $PM_{2.5}$ is primarily formed by incomplete combustion of fuels or through secondary formation in the atmosphere.[51]

PM causes a wide variety of health and environmental impacts. PM has been linked to respiratory and cardiovascular problems, including coughing, painful breathing, aggravated asthma attacks, chronic bronchitis, decreased lung function, heart attacks, and premature death. Sensitive populations, include the elderly, children, and people with existing heart or lung problems, are most at risk from PM pollution.[52] PM also reduces visibility,[53] and may damage important cultural resources.[54] Black carbon, a component of PM emitted by combustion sources such as flares and older diesel engines, also warms the climate and thus contributes to climate change.[55]

b. Other Local Impacts

The proposed project will also likely impact local water quality, fish and wildlife, and other environmental resources. Likely water impacts include the effects of water withdrawals necessary for the floating LNG liquefaction facility and export terminal construction, stormwater runoff, discharge and suspension or re-suspension of sediment as a result of dredging and ship transits. These water quality impacts, as well as other disturbances from construction and operation, will affect local fish and wildlife.

The Sierra Club intends to submit comments during the NEPA process that more fully explore local environmental impacts in light of the project design.

2. Environmental Impacts of Induced Gas Production

Further, and likely greater, environmental impacts will result from increased gas production. EOS, the EIA, NERA, essentially every other LNG export applicant, and other informed commenters all agree that LNG exports will induce additional production in the United States, with a general agreement that roughly 63% of exported gas will come from new production.[56]

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[51] *See* EPA, Particulate Matter, Health, *available at* http://www.epa.gov/pm/health.html, attached as Exhibit 24; BLM, *West Tavaputs Plateau Natural Gas Full Field Development Plan Final Environmental Impact Statement* ("West Tavaputs FEIS"), at 3-19 (July 2010), *available at* http://www.blm.gov/ut/st/en/fo/price/energy/Oil_Gas/wtp_final_eis.html.
[52] O&G NSPS RIA, *supra* n.37, at 4-19; EPA, Particulate Matter, Health
[53] EPA "Visibility – Basic Information" http://www.epa.gov/visibility/what.html, attached as Exhibit 25.
[54] *See* EPA, Particulate Matter, Health, *supra* n.51; West Tavaputs EIS, *supra* n.51, at 3-19; O&G NSPS RIA, *supra* n.37, at 4-24.
[55] UNEP Report at 6; IPCC (2007) at Section 2.4.4.3.
[56] *EIA Export Study*, *supra* n.3, at 10.

Available tools also allow DOE to predict where increased production will occur, although such localized predictions are not necessary for meaningful analysis of environmental impacts. NEPA and the NGA therefore require DOE/FE to consider the effects of this additional production. Although DOE/FE recently refused to consider induced production in the earlier *Sabine Pass* proceeding, that order applied the wrong legal standard of foreseeability and is factually incorrect (and factually distinct from the present case) as it understates DOE's ability to predict induced drilling.

a. EOS's Proposal Will Induce Additional U.S. Gas Production

EOS asserts, over and over again, that their project will increase US gas production. EOS claims that its proposed exports would "increas[e] domestic gas production." EOS App. at 13. EOS claims that "jobs will be indirectly created by the increase in drilling for and production of natural gas required to support the Export Authorization." *Id.* at 14. "EOS's staffing will be dwarfed by the total number of new jobs created by the increased production of natural gas required for the Export Authorization." *Id.* at 16. The project will cause "increased economic activity related to exploration, production, and infrastructure construction." *Id.* "Demand created by the Export Authorization will be fully anticipated by the market," allowing "plenty of time for natural gas producers to increase production . . . ." *Id.* at 21.

The EIA and private modelers agree that domestic gas production will increase in response to exports, although EOS failed to cite any of this evidence. The EIA predicts that "about 60 to 70 percent" (63% in EIA's reference cases) of additional demand created by LNG exports would be met by increases in domestic production, with "about three quarters of this increased production [coming] from shale sources."[57]

Accordingly, EOS's proposed export of 1.6 bcf/d of gas plus the additional 10% that EIA found will be consumed in the liquefaction process,[58] can be expected to induce an additional 1.11 bcf/d of production.

Available information also predicts where this additional production will occur. EOS explains that the most likely sources of gas for the proposed exports are nearby fields in Texas, Oklahoma and Louisiana. EOS App. at 10. Available models can provide more sophisticated predictions as to where production supplying additional exports from EOS would occur. EIA's core analytical tool is the National Energy Modeling System ("NEMS"). NEMS was used to produce the EIA exports study. NEMS models the economy's energy use through a series of interlocking modules that represent different energy sectors on geographic levels.[59] Notably, the "Natural Gas Transmission and

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[57] From the *EIA Export Study*, *Id.* at 6, 10.
[58] Id. at 2.
[59] EIA, *The National Energy Modeling System: An Overview*, 1-2 (2009), attached as Exhibit 26, available at http://www.eia.gov/oiaf/aeo/overview/pdf/0581(2009).pdf.

Distribution" module models the relationship between U.S. and Canadian gas production, consumption, and trade, specifically projecting U.S. production, Canadian production, imports from Canada, *etc*.[60] For each region, the module links supply and demand annually, taking transmission costs into account, in order to project how demand will be met by the transmission system.[61] Importantly, the Transmission Module is *already* designed to model LNG imports and exports, and contains an extensive modeling apparatus allowing it to do so on the basis of production in the U.S., Canada, and Mexico.[62] At present, the Module focuses largely on LNG imports, reflecting U.S. trends up to this point, but it also already links the Supply Module to the existing Alaskan *export* terminal and projects exports from that site and their impacts on production.[63]

Similarly, EIA's "Oil and Gas Supply" module models individual regions and describes how production responds to demand across the country. Specifically, the Supply Module is built on detailed state-by-state reports of gas production curves across the country.[64] As EIA explains, "production type curves have been used to estimate the technical production from known fields" as the basis for a sophisticated "play-level model that projects the crude oil and natural gas supply from the lower 48."[65] The module distinguishes coalbed methane, shale gas, and tight gas from other resources, allowing for specific predictions distinguishing unconventional gas supplies from conventional supplies.[66] The module further projects the number of wells drilled each year, and their likely production – which are important figures for estimating environmental impacts.[67] In short, the supply module "includes a comprehensive assessment method for determining the relative economics of various prospects based on future financial considerations, the nature of the undiscovered and discovered resources, prevailing risk factors, and the available technologies. The model evaluates the economics of future exploration and development from the perspective of an operator making an investment decision."[68] Thus, for each play in the lower 48 states, the EIA is able to predict future production based on existing data. The model is also equipped to evaluate policy changes that might impact production; according to EIA, "the model design provides the flexibility to evaluate alternative or new taxes, environmental, or

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[60] *Id.* at 59.
[61] EIA, *Model Documentation: Natural Gas Transmission and Distribution Module of the National Energy Modeling System*, 15-16 (2012), attached as Exhibit 27, *available at* http://www.eia.gov/FTPROOT/modeldoc/m062(2011).pdf.
[62] *See id.* at 22-32.
[63] *See id.* at 30-31.
[64] EIA, *Documentation of the Oil and Gas Supply Module*, 2-2 (2011), attached as Exhibit 28, *available at* http://www.eia.gov/FTPROOT/modeldoc/m063(2011).pdf.
[65] *Id.* at 2-3.
[66] *Id.* at 2-7.
[67] *See id.* at 2-25 to 2-26.
[68] *Id.* at 2-3.

other policy changes in a consistent and comprehensive manner."[69] Thus, there is no technical barrier to modeling where exports will induce production going forward. Indeed, EIA used this model for its export study, which forecast production and price impacts.

Deloitte Marketpoint has provided similar discussion of the ways exports will induce domestic production.[70] Deloitte explains that its "World Gas Model" includes detailed global gas resources, including modeling of "575 plays in the US alone."[71] For this model, "Within each major region are very detailed representations of many market elements: production, liquefaction, transportation, market hubs, regasification and demand by country or sub area."[72] This includes modeling individual "producers, pipelines, refineries, ships, distributors, and consumers." *Id*. Deloitte applied this model to another proposal and derived specific volumes of predicted production increases in five distinct shale gas plays.[73] While Deloitte only provides as aggregate estimates for other shale plays and for non-shale sources, it appears that Deloitte's model is capable of providing geographically specifying where this aggregated production will occur. We offer no opinion at this time about the strengths or weaknesses of Deloitte's models relative to EIA's. We simply note that multiple tools exist which allow predictions of how and where production will respond to exports.

b. Induced Production Must Be Considered in the NEPA and NGA Analyses

NEPA regulations, applicable case law, and recent EPA scoping comments all call for DOE/FE to consider the environmental effects of induced production. As noted above, NEPA requires consideration of "indirect effects" of the proposed action, which include "growth inducing effects" and "reasonably foreseeable" effects "removed in distance" from the site of the proposed action. 40 C.F.R. § 1508.8(b). Here, induced production is not only an effect of the project – it is an essential part of the purported justification for it, as explained in the preceding section*., e.g.*, EOS App. at 16-17. It is therefore plainly a "reasonably foreseeable" effect that must be analyzed in NEPA.

Several courts have held that natural resource production and other analogous upstream impacts induced by new infrastructure development must be considered in NEPA. The Eighth Circuit illustrated the "reasonably foreseeable" standard in analogous circumstances considering the converse of the dynamic here, holding that increased consumption was a reasonably foreseeable consequence of increased supply. *Mid States Coalition for Progress v. Surface Transportation Board*, 345 F.3d 520 (8th Cir. 2003). At issue there was Surface Transportation Board award of a certificate of "public

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[69] *Id.*
[70] Deloitte Study, *supra* n.17, at 14.
[71] *Id.* at 25.
[72] *Id.* at 24.
[73] *Id.*

convenience and necessity" for construction of a rail line under 49 U.S.C. § 10901. 345 F.3d at 533. This line would provide an additional, shorter, faster, and cheaper route to market for low-sulfur coal mined in the Powder River Basin. *Id.* at 549. Sierra Club argued that the project would therefore increase nationwide consumption of coal, consequently increasing emissions of many harmful air pollutants, and that NEPA required consideration of this effect. *Id.* The Board had refused to analyze the impacts of this increased coal consumption. Specifically, the Board argued that any changes in domestic coal consumption would occur regardless of whether the line was built, because existing rail lines already provided a route between the mines and existing demand. *Id.* The court rejected the Board's view. The project would increase the availability of inexpensive low sulfur coal, making coal "a more attractive option" to potential consumers. *Id.* Provision of a cheaper and more plentiful supply of coal would "most assuredly affect the nation's long-term demand for coal." *Id.* Accordingly, an increase in coal consumption was reasonably foreseeable, and NEPA required consideration of this impact. *Id.*

Similarly, the Ninth Circuit recently held that, where the Surface Transportation Board was considering a proposal to expand a railway line which would enable increased coal production at several mines, NEPA required the Board to consider the impacts of increased mining. *N. Plains Resource Council v. Surface Transp. Bd.*, 668 F.3d 1067, 1081-82 (9th Cir. 2011). In *Northern Plains*, the court pointed to the agency's reliance on the induced coal mine development "to justify the financial soundness of the proposal," *id.* at 1082. Because the agency anticipated induced coal production in justifying its proposal, such production was reasonably foreseeable, and NEPA analysis of its impacts was required. Here, a decision by DOE/FE to rely on the supposed economic benefits of increased production, while simultaneously ignoring the impacts of this production, would be squarely inconsistent with *Northern Plains*.

Border Power Plant Working Group v. DOE, 260 F. Supp. 2d 997 (S.D. Cal. 2003), also required consideration of upstream environmental impacts induced by the construction of new energy infrastructure. That case involved applications to construct and operate transmission lines across the U.S.-Mexico border. The court held that DOE was required to consider the environmental effects of upstream electricity generation induced by the new infrastructure, rejecting DOE's decision to exclude these upstream impacts from analysis.[74] *Id.* at 1017. Consideration of induced impacts was required even though the upstream electricity generation would occur in Mexico, outside the jurisdiction of DOE or any other U.S. agency. *Id.* at 1016-17. Here, too, DOE/FE is required to consider the impacts of natural gas production induced by EOS's proposal, regardless of DOE's regulatory authority over that production.

[74] The final EIS for the project at issue in *Border Power Plant Working Group*, produced after remand from the court, is available at http://energy.gov/nepa/downloads/eis-0365-final-environmental-impact-statement. Upstream air quality impacts are considered in pages 4-43 to 4-65 of this final EIS.

EPA has also argued, in scoping comments it submitted regarding other LNG export proposals, that induced production should be included in NEPA review. In scoping comments for the Excelerate project in Texas, EPA recommended that in light of the regulatory definition of indirect effects and the EIA Export Study's prediction of induced production, FERC should "consider available information about the extent to which drilling activity might be stimulated by the construction of an LNG export facility on the Gulf coast, and any potential environmental effects associated with that drilling expansion."[75] EPA used similar language regarding the Jordan Cove and Oregon LNG proposals.[76] EPA's scoping comments for the Cove Point facility in Maryland also recommended analyzing "indirect effects related to gas drilling and combustion," and stressed that, in addition to reviewing the *economic* impacts of induced drilling, DOE/FE should "thoroughly consider the indirect and cumulative *environmental* impacts" of export.[77]

Although DOE/FE's August 2012 *Sabine Pass* order "accept[ed] and adopt[ed] [FERC's] determination that induced shale gas production is not a reasonably foreseeable effect [of LNG exports] for purposes of NEPA analysis," DOE/FE should not follow *Sabine Pass* here. The *Sabine Pass* order contained factual and legal errors and thus should not be the basis for future DOE/FE decisions.[78] Although DOE/FE denied Sierra Club's petition for rehearing of that order, DOE/FE did so without reaching the merits of our petition, and as such, DOE/FE has not responded to the errors identified therein.[79]

The first flaw in DOE/FE's *Sabine Pass* decision is that DOE/FE refused to analyze reasonably foreseeable future environmental effects based on its unlawful demand that these effects' scope and nature first be known with a high degree of certainty. DOE/FE stated that it is "unknown" if "any" new production will result from the proposed exports. *Sabine Pass* at 28. Although it is true that the precise scope of production impacts cannot be determined with complete certainty, certainty is not required. "An impact is 'reasonably foreseeable' if it is 'sufficiently likely to occur that a person of ordinary prudence would take it into account in reaching a decision.'" *City of Shoreacres v. Waterworth*, 420 F.3d 440, 453 (5th Cir. 2005) (quoting *Sierra Club v. Marsh*, 976 F.2d 763, 767 (1st Cir. 1992)). NEPA requires "[r]easonable forecasting and speculation," and

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[75] EPA, *Scoping Comments – Excelerate Liquefaction Solutions*, FERC Dkt. PF13-1, at 14 (Apr. 9, 2013), attached as Exhibit 29.

[76] EPA, *Scoping Comments – The Jordan Cove Energy Project LP*, *supra* n.20, at 14, EPA, *Scoping Comments – The Oregon LNG Export Project and Washington Expansion Project*, *supra* n.22

[77] EPA, *Scoping Comments – Cove Point Liquefaction Project*, *supra* n.21, at 2-3 (emphasis added).

[78] DOE is not bound by its prior decisions: it may reverse its position "with or without a change in circumstances" so long as it provides "a reasoned analysis" for the change. *Louisiana Pub. Serv. Comm'n v. FERC*, 184 F.3d 892, 897 (D.C. Cir. 1999) (quoting *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 57 (1983)).

[79] DOE/FE Order 2961-B, Jan. 25, 2013.

courts "must reject any attempt by agencies to shirk their responsibilities under NEPA by labeling any and all discussion of future environmental effects as 'crystal ball inquiry.'" *Scientists' Inst. for Pub. Info., Inc. v. Atomic Energy Comm'n*, 481 F.2d 1079, 1092 (D.C. Cir. 1973). As explained above, every available source concludes that it is *likely* that the majority of exported gas will come from induced additional production. Thus, an aggregate production increase is unarguably a "reasonably foreseeable" consequence of exports.

DOE/FE's second error in *Sabine Pass* was to adopt FERC's conclusion that induced production was outside the scope of NEPA analysis because "while it may be the case that additional shale gas development will result from the Liquefaction Project, the amount, timing and location of such development activity is simply unknowable at this time." *Sabine Pass* at 13 (quoting 140 FERC ¶ 61,076, P9 (July 26, 2012)). Such specific, localized predictions are not required for meaningful environmental analysis, but even if they were, DOE/FE has the resources to provide them.

As a threshold matter, analysis of the environmental impacts of induced gas production does not require knowledge of the precise sites where additional production will occur. Environmental costs (and the economic costs that accompany them) can be determined in the aggregate. The net increases in, for instance, air pollution associated with the number of wells that will be induced can be quantified based on EPA's emissions inventories. The net volumes of waste can similarly be derived from industry reports and state discharge figures. And these impacts can be localized, at a minimum, by region. Indeed, for some of the environmental impacts of production, such as emissions of many air pollutants and consumption of water, the impacts are likely to be experienced at the regional level. Even for those impacts that are more closely tied to a specific location, such as habitat fragmentation, DOE/FE can and must acknowledge that the impact will occur, including an estimate of the severity of the impact averaged across potential locations. *See Scientists' Inst. for Pub. Info.*, 481 F.2d at 1096-97 (where there are reasonable estimates of the deployment of nuclear power plants, the amount of waste produced, and the land needed to store waste, NEPA required analysis of the impacts of such storage even though the agency could not predict *where* such storage would occur).

Even if DOE/FE were to conclude, wrongly, that NEPA only requires analysis of induced drilling impacts that can be predicted to occur in a particular location, DOE/FE has the tools to make precisely that prediction, as explained in the previous section. If such local impact predictions are not yet in the record, NEPA regulations provide that DOE/FE "shall" obtain this information unless DOE/FE demonstrates that the costs of obtaining it are "exorbitant." 40 C.F.R. § 1502.22.

In summary, all the available evidence indicates that EOS's proposed exports will induce additional gas production in the U.S. This increase is reasonably foreseeable, and its environmental effects must be analyzed under NEPA.

c. Induced Production Will Impose Significant Environmental Harms

Natural gas production—from both conventional and unconventional sources—is a significant air pollution source, can disrupt ecosystems and watersheds, leads to industrialization of entire landscapes, threatens groundwater, and presents challenging waste disposal issues. DOE/FE must consider the increase in these environmental harms that exports are likely to stimulate.

Much of the induced production resulting from exports is likely to come from shale gas and other unconventional sources. EIA has concluded that "[o]n average, across all cases and export scenarios, the shares of the increase in total domestic production coming from shale gas, tight gas, [and] coalbed sources are 72 percent, 13 percent, [and] 8 percent," respectively.[80]

A subcommittee of the DOE's Secretary of Energy's Advisory Board recently highlighted "a real risk of serious environmental consequences" resulting from continued expansion of shale gas production.[81] Shale gas production (as well as coalbed and tight sands production) typically requires the controversial practice of hydraulic fracturing, or fracking. As we explain below, natural gas production in general, and fracking in particular, impose a large number of environmental harms.

i. Natural Gas Production is a Major Source of Air Pollution

Below, we briefly describe some of the primary air pollution problems caused by the industry. These issues include direct emissions from production equipment and indirect emissions caused by natural gas replacing cleaner energy sources. *See* **Figure 1**, below. EPA has moved to correct some of these problems with new air regulations, but, as we later discuss, these standards do not fully address the problem. FERC must therefore consider the air pollution impacts of increased natural gas production despite EPA's rules.

Air Pollution Problems from Natural Gas

Natural gas production operations emit methane (CH_4), volatile organic compounds (VOCs), nitrogen oxides (NO_x), sulfur dioxide (SO_2), hydrogen sulfide (H_2S), and particulate matter (PM_{10} and $PM_{2.5}$). These operations also emit listed hazardous air pollutants (HAPs) in significant quantities, and so contribute to cancer risks and other acute public health problems. Pollutants are emitted during all stages of natural gas development, including (1) oil and natural gas production, (2) natural gas processing, (3)

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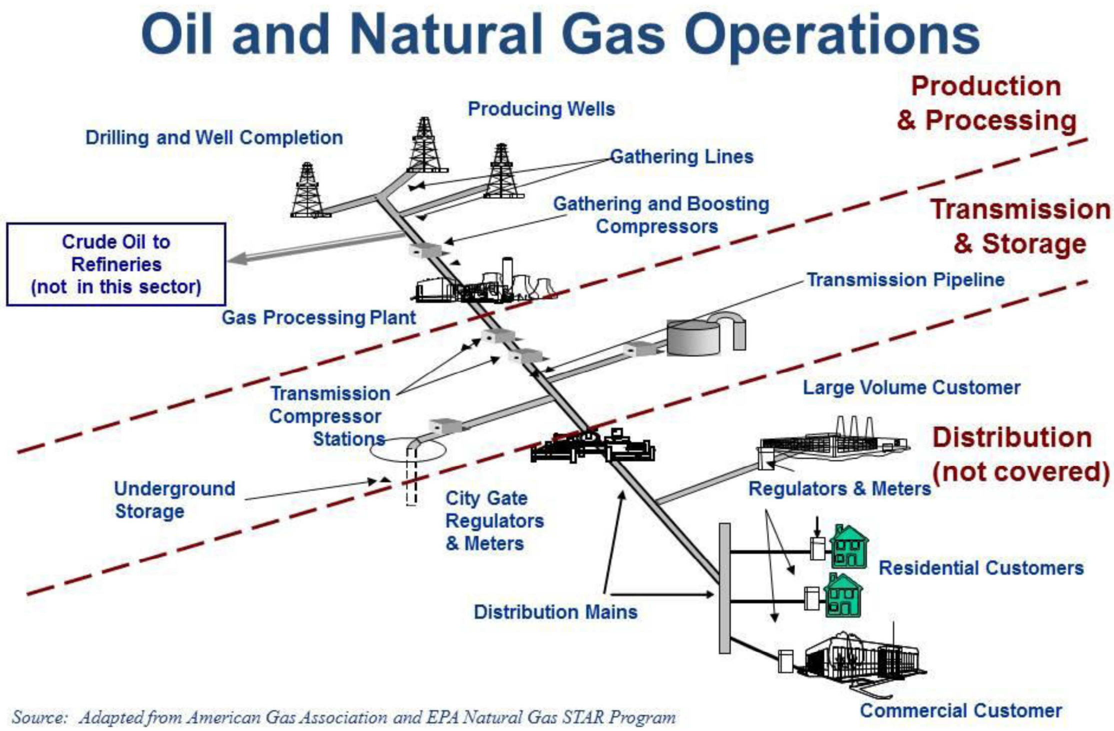
[80] EIA Export Study, *supra* n.3, at 11.

[81] DOE, Secretary of Energy's Advisory Board, Shale Gas Production Subcommittee Second 90-Day Report (2011) at 10, attached as Exhibit 30. *See also* DOE, Shale Gas Production Subcommittee First 90-Day Report, attached as Exhibit 31.

natural gas transmission, and (4) natural gas distribution.[82] Within these development stages, the major sources of air pollution include wells, compressors, pipelines, pneumatic devices, dehydrators, storage tanks, pits and ponds, natural gas processing plants, and trucks and construction equipment.

Figure 1: The Oil and Natural Gas Sector



There is strong evidence that emissions from natural gas production are higher than have been commonly understood. A recent study by a consortium of researchers led by the National Ocean and Atmospheric Administration (NOAA) Earth System Research Laboratory recorded pollution concentrations near gas fields substantially greater than EPA estimates would have predicted. That study monitored air quality around oil and gas fields.[83] The researchers observed high levels of methane, propane, benzene, and other volatile organic compounds in the air around the fields. According to the study authors, their "analysis suggests that the emissions of the species we measured" – that is, the cancer-causing, smog-forming, and climate-disrupting pollutants released from these operations – "are most likely underestimated in current inventories," perhaps by

[82] EPA, Oil and Natural Gas Sector: Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, Background Technical Support Document for the Proposed Rules, at 2-4 (July 2011) ("2011 TSD"), attached as Exhibit 32.

[83] G. Petron *et al.*, *Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study*, 117 J. of Geophysical Research 4304, DOI 10.1029/2011JD016360 (2012), attached as Exhibit 33.

as much as a factor of two, which would imply a leak rate of about 4.8% of production.[84] A second announced NOAA study suggests that leak rates may be as high as 9%, suggesting even more severe consequences.[85] Most troublingly, a California study identified a 17% leak rate for oil and gas operations in the Los Angeles basin.[86]

These emissions have dire practical consequences. A second research team, led by the Colorado School of Public Health, measured benzene and other pollutants released from unconventional well completions.[87] Elevated levels of these pollutants correspond to increased cancer risks for people living within half of a mile of a well[88] – a very large population which will increase as drilling expands.

We discussed the harmful effects of many of these pollutants in part III.C.1.a, above. Below, we detail the sources of emissions within the gas production industry and provide further information regarding the serious global, regional, and local impacts these exploration and production emissions entail:

Methane: Methane is the dominant pollutant from the oil and gas sector. Emissions occur as result of intentional venting or unintentional leaks during drilling, production, processing, transmission and storage, and distribution. For example, methane is emitted when wells are completed and vented, as part of operation of pneumatic devices and compressors, and as a result of leaks (fugitive emissions) in pipelines, valves, and other equipment. EPA has identified natural gas systems as the "single largest contributor to United States anthropogenic methane emissions."[89] The industry is responsible for over 40% of total U.S. methane emissions.[90] Methane causes harm both because of its contributions to climate change and as an ozone precursor.

Methane is a potent greenhouse gas that contributes substantially to global climate change. The Intergovernmental Panel on Climate Change estimates that methane has 34 times the global warming potential of carbon dioxide over a 100 year time frame and at least 86 times the global warming potential of carbon dioxide over a 20-year time

[84] *Id.* at 4304.
[85] J. Tollefson, *Methane leaks erode green credentials of natural gas*, Nature (2013), attached as Exhibit 34.
[86] Peischl, J., *et al.*, *Quantifying sources of methane using light alkanes in the Los Angeles basin, California*, J. Geophys. Res. Atmos (2013), attached as Exhibit 35.
[87] L. McKenzie *et al.*, *Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources*, Science of the Total Environment (In Press, Mar. 22, 2012), attached as Exhibit 36.
[88] *Id.* at 2.
[89] Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 76 Fed. Reg. 52,738, 52,792 (Aug. 23, 2011), attached as Exhibit 37. 76 Fed. Reg. 52,738, *supra* n.45, at 52,792.
[90] *Id.* at 52,791–92.

frame.[91] Because of methane's effects on climate, EPA has found that methane, along with five other well-mixed greenhouse gases, endangers public health and welfare within the meaning of the Clean Air Act.[92] The oil and gas production industry is a significant emitter of this dangerous pollutant; its methane emissions amount to 5% of all carbon dioxide equivalent (CO_2e) emissions in the country.[93]

Methane also reacts in the atmosphere to form ozone.[94] As we discuss elsewhere, ozone is a major public health threat, linked to a wide range of maladies. In addition to these public health harms, ozone can damage vegetation, agricultural productivity, and cultural resources. Ozone is also a greenhouse gas, meaning that methane is doubly damaging to climate – first in its own right, and then as an ozone precursor.

***Volatile Organic Compounds (VOCs) and NO_x*:** The gas industry is also a major source of two other ozone precursors: VOCs and NO_x.[95] VOCs are emitted from well drilling and completions, compressors, pneumatic devices, storage tanks, processing plants, and as fugitives from production and transmission.[96] The primary sources of NO_x are compressor engines, turbines, and other engines used in drilling and hydraulic fracturing.[97] NO_x is also produced when gas is flared or used for heating.[98]

As a result of significant VOC and NO_x emissions associated with oil and gas development, numerous areas of the country with heavy concentrations of drilling are now suffering from serious ozone problems. For example, the Dallas Fort Worth area in Texas is home to substantial oil and gas development. Within the Barnett shale region,

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[91] IPCC, *Climate Change 2013: The Physical Science Basis: Chapter 8,* page 714, Table 8.7, attached as Exhibit 38. Another recent study by Shindell *et al.* provides an even higher estimate for methane's 20-year GWP, at at 105.
[92] EPA, Endangerment and Cause or Contribute Findings for Greenhouse Gases, 74 Fed. Reg. 66,496, 66,516 (Dec. 15, 2009) ("Endangerment Finding"), attached as Exhibit 39.
[93] 76 Fed. Reg. 52,738, *supra* n.89, at 52,791–92.
[94] *Id.* at 52,791.
[95] *See, e.g.*, Al Armendariz, Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements (Jan. 26, 2009), available at http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf (hereinafter "Barnett Shale Report") at 24, attached as Exhibit 40.
[96] *See, e.g.,* 2011 TSD, *supra* n.82, at 4-7, 5-6, 6-5, 7-9, 8-1 (Exhibit 32); *see also* Barnett Shale Report, *supra* n.95, at 24 (Exhibit 40).
[97] *See, e.g.*, 2011 TSD, *supra* n.82, at 3-6; Barnett Shale Report, *supra* n.95, at 24 (Exhibit 37); Air Quality Impact Analysis Technical Support Document for the Revised Draft Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project at 11 (Table 2.1).), attached as Exhibit 41.
[98] 2011 TSD, *supra* n.82, at 3-6; Colorado Department of Public Health and Environment, *Colorado Visibility and Regional Haze State Implementation Plan for the Twelve Mandatory Class I Federal Areas in Colorado*, Appendix D at 1 (2011), available at http://www.cdphe.state.co.us/ap/RegionalHaze/AppendixD/4-FactorHeaterTreaters07JAN2011FINAL.pdf, attached as Exhibit 42.

as of September 2011, there were more than 15,306 gas wells and another 3,212 wells permitted.[99] Of the nine counties surrounding the Dallas Fort Worth area that EPA has designated as "nonattainment" for ozone, five contain significant oil and gas development.[100] A 2009 study found that summertime emissions of smog-forming pollutants from these counties were roughly comparable to emissions from motor vehicles in those areas.[101]

Oil and gas development has also brought serious ozone pollution problems to rural areas, such as western Wyoming.[102] On July 20, 2012, the US EPA designated Wyoming's Upper Green River Basin as a marginal nonattainment area for ozone.[103] In an extended assessment, the Wyoming Department of Environmental Quality ("WDEQ") found that ozone pollution was "primarily due to local emissions from oil and gas . . . development activities: drilling, production, storage, transport, and treating."[104] In the winter of 2011, the residents of Sublette County suffered thirteen days with ozone concentrations considered "unhealthy" under EPA's current air-quality index, including days when the ozone pollution levels exceeded the worst days of smog pollution in Los Angeles.[105] In 2013, a Wyoming Department of Health study linked elevated levels of ozone pollution to increased visits at two local health clinics for respiratory-related complaints.[106] In the past, residents have faced repeated warnings regarding elevated ozone levels and the resulting risks of going outside[107] and WDEQ has drated a plan, which includes weather

[99] Texas Railroad Commission history of Barnett Shale, attached as Exhibit **43**.
[100] Barnett Shale Report, *supra* n.95, at 1, 3 (Exhibit 37).
[101] *Id.* at 1, 25-26.
[102] Schnell, R.C, *et al*. (2009), "Rapid photochemical production of ozone at high concentrations in a rural site during winter," *Nature Geosci.* 2 (120 – 122). DOI: 10.1038/NGEO415, attached as Exhibit 44.
[103] Air Quality Designations for the 2008 Ozone National Ambient Air Quality Standards, 77 Fed. Reg. 30088, 30157 (May 21, 2012), attached as Exhibit 45.
[104] Wyoming Department of Environmental Quality, Technical Support Document I for Recommended 8-hour Ozone Designation of the Upper Green River Basin (March 26, 2009) at viii, *available at* http://deq.state.wy.us/out/downloads/Ozone%20TSD_final_rev%203-30-09_jl.pdf, attached as Exhibit 46.
[105] EPA, *Daily Ozone AQI Levels in 2011 for Sublette County, Wyoming*, *available at* http://www.epa.gov/cgi-bin/broker?msaorcountyName=countycode &msaorcountyValue=56035&poll=44201&county=56035&msa=-1&sy=2011&flag=Y &_debug=2&_service=data&_program=dataprog.trend_tile_dm.sas, attached as Exhibit 47; *see also* Wendy Koch, *Wyoming's Smog Exceeds Los Angeles' Due to Gas Drilling*, USA Today, *available at* http://content.usatoday.com/communities/greenhouse/post/ 2011/03/wyomings-smog-exceeds-los-angeles-due-to-gas-drilling/1, attached as Exhibit 48.
[106] State of Wyoming, Department of Health, *Associations of Short-Term Exposure to Ozone and Respiratory Outpatient Clinic Visits — Sublette County, Wyoming, 2008–2011* (Mar. 1, 2013) at 3, available at http://www.health.wyo.gov/phsd/ehl/index.html and attached Exhibit 49.
[107] *See, e.g.*, 2011 DEQ Ozone Advisories, Pinedale Online! (Mar. 17, 2011), http://www.pinedaleonline.com/news/2011/03/OzoneCalendar.htm (documenting ten ozone advisories in February and March 2011), attached as Exhibit 50; Wyoming Department of Environmental Quality, Ozone Advisory for Monday, Feb. 28, Pinedale Online! (Feb. 27, 2011), http://www.pinedaleonline.com/news/2011/02/OzoneAdvisoryforMond.htm, attached as Exhibit 51.

forecasting, public updates and short-term ozone emission reduction measures, in anticipation of elevated ozone levels in 2014.[108]

Ozone problems are mounting in other Rocky Mountain states as well. In recent years Northeastern Utah's Uintah Basin has experienced severe ozone pollution. In the winter of 2012 to 2013, this region suffered over fifty days where air quality monitors measured ozone in excess of federal standards and some days where ozone levels were almost twice the federal standard.[109] The Utah Department of Environmental Quality has determined that "Oil and gas operations were responsible for 98-99 percent of volatile organic compound (VOC) emissions and 57-61 percent of nitrogen oxide (NOx) emissions," the primary chemical contributors to ozone formation.[110] The Bureau of Land Management (BLM) has similarly identified the multitude of oil and gas wells in the region as the primary cause of the ozone pollution.[111]

Rampant oil and gas development in Colorado and New Mexico is also leading to high levels of VOCs and NO_x. In 2008, the Colorado Department of Public Health and Environment concluded that the smog-forming emissions from oil and gas operations exceed vehicle emissions for the entire state.[112] Moreover, significant additional drilling has occurred since 2008. Colorado is now home to more than 51,000 wells.[113] On July 20, 2012, the US EPA designated the metropolitan Denver and the North Front Range area in Colorado as a marginal nonattainment area for ozone.[114] Additionally, portions of Colorado's Western Slope now qualify as a nonattainment area because the three year average ozone value is above the NAAQS.[115] Monitoring also shows that many

[108] *DEQ plans for the 2014 winter ozone season*, Pinedale Online! (Dec. 19, 2013), available at http://www.pinedaleonline.com/news/2013/12/DEQplansforthe2014wi.htm and attached as Exhibit 52.
[109] *See, e.g.*, Utah Dept. of Environmental Quality, *Utah's Environment 2013: Planning and Analysis: Uintah Basin Ozone Study* (updated Jan. 17, 2014), *available at* http://www.deq.utah.gov/envrpt/Planning/s12.htm¸attached as Exhibit 53.
[110] Utah Dept. of Environmental Quality, *Uinta Basin: Ozone in the Uinta Basin* (Updated Jan. 28,2014), *available at* http://www.deq.utah.gov/locations/uintahbasin/ozone.htm, attached as Exhibit 54.
[111] BLM, *GASCO Energy Inc. Uinta Basin Natural Gas Development Draft Environmental Impact Statement* ("GASCO DEIS"), at 3-13, *available at* http://www.blm.gov/ut/st/en/fo/vernal/planning/nepa_/gasco_energy_eis.html, attached as Exhibit 55.
[112] Colo. Dept. of Public Health & Env't, Air Pollution Control Division, Oil and Gas Emission Sources, Presentation *for the Air Quality Control Commission Retreat*, at 3-4 (May 15, 2008), attached as Exhibit 56.
[113] Colorado Oil & Gas Conservation Commission, *Colorado Weekly & Monthly Oil and Gas Statistics*, at 11 (Jan. 7, 2014), available at http://cogcc.state.co.us/ (library—statistics—weekly/monthly well activity), attached as Exhibit 57.
[114] Air Quality Designations for the 2008 Ozone National Ambient Air Quality Standards, 77 Fed. Reg. at 30110, *supra* n.103.
[115] Colorado Air Quality Control Commission, 2013 Summer Ozone Season Review (Oct. 17, 2013) slides at 5, available at http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=Content-Type&blobheadervalue1=inline%3B+filename%3D%22Review+of+the+2013+Ozone+Season+%2822+pages%29.pdf%22&blobheadervalue2=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251896466011&ssbinary=true and attached as Exhibit 58.

other areas of the state have ozone pollution levels that exceed levels EPA has recognized as having significant health impacts.[116] In 2013, the Colorado Department of Public Health and Environment issued 42 advisories, cautioning active children and adults, older adults, and people with asthma to reduce prolonged or heavy outdoor exertion, for the Front Range region due to ozone levels had been exceeded or were expected to be exceeded.[117]

There is also significant development in the San Juan Basin in southeastern Colorado and northwestern New Mexico, with approximately 35,000 wells in the Basin. As a result of this development and several coal-fired power plants in the vicinity, the Basin suffers from serious ozone pollution.[118] This pollution is taking a toll on residents of San Juan County. The New Mexico Department of Public Health has documented increased emergency room visits associated with high ozone levels in the County.[119]

VOC and NO_x emissions from oil and gas development are also harming air quality in national parks and wilderness areas. Researchers have determined that numerous "Class I areas" – a designation reserved for national parks, wilderness areas, and other such lands[120] – are likely to be impacted by increased ozone pollution as a result of oil and gas development in the Rocky Mountain region. Affected areas include Mesa Verde National Park and Weminuche Wilderness Area in Colorado and San Pedro Parks Wilderness Area, Bandelier Wilderness Area, Pecos Wilderness Area, and Wheeler Peak Wilderness Area in New Mexico.[121] These areas are all near concentrated oil and gas development in the San Juan Basin.[122]

As oil and gas development moves into new areas, particularly as a result of the boom in development of shale resources, ozone problems are likely to follow. For example,

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[116] *Id.* at 2-11.

[117] Colorado Department of Public Health and the Environment, Forecasting Air Quality in Colorado (May 16, 2013) at slides 2-3, 5, available at http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=Content-Type&blobheadervalue1=inline%3B+filename%3D%22Forecasting+Air+Quality+in+Colorado+-+15+pgs.pdf%22&blobheadervalue2=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251854889571&ssbinary=true and attached as Exhibit 59.

[118] *See Four Corners Air Quality Task Force Report of Mitigation Options*, at vii (Nov. 1, 2007), *available at* http://www.nmenv.state.nm.us/aqb/4C/TaskForceReport.html, attached as Exhibit 60.

[119] Myers *et al.*, *The Association Between Ambient Air Quality Ozone Levels and Medical Visits for Asthma in San Juan County* (Aug. 2007), *available at* http://www.nmenv.state.nm.us/aqb/4c/Documents/SanJuanAsthmaDocBW.pdf, attached as Exhibit 61.

[120] *See* 42 U.S.C. § 7472(a).

[121] Rodriguez et al., *Regional Impacts of Oil and Gas Development on Ozone Formation in the Western United States*, 59 Journal of the Air and Waste Management Association 1111 (Sept. 2009), available at http://www.wrapair.org/forums/amc/meetings/091111_Nox/Rodriguez_et_al_OandG_Impacts_JAWMA9_09.pdf, attached as Exhibit 62.

[122] *Id.* at 1112.

regional air quality models predict that gas development in the Haynesville shale will increase ozone pollution in northeast Texas and northwest Louisiana and may lead to violations of ozone NAAQS.[123]

Moreover, VOCs are not simply ozone precursors. They are also co-emitted with a stew "hazardous air pollutants" (HAPs) including benzene. HAPs, by definition, are toxic and also may be carcinogenic. High levels of carcinogens, including benzene compounds, are associated with gas production sites. Unsurprisingly, recent risk assessments from Colorado document elevated health risks for residents living near gas wells.[124] Indeed, levels of benzene and other toxics near wells in rural Colorado were "higher than levels measured at 27 out of 37 EPA air toxics monitoring sites . . . including urban sites" in major industrial areas."[125] These pollution levels are even more concerning than these high concentrations would suggest because several of the toxics emitted by gas operations are endocrine disruptors, which are compounds known to harm human health by acting on the endocrine system even at very low doses; some such compounds may, in fact, be especially dangerous specifically at the low, chronic, doses one would expect near gas operations.[126]

Sulfur dioxide: Oil and gas production also emits sulfur dioxide, primarily from natural gas processing plants.[127] Sulfur dioxide is released as part of the sweetening process, which removes hydrogen sulfide from the gas.[128] Sulfur dioxide is also created when gas containing hydrogen sulfide (discussed below) is combusted in boilers or heaters.[129]

Hydrogen sulfide: Some natural gas contains hydrogen sulfide. Gas containing hydrogen sulfide above a specific threshold is classified as "sour gas."[130] According to EPA, there are 14 major areas in the U.S., found in 20 different states, where natural gas tends to be sour.[131] All told, between 15 and 20% of the natural gas in the U.S. may contain hydrogen sulfide.[132]

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[123] *See* Kemball-Cook et al., *Ozone Impacts of Natural Gas development in the Haynesville Shale* 44 Environ. Sci. Technol. 9357, 9362 (2010), attached as Exhibit 63.
[124] McKenzie, *supra* n.87.
[125] *Id.* at 5.
[126] *See* L. Vandenberg *et al.*, *Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses*, Endocrine Disruption Review (2012), attached as Exhibit 64.
[127] 76 Fed. Reg., *supra* n.89, at 52,756.
[128] 2011 TSD, *supra* n.82, at 3-3 to 3-5.
[129] 76 Fed. Reg., *supra* n.89, at 52,756.
[130] *Id.* at 52,756. Gas is considered "sour" if hydrogen sulfide concentration is greater than 0.25 grain per 100 standard cubic feet, along with the presence of carbon dioxide. *Id.*
[131] EPA, Office of Air Quality Planning and Standards, *Report to Congress on Hydrogen Sulfide Air Emissions Associated with the Extraction of Oil and Natural Gas* (EPA-453/R-93-045), at ii (1993) (hereinafter "EPA Hydrogen Sulfide Report"), attached as Exhibit 65.
[132] Lana Skrtic, *Hydrogen Sulfide, Oil and Gas, and People's Health* ("Skrtic Report"), at 6 (May 2006), *available at* http://www.earthworksaction.org/pubs/hydrogensulfide_oilgas_health.pdf, attached as Exhibit 66.

Given the large amount of drilling in areas with sour gas, EPA has concluded that the potential for hydrogen sulfide emissions from the oil and gas industry is "significant."[133] Hydrogen sulfide may be emitted during all stages of development, including exploration, extraction, treatment and storage, transportation, and refining.[134] For example, hydrogen sulfide is emitted as a result of leaks from processing systems and from wellheads in sour gas fields.[135]

Hydrogen sulfide emissions from the oil and gas industry are concerning because this pollutant may be harmful even at low concentrations.[136] Hydrogen sulfide is an air pollutant with toxic properties that smells like rotten eggs and can lead to neurological impairment or death. Long-term exposure to hydrogen sulfide is linked to respiratory infections, eye, nose, and throat irritation, breathlessness, nausea, dizziness, confusion, and headaches.[137] Although hydrogen sulfide was originally included in the Clean Air Act's list of hazardous air pollutants, it was removed with industry support.[138]

Although direct monitoring of hydrogen sulfide around oil and gas sources is limited, there is evidence that these emissions may be substantial, and have a serious impact on people's health. For example, North Dakota reported 3,300 violations of an odor-based hydrogen sulfide standard around drilling wells.[139] People in northwest New Mexico and western Colorado living near gas wells have long complained of strong odors, including but not limited to hydrogen sulfide's distinctive rotten egg smell. Residents have also experienced nose, throat and eye irritation, headaches, nose bleeds, and dizziness.[140] An air sample taken by a community monitor at one family's home in western Colorado in January 2011 contained levels of hydrogen sulfide concentrations 185 times higher than safe levels.[141]

Particulate Matter (PM): The oil and gas industry is a major source of PM pollution. This pollution is generated by heavy equipment used to move and level earth during well pad and road construction. Vehicles also generate fugitive dust by traveling on access roads

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133 EPA Hydrogen Sulfide Report, *supra* n. 131, at III-35.
134 *Id.* at ii.
135 2011 TSD, *supra* n.82, at 2-3.
136 *See* James Collins & David Lewis, Report to CARB, Hydrogen Sulfide: Evaluation of Current California Air Quality Standards with Respect to Protections of Children (2000), *available at* http://oehha.ca.gov/air/pdf/oehhah2s.pdf, attached as Exhibit 67.
137 EPA Hydrogen Sulfide Report, *supra* n. 131, at ii.
138 *See* Pub. L. 102-187 (Dec. 4, 1991). We do not concede that this removal was appropriate. Hydrogen sulfide meets section 112 of the Clean Air Act's standards for listing as a hazardous air pollutant and should be regulated accordingly.
139 EPA Hydrogen Sulfide Report, *supra* n. 131, at III-35.
140 See Global Community Monitor, *Gassed! Citizen Investigation of Toxic Air Pollution from Natural Gas Development*, at 11-14 (2011), attached as Exhibit 68.
141 *Id.* at 21.

during drilling, completion, and production activities.[142] Diesel engines used in drilling rigs and at compressor stations are also large sources of fine PM/diesel soot emissions. VOCs are also a precursor to formation of $PM_{2.5}$.[143]

PM emissions from the oil and gas industry are leading to significant pollution problems. For example, monitors in Uintah County and Duchesne County, Utah have repeatedly measured wintertime $PM_{2.5}$ concentrations above federal standards.[144] These elevated levels of $PM_{2.5}$ have been linked to oil and gas activities in the Uinta Basin.[145] Modeling also shows that road traffic associated with energy development is pushing PM_{10} levels very close to violating NAAQS standards.[146]

Federal and State Air Rules Will Not Fully Address These Air Pollution Problems

In 2012 EPA finalized new source performance standards and standards for hazardous air pollutants[147] for oil and gas production. These standards do reduce some of these pollution problems, they will not solve them. First, the rules do not even address some pollutants, including NO_x, methane, and hydrogen sulfide, so any reductions of these pollutants occur only as co-benefits of the VOC reductions that the rules require.[148] Second, the rules do not control emissions from most transmission infrastructure.[149] Third, existing sources of air pollution are not controlled for any pollutant, meaning that increased use of existing infrastructure will produce emissions uncontrolled by the rules. Fourth, without full enforcement, the rules will not reduce emissions completely. Fifth, the rules will not address important emissions effects of LNG in particular, including LNG exports' tendency to increase the use of coal power. Thus, though DOE/FE might work with EPA to fully understand the emissions levels likely after the rules are fully implemented, it may not rely upon the EPA rules to avoid weighing and disclosing these impacts.

Similarly, while some states, such as Colorado, are in the process of updating their rules for air emission from oil and gas production, these regulations suffer many of the same limitations, and do not provide a basis for DOE/FE to avoid assessing the ways in which LNG exports will degrade air quality by inducing additional gas production.

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[142] *See* BLM, GASCO Energy Inc. Uinta Basin Natural Gas Development Project Draft Environmental Impact Statement, at App. J at 2 (Oct. 2010) ("GASCO DEIS").
[143] O&G NSPS RIA, *supra* n.37, at 4-18.
[144] GASCO DEIS, *supra* n.142, at 3-12.
[145] West Tavaputs FEIS, *supra* n.51, at 3-20.
[146] *See* GASCO DEIS, *supra* n.142, at 4-27.
[147] *See* EPA, Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants, 77 Fed. Reg. 49,490 (Aug. 16, 2012), *available at* http://www.gpo.gov/fdsys/pkg/FR-2012-08-16/pdf/2012-16806.pdfl.
[148] *See id.* at 49,513-14.
[149] *See, e.g.*, *id.* at 49,523.

EOS Itself Will Induce Significant Production-related Air Emissions

As we have discussed above, under its current nFTA application, EOS proposes to export about 584 bcf/y of natural gas, and will demand approximately an additional 10% of this gas for the liquefaction process. Thus, EOS's proposal would create roughly 642.4 bcf/year of new gas demand. The EIA predicts that about 63% of demand for exports will come from new production, which in this case would amount to 404.71 bcf/year. EPA conversion factors allow us to estimate the emissions impacts of this new production. EPA's current greenhouse gas inventory implies that about 1.5% of gross gas production leaks to the atmosphere in one way or another.[150] As noted above, however, these estimates may be too low: EPA's emissions estimates are based on industry's self-reported data and assumed emission factors, whereas recent work by National Oceanic and Atmospheric Administration ("NOAA") scientists based on direct measurement at gas fields identified leak rates in those fields between 4.8% and 9%.[151] These leak rates, and EPA conversion factors between the typical volumes of methane, VOC, and HAP in natural gas,[152] make it possible to estimate the potential impact of increasing gas production in the way that LNG export would require.

The table below uses these conversion factors to calculate the emissions associated with producing 642.4 bcf/year of new gas demand, the likely inducement specifically attributable to EOS. We calculate for a 1% leak rate (which is below the current value, but is included as a conservative case to reflect successful air pollution controls more extensive than those which EPA has promulgated), the current EPA estimated rate of 1.5%, and the higher leak rates the NOAA studies suggest, generating results for methane, VOC, and HAP.[153]

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150 EPA's 2013 inventory does not explicitly state the leak rate for natural gas production. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2011*, Table ES-2 (2013), attached as Exhibit 69. EPA's prior inventory implied a leak rate of 2.4%, as extrapolated by a previous study. Alvarez *et al.*, *Greater focus needed on methane leakage from natural gas infrastructure*, Proceedings of the National Academy of Science (Apr. 2012) at 1, attached as Exhibit 70. Because the current inventory's sector-wide emissions estimates for the same time periods have been reduced by roughly 1/3, the current inventory implies a leak rate of roughly 1.5%.

151 *See* G. Petron *et al.*, *Hydrocarbon emissions characterization in the Colorado Front*, *supra* n.83; J. Tollefson, *Methane leaks erode green credentials of natural gas*, *supra* n.85.

152 *See* 2011 TSD, *supra* n.82, at Table 4.2. EPA calculated average composition factors for gas from well completions. These estimates, which are based on a range of national data are robust, but necessarily imprecise for particular fields and points along the line from wellhead to LNG terminal. Nonetheless, they provide a beginning point for quantitative work. EPA's conversions are: 0.0208 tons of methane per mcf of gas; 0.1459 lb VOC per lb methane; and 0.0106 lb HAP per lb methane.

153 These figures were calculated by multiplying the volume of gas to be exported (in bcf) by 1,000,000 to convert to mcf, and then by 63% to generate new production volumes. The new production volumes of gas were, in turn, multiplied by the relevant EPA conversion factors to generate tonnages of the relevant pollutants. These results are approximations: Although we reported the arithmetic results of this calculation, of course only the first few significant figures of each value should be the focus.

Table 1: Emissions Associated with Production of 642.4 bcf/y of Natural Gas

Leak Rate	Methane (tpy)	VOC (tpy)	HAP (tpy)
1%	133,619	19,495	1,416
1.50%	200,429	29,243	2,125
4.80%	641,372	93,576	6,799
9%	1,202,573	175,455	12,747

Thus, EOS's current proposal, alone, would be responsible for tens of thousands of tons of increased air pollution. Notably, the threshold for major source permitting under the Clean Air Act is generally just tens of tons of pollution; for greenhouse gases, it is generally 75,000 tons. EOS would thus greatly increase air pollution in the regions from which it draws its gas, imperiling public health and the global climate.

ii. Gas Production Disrupts Landscapes and Habitats

Increased oil and gas production will transform the landscape of regions overlying shale gas plays, bringing industrialization to previously rural landscapes and significantly affecting ecosystems, plants, and animals. These impacts are large and difficult to manage.

Land use disturbance associated with gas development impacts plants and animals through direct habitat loss, where land is cleared for gas uses, and indirect habitat loss, where land adjacent to direct losses loses some of its important characteristics.

Regarding direct losses, land is lost through development of well pads, roads, pipeline corridors, corridors for seismic testing, and other infrastructure. The Nature Conservancy (TNC) estimated that in Pennsylvania, "[w]ell pads occupy 3.1 acres on average while the associated infrastructure (roads, water impoundments, pipelines) takes up an additional 5.7 acres, or a total of nearly 9 acres per well pad."[154] New York's Department of Environmental Conservation reached similar estimates.[155] After initial drilling is completed the well pad is partially restored, but 1 to 3 acres of the well pad will remain disturbed through the life of the wells, estimated to be 20 to 40 years.[156] Associated infrastructure such as roads and corridors will likewise remain disturbed. Because these disturbances involve clearing and grading of the land, directly disturbed land is no longer suitable as habitat.[157]

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[154] TNC, Pennsylvania Energy Impacts Assessment, Report 1: Marcellus Shale Natural Gas and Wind 10, 18 (2010), attached as Exhibit 71.

[155] N.Y. Dep't of Envtl. Conservation, Revised Draft Supplemental General Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program, 5-5 (2011) ("NY RDSGEIS"), available at http://www.dec.ny.gov/energy/75370.html.

[156] Id. at 6-13.

[157] *Id.* at 6-68.

Indirect losses occur on land that is not directly disturbed, but where habitat characteristics are affected by direct disturbances. “Adjacent lands can also be impacted, even if they are not directly cleared. This is most notable in forest settings where clearings fragment contiguous forest patches, create new edges, and change habitat conditions for sensitive wildlife and plant species that depend on “interior” forest conditions.”[158] “Research has shown measureable impacts often extend at least 330 feet (100 meters) into forest adjacent to an edge.”[159]

TNC’s study of the impacts of gas extraction in Pennsylvania is particularly telling. TNC mapped projected wells across the state, considering how the wells and their associated infrastructure, including roads and pipelines, interacted with the landscape. TNC’s conclusions make for grim reading. It concluded:

- About 60,000 new Marcellus wells are projected by 2030 in Pennsylvania with a range of 6,000 to 15,000 well pads, depending on the number of wells per pad;

- Wells are likely to be developed in at least 30 counties, with the greatest number concentrated in 15 southwestern, north central, and northeastern counties;

- Nearly two thirds of well pads are projected to be in forest areas, with forest clearing projected to range between 34,000 and 83,000 acres depending on the number of number of well pads that are developed. An additional range of 80,000 to 200,000 acres of forest interior habitat impacts are projected due to new forest edges created by well pads and associated infrastructure (roads, water impoundments);

- On a statewide basis, the projected forest clearing from well pad development would affect less than one percent of the state’s forests, but forest clearing and fragmentation could be much more pronounced in areas with intensive Marcellus development;

- Approximately one third of Pennsylvania’s largest forest patches (>5,000 acres) are projected to have a range of between 1 and 17 well pads in the medium scenario;

- Impacts on forest interior breeding bird habitats vary with the range and population densities of the species. The widely-distributed scarlet tanager would see relatively modest impacts to its statewide population while black-throated

[158] Pennsylvania Energy Impacts Assessment, *supra* n.154, at 10.
[159] NY RDSGEIS, *supra* n.155, at 6-75.

blue warblers, with a Pennsylvania range that largely overlaps with Marcellus development area, could see more significant population impacts;

- Watersheds with healthy eastern brook trout populations substantially overlap with projected Marcellus development sites. The state's watersheds ranked as "intact" by the Eastern Brook Trout Joint Venture are concentrated in north central Pennsylvania, where most of these small watersheds are projected to have between two and three dozen well pads;

- Nearly a third of the species tracked by the Pennsylvania Natural Heritage Program are found in areas projected to have a high probability of Marcellus well development, with 132 considered to be globally rare or critically endangered or imperiled in Pennsylvania. Several of these species have all or most of their known populations in Pennsylvania in high probability Marcellus gas development areas.

- Marcellus gas development is projected to be extensive across Pennsylvania's 4.5 million acres of public lands, including State Parks, State Forests, and State Game Lands. Just over 10 percent of these lands are legally protected from surface development.[160]

Increased gas production will exacerbate these problems, which is bad news for the state's lands and wildlife and the hunting, angling, tourism, and forestry industries that depend on them. Although TNC adds that impacts could be reduced with proper planning,[161] more development makes mitigation more difficult. Indeed, the Pennsylvania Department of Conservation and Natural Resources recently concluded that "zero" remaining acres of the state forests are suitable for leasing with surface disturbing activities, or the forests will be significantly degraded.[162]

These land disturbance effects will harm rural economies and decrease property values, as major gas infrastructure transforms and distorts the existing landscape. They will also harm endangered species in regions where production would increase in response to EOS's exports. Harm to these species and their habitat is inconsistent with the profound public interest in land and species conservation, as expressed in the Endangered Species Act and similar statutes.

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[160] Pennsylvania Energy Impacts Assessment, *supra* n.154, at 29.
[161] *See id.*
[162] Penn. Dep't of Conservation and Natural Resources, Impacts of Leasing Additional State Forest for Natural Gas Development (2011), attached as Exhibit 72.

iii. Gas Production Poses Risks to Ground and Surface Water

As noted above, most of the increased production that would result from EOS's proposal will likely be from shale and other unconventional gas sources, and producing gas from these sources requires hydraulic fracturing, or fracking.[163] Hydraulic fracturing involves injecting a base fluid (typically water),[164] sand or other proppant, and various fracturing chemicals into the gas-bearing formation at high pressures to fracture the rock and release additional gas. Each step of this process presents a risk to water resources. Withdrawal of the water may overtax the water source. Fracking itself may contaminate groundwater with either chemicals added to the fracturing fluid or with naturally occurring chemicals mobilized by fracking. After the well is fracked, some water will return to the surface, composed of both fracturing fluid and naturally occurring "formation" water. This water, together with drilling muds and drill cuttings, must be disposed of without further endangering water resources.

Water Withdrawals

Fracking requires large quantities of water. The precise amount of water varies by the shale formation being fracked. The amount of water varies by well and by formation. For example, estimates of water needed to frack a Marcellus Shale wells range from 4.2 to over 7.2 million gallons.[165] In the Gulf States' shale formations (Barnett, Haynesville, Bossier, and Eagle Ford), fracking a single well requires from 1 to over 13 million gallons of water, with averages between 4 and 8 million gallons.[166] Fresh water constitutes 80% to 90% of the total water used to frack a well even where operators recycle "flowback" water from the fracking of previous wells for use in drilling the current one.[167] Many wells are fractured multiple times over their productive life.

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[163] *See* DOE, Shale Gas Production Subcommittee First 90-Day Report, *supra* n.81, at 8.

[164] The majority of hydraulic fracturing operations are conducted with a water-based fracturing fluid. Fracking may also be conducted with oil or synthetic-oil based fluid, with foam, or with gas.

[165] TNC, Pennsylvania Energy Impacts Assessment, *supra* n.154, at 10, 18; *accord* NY RDSGEIS, *supra* n.155, at 6-10 ("Between July 2008 and February 2011, average water usage for high-volume hydraulic fracturing within the Susquehanna River Basin in Pennsylvania was 4.2 million gallons per well, based on data for 553 wells."). Other estimates suggest that as much as 7.2 million gallons of frack fluid may be used in a 4000 foot well bore. NRDC, *et al.*, *Comment on NY RDSGEIS on the Oil, Gas and Solution Mining Regulatory Program* (Jan. 11, 2012) (Attachment 2, Report of Tom Myers, at 10), attached as Exhibit 73 ("Comment on NY RDSGEIS").

[166] Jean-Philippe Nicot, *et al.*, *Draft Report – Current and Projected Water Use in the Texas Mining and Oil and Gas Industry*, 52-54 (Feb. 2011) (water use from 1 to over 13 million gallons), attached as Exhibit 74; Jean-Philippe Nicot, *et al.*, *Oil & Gas Water Use in Texas: Update to the 2011 Mining Water Use Report* 11-14 (Sept. 2012) (updated data presented as averages), attached as Exhibit 75**.** DOE's Shale Gas Subcommittee generally states that nationwide, fracking an individual well requires between 1 and 5 million gallons of water. DOE, Shale Gas Production Subcommittee First 90-Day Report, *supra* n.81, at 19.

[167] NY RDSGEIS, *supra* n.155, at 6-13; *accord* Nicot 2012, *supra* n.166, at 54.

Water withdrawals can drastically impact aquatic ecosystems and human communities. Reductions in instream flow negatively affect aquatic species by changing flow depth and velocity, raising water temperature, changing oxygen content, and altering streambed morphology.[168] Even when flow reductions are not themselves problematic, the intake structures can harm aquatic organisms.[169] Where water is withdrawn from aquifers, rather than surface sources, withdrawal may cause permanent depletion of the source. This risk is even more prevalent with withdrawals for fracking than it is for other withdrawals, because fracking is a consumptive use. Fluid injected during the fracking process is intended to be deposited below freshwater aquifers and into sealed formations.[170] Thus, the water withdrawn from the aquifer will be used in a way that does not recharge it.

Groundwater Contamination

Fracturing poses a serious risk of groundwater contamination. Contaminants include chemicals added to the fracturing fluid and naturally occurring chemicals that are mobilized from deeper formations to groundwater via the fracking process. Contamination may have several causes, such as improper well siting, poor well design and construction, including casing and cementing; blow-outs and other catastrophic accidents; leaks in wells, pipes, and waste pits; spills of hydraulic fracturing chemicals and waste; fracturing operations that were inappropriately conducted near an improperly plugged well, fractures that grew out of zone, or a combination of these causes. Although information on groundwater contamination is incomplete, the available research indicates that contamination has already occurred on multiple occasions.

One category of potential contaminants includes chemicals added to the drilling mud and fracturing fluid. The fluid used for slickwater fracturing is typically comprised of more than 98% fresh water and sand, with chemical additives comprising 2% or less of the fluid.[171] Chemicals are added as solvents, surfactants, friction reducers, gelling agents, bactericides, and for other purposes.[172] New York recently identified 322 unique ingredients used in fluid additives, recognizing that this constituted a partial list.[173] These chemicals include petroleum distillates; aromatic hydrocarbons; glycols; glycol ethers; alcohols and aldehydes; amides; amines; organic acids, salts, esters and related

[168] NY RDSGEIS, *supra* n.155, at 6-3 to 6-4, *see also* Maya Weltman-Fahs, Jason M. Taylor, *Hydraulic Fracturing and Brook Trout Habitat in the Marcellus Shale Region: Potential Impacts and Research Needs*, 38 Fisheries 4, 6-7 (Jan. 2013), attached as Exhibit 76.
[169] NY RDSGEIS, *supra* n.155, at 6-4.
[170] *Id.* at 6-5; First 90-Day Report, *supra* n.81, at 19 ("[I]n some regions and localities there are significant concerns about consumptive water use for shale gas development.").
[171] NY RDSGEIS, *supra* n.155, at 5-40.
[172] *Id.* at 5-49.
[173] *Id.* at 5-41.

chemicals; microbicides; and others. Many of these chemicals present health risks.[174] Of particular note is the use of diesel, which the DOE Subcommittee has singled out for its harmful effects and recommended be banned from use as a fracturing fluid additive.[175] The minority staff of the House Committee on Energy and Commerce has determined that, despite diesel's risks, between 2005 and 2009 "oil and gas service companies injected 32.2 million gallons of diesel fuel or hydraulic fracturing fluids containing diesel fuel in wells in 19 states."[176]

Contamination may also result from chemicals naturally occurring in the formation. Flowback and produced water "may include brine, gases (e.g. methane, ethane), trace metals, naturally occurring radioactive elements (e.g. radium, uranium) and organic compounds."[177] For example, mercury naturally occurring in the formation becomes mixed in with water-based drilling muds, resulting in up to 5 pounds of mercury in the mud per well drilled in the Marcellus region.[178]

There are several vectors by which these chemicals can reach groundwater supplies. Perhaps the most common or significant are inadequacies in the casing of the vertical well bore.[179] The well bore inevitably passes through geological strata containing groundwater, and therefore provides a conduit by which chemicals injected into the well or traveling from the target formation to the surface may reach groundwater. The well casing isolates the groundwater from intermediate strata and the target formation. This casing must be strong enough to withstand the pressures of the fracturing process—the very purpose of which is to shatter rock. Multiple layers of steel casing must be used, each pressure tested before use, then centered within the well bore. Each layer of casing must be cemented, with careful testing to ensure the integrity of the cementing.[180]

Separate from casing failure, contamination may occur when the zone of fractured rock intersects an abandoned and poorly sealed well or natural conduit in the rock.[181] One

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[174] *Id.* at 5-75 to 5-78.
[175] DOE, Shale Gas Production Subcommittee First 90-Day Report, *supra* n.81, at 25.
[176] Natural Resources Defense Council, Earthjustice, and Sierra Club, Comments [to EPA] on Permitting Guidance for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels 3, (June 29, 2011) (quoting Letter from Reps. Waxman, Markey, and DeGette to EPA Administrator Lisa Jackson 1 (Jan. 31, 2001)) ("Comment on Diesel Guidance"), attached as Exhibit 77.
[177] Shale Gas Production Subcommittee First 90-Day Report, *supra* n.81, at 21; *see also* Comment on NY RDSGEIS, *supra* n.165, attachment 3, Report of Glen Miller, at 2.
[178] Comment on NY RDSGEIS, *supra* n.165, attachment 1, Report of Susan Harvey, at 92.
[179] DOE, Shale Gas Production Subcommittee First 90-Day Report, *supra* n.81, at 20.
[180] Comment on Diesel Guidance, *supra* n.176, at 5-9.
[181] Comment on NY RDSGEIS, *supra* n.165, attachment 3, Report of Tom Myers, at 12-15.

recent study concluded, on the basis of geologic modeling, that frack fluid may migrate from the hydraulic fracture zone to freshwater aquifers in less than ten years.[182]

Available empirical data indicates that fracking has resulting in groundwater contamination in at least five documented instances. One study "documented the higher concentration of methane originating in shale gas deposits . . . into wells surrounding a producing shale production site in northern Pennsylvania."[183] By tracking certain isotopes of methane, this study – which the DOE Subcommittee referred to as "a recent, credible, peer-reviewed study" determined that the methane originated in the shale deposit, rather than from a shallower source.[184] Two other reports "have documented or suggested the movement of fracking fluid from the target formation to water wells linked to fracking in wells."[185] "Thyne (2008)[[186]] had found bromide in wells 100s of feet above the fracked zone. The EPA (1987)[[187]] documented fracking fluid moving into a 416-foot deep water well in West Virginia; the gas well was less than 1000 feet horizontally from the water well, but the report does not indicate the gas-bearing formation."[188]

More recently, EPA has investigated groundwater contamination in Pavillion, Wyoming and Dimock, Pennsylvania. In the Pavillion investigation, EPA's draft report concludes that "when considered together with other lines of evidence, the data indicates likely impact to ground water that can be explained by hydraulic fracturing."[189] EPA tested water from wells extending to various depths within the range of local groundwater. At the deeper tested wells, EPA discovered inorganics (potassium, chloride), synthetic organic (isopropanol, glycols, and tert-butyl alcohol), and organics (BTEX, gasoline and

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[182] Tom Myers, *Potential Contaminant Pathways from Hydraulically Fractured Shale to Aquifers* (Apr. 17, 2012), attached as Exhibit 78.

[183] DOE, Shale Gas Production Subcommittee First 90-Day Report at 20 (citing Stephen G. Osborn, Avner Vengosh, Nathaniel R. Warner, and Robert B. Jackson, *Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing*, Proceedings of the National Academy of Science, 108, 8172-8176, (2011), attached as Exhibit 79).

[184] *Id.*

[185] Comment on NY RDSGEIS, *supra* n.165, attachment 3, Report of Tom Myers, at 13.

[186] Dr. Myers relied on Geoffrey Thyne, *Review of Phase II Hydrogeologic Study* (2008), prepared for Garfield County, Colorado, *available at* http://cogcc.state.co.us/Library/Presentations/Glenwood_Spgs_HearingJuly_2009/(1_A)_ReviewofPhase-II-HydrogeologicStudy.pdf.

[187] Environmental Protection Agency, *Report to Congress, Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy*, vol. 1 (1987), *available at* nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=20012D4P.txt, attached as Exhibit 80.

[188] Comment on NY RDSGEIS, *supra* n.165, attachment 3, Report of Tom Myers, at 13.

[189] EPA, Draft Investigation of Ground Water Contamination near Pavillion, Wyoming, at xiii (2011), available at http://www.epa.gov/region8/superfund/wy/pavillion/EPA_ReportOnPavillion_Dec-8-2011.pdf, attached as Exhibit 81. EPA has not yet released a final version of this report, instead recently extending the public comment period to September 30, 2013. 78 Fed. Reg. 2396 (Jan. 11, 2013).

diesel range organics) at levels higher than expected.[190] At shallower levels, EPA detected "high concentrations of benzene, xylenes, gasoline range organics, diesel range organics, and total purgeable hydrocarbons."[191] EPA determined that surface pits previously used for storage of drilling wastes and produced/flowback waters were a likely source of contamination for the shallower waters, and that fracturing likely explained the deeper contamination.[192] The U.S. Geological Survey, in cooperation with the Wyoming Department of Environmental Quality, also provided data regarding chemicals found in wells surrounding Pavillion.[193] Although the USGS did not provide analysis regarding the likely source of the contaminants found, an independent expert who reviewed the USGS and EPA data at the request of Sierra Club and other environmental groups concluded that the USGS data supports EPA's findings.[194] EPA stated that it would turn further investigation of contamination of Pavillion over to Wyoming, such that EPA will not finalize its draft report, but that EPA "stands behind its work and data" in the draft report.[195]

EPA also identified elevated levels of hazardous substances in home water supplies near Dimock, Pennsylvania.[196] EPA's initial assessment concluded that "a number of home wells in the Dimock area contain hazardous substances, some of which are not naturally found in the environment," including arsenic, barium, bis(2(ethylhexyl)phthalate, glycol compounds, manganese, phenol, and sodium.[197] Arsenic, barium, and manganese were present in five home wells "at levels that could present a health concern."[198] Many of these chemicals, including arsenic, barium, and manganese, are hazardous substances as defined under CERCLA section 101(14). *See* 42 U.S.C. § 9604(a); 40 C.F.R. § 302.4. EPA's assessment was based in part on "Pennsylvania Department of Environmental Protection (PADEP) and Cabot Oil and Gas Corporation (Cabot) sampling information,

[190] *Id.* at xii.
[191] *Id.* at xi.
[192] *Id.* at xi, xiii.
[193] USGS, *Groundwater-Quality and Quality-Control Data for two Monitoring Wells near Pavillion, Wyoming, April and May 2012*, USGS Data Series 718 p.25 (2012), attached as Exhibit 82.
[194] Tom Myers, *Assessment of Groundwater Sampling Results Completed by the U.S. Geological Survey* (Sept. 30, 2012), attached as Exhibit 83. Another independent expert, Rob Jackson of Duke University, has stated that the USGS and EPA data is "suggestive" of fracking as the source of contamination. Jeff Tollefson, *Is Fracking Behind Contamination in Wyoming Groundwater?*, Nature (Oct. 4, 2012), attached as Exhibit 84. *See also* Tom Myers, *Review of DRAFT: Investigation of Ground Water Contamination near Pavillion Wyoming* (April 30, 2012) (concluding that EPA's initial study was well-supported), attached as Exhibit 85.
[195] http://www2.epa.gov/region8/pavillion (last accessed Aug. 2, 2013), attached as Exhibit 86.
[196] EPA Region III, Action Memorandum - Request for Funding for a Removal Action at the Dimock Residential Groundwater Site (Jan. 19, 2012), available at http://www.epaosc.org/sites/7555/files/Dimock%20Action%20Memo%2001-19-12.PDF, attached as Exhibit 87; EPA, *EPA Completes Drinking Water Sampling in Dimock, Pa.* (Jul. 25, 2012), attached as Exhibit 88.
[197] EPA Region III Action Memorandum, *supra* n.196 , at 1, 3-4.
[198] *EPA Completes Drinking Water Sampling in Dimock, Pa.*, *supra* n.196.

consultation with an EPA toxicologist, the Agency for Toxic Substances and Disease Registry (ATSDR) Record of Activity (AROA), issued, 12/28/11, and [a] recent EPA well survey effort."[199] The PADEP information provided reason to believe that drilling activities in the area led to contamination of these water supplies. Drilling in the area began in 2008, and was conducted using the hazardous substances that have since been discovered in well water. Shortly thereafter methane contamination was detected in private well water. The drilling also caused several surface spills. Although EPA ultimately concluded that the five homes with potentially unsafe levels of hazardous substances had water treatment systems sufficient to mitigate the threat, [200] the Dimock example indicates the potential for gas development to contaminate groundwater.

The serious groundwater contamination problems experienced at the Pavillion and Dimock sites demonstrate a possibility of contamination, and attendant human health risks. Such risks are not uncommon in gas field sites, and will be intensified by production for export. DOE/FE must account for these risks, as well, in its economic evaluation.

Waste Management

Fracturing produces a variety of liquid and solid wastes that must be managed and disposed of. These include the drilling mud used to lubricate the drilling process, the drill cuttings removed from the well bore, the "flowback" of fracturing fluid that returns to the surface in the days after fracking, and produced water that is produced over the life of the well (a mixture of water naturally occurring in the shale formation and lingering fracturing fluid). Because these wastes contain the same contaminants described in the preceding section, environmental hazards can arise from their management and ultimate disposal.

On site, drilling mud, drill cuttings, flowback and produced water are often stored in pits. Open pits can have harmful air emissions, can leach into shallow groundwater, and can fail and result in surface discharges. Many of these harms can be minimized by the use of seal tanks in a "closed loop" system.[201] Presently, only New Mexico mandates the use of closed loop waste management systems, and pits remain in use elsewhere.

Flowback and produced water must ultimately be disposed of offsite. Some of these fluids may be recycled and used in further fracturing operations, but even where a fluid recycling program is used, recycling leaves concentrated contaminants that must be disposed of. The most common methods of disposal are disposal in underground

[199] EPA Region III Action Memorandum, *supra* n.196 , at 1.
[200] *EPA Completes Drinking Water Sampling in Dimock, Pa.*, *supra* n.196.
[201] *See, e.g.,* NY RDSGEIS, *supra* n.155, at 1-12.

injection wells or through water treatment facilities leading to eventual surface discharge.

Underground injection wells present risks of groundwater contamination similar to those identified above for fracking itself. Gas production wastes are not categorized as hazardous under the Safe Drinking Water Act, 42 U.S.C. § 300f *et seq.*, and may be disposed of in Class II injection wells. Class II wells are brine wells, and the standards and safeguards in place for these wells were not designed with the contaminants found in fracking wastes in mind.[202]

Additionally, underground injection of fracking wastes appears to have induced earthquakes in several regions. For example, underground injection of fracking waste in Ohio has been correlated with earthquakes as high as 4.0 on the Richter scale.[203] Underground injection may cause earthquakes by causing movement on existing fault lines: "Once fluid enters a preexisting fault, it can pressurize the rocks enough to move; the more stress placed on the rock formation, the more powerful the earthquake."[204] Underground injection is more likely than fracking to trigger large earthquakes via this mechanism "because more fluid is usually being pumped underground at a site for longer periods."[205] In light of the apparent induced seismicity, Ohio has put a moratorium on injection in the affected region. Similar associations between earthquakes and injection have occurred in Arkansas, Texas, Oklahoma and the United Kingdom.[206] In light of these effects, Ohio and Arkansas have placed moratoriums on injection in the affected areas.[207] The recently released abstract of a forthcoming United States Geological Survey study affirms the connection between disposal wells and earthquakes.[208]

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[202] *See* NRDC et al., Petition for Rulemaking Pursuant to Section 6974(a) of the Resource Conservation and Recovery Act Concerning the Regulation of Wastes Associated with the Exploration, Development, or Production of Crude Oil or Natural Gas or Geothermal Energy (Sept. 8, 2010), attached as Exhibit 89.
[203] Columbia University, Lamont-Doherty Earth Observatory, Ohio Quakes Probably Triggered by Waste Disposal Well, Say Seismologists (Jan. 6, 2012), available at http://www.ldeo.columbia.edu/news-events/seismologists-link-ohio-earthquakes-waste-disposal-wells, attached as Exhibit 90.
[204] *Id.*
[205] *Id.*
[206] *Id.*; *see also* Alexis Flynn, Study Ties Fracking to Quakes in England, Wall Street Journal (Nov. 3, 2011), *available at* http://online.wsj.com/article/ SB10001424052970203804204577013771109580352.html, attached as Exhibit 91.
[207] Lamont-Doherty Earth Observatory; Arkansas Oil and Gas Commission, Class II Commercial Disposal Well or Class II Disposal Well Moratorium (Aug. 2, 2011), *available at* http://www.aogc.state.ar.us/Hearing%20Orders/2011/July/180A-2-2011-07.pdf, attached as Exhibit 92.
[208] Ellsworth, W. L., et al., Are Seismicity Rate Changes in the Midcontinent Natural or Manmade?, Seismological Society of America, (April 2012), available at http://www2.seismosoc.org/FMPro?-db=Abstract_Submission_12&-recid=224&-format=%2Fmeetings%2F2012%2Fabstracts%2Fsessionabstractdetail.html&-lay=MtgList&-find, attached as Exhibit 93.

As an alternative to underground injection, flowback and produced water is also sent to water treatment facilities, leading to eventual surface discharge. This presents a separate set of environmental hazards, because these facilities (particularly publicly owned treatment works) are not designed to handle the nontraditional pollutants found in fracking wastes. For example:

> One serious problem with the proposed discharge (dilution) of fracture treatment wastewater via a municipal or privately owned treatment plant is the observed increases in trihalomethane (THM) concentrations in drinking water reported in the public media (Frazier and Murray, 2011), due to the presence of increased bromide concentrations. Bromide is more reactive than chloride in formation of trihalomethanes, and even though bromide concentrations are generally lower than chloride concentrations, the increased reactivity of bromide generates increased amounts of bromodichloromethane and dibromochloromethane (Chowdhury, et al., 2010). Continued violations of an 80microgram/L THM standard may ultimately require a drinking water treatment plant to convert from a standard and cost effective chlorination disinfection treatment to a more expensive chloramines process for water treatment. Although there are many factors affecting THM production in a specific water, simple (and cheap) dilution of fracture treatment water in a stream can result in a more expensive treatment for disinfection of drinking water. This transfer of costs to the public should not be permitted.[209]

Similarly, municipal treatment works typically to not treat for radioactivity, whereas produced water can have high levels of naturally occurring radioactive materials. In one examination of three samples of produced water, radioactivity (measured as gross alpha radiation) were found ranging from 18,000 pCi / L to 123,000 pCi/L, whereas the safe drinking water standard is 15 pCi/L.[210]

3. Other Nationwide and Global Environmental Impacts

a. Changes in Domestic Power Production

EOS's export proposal will further increase air pollution by increasing the amount of coal used for domestic electricity production. The EIA Export Study predicts that exports, by

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[209] Comment on NY RDSGEIS, *supra* n.165, attachment 3, Report of Glen Miller, at 13.
[210] *Id.* at 4.

causing natural gas prices to rise, will a shift from natural gas powered electricity generation to other forms of generation. According to the EIA,this shift will "primarily" be to coal-fired generation, and only secondarily to renewable sources.[211] Specifically, EIA predicts that 72 percent of the decrease in gas-fired electricity production will be replaced by coal-fired production, with increased liquid fuel consumption, increased renewable generation, and decreases in total consumption making up the remainder (8, 9, and 11 percent, respectively).[212]

The shift from gas- to coal-fired electricity generation will increase emissions of both traditional air pollutants and greenhouse gases. Gas-fired power plants generate less than a third of the nitrogen oxides and one percent of the sulfur oxides that coal-fired plants generate.[213] Thus, the EIA Export Study demonstrates that exports will harm the local environment by causing the opposite shift here.[214]

Coal-fired plants also release roughly twice the carbon dioxide combustion emissions as gas-fired plants, although, as discussed in the following section, some of this combustion advantage is offset by the greenhouse gas emissions resulting from gas production. Accordingly, the price increase and corresponding shift to coal-fired power generation risks increasing greenhouse gas pollution. The *EIA Export Study* concluded that under every scenario modeled, exports would produce a significant increase in domestic greenhouse gas emissions, as illustrated by the table below. As we explain in the following section, however, the comparative life-cycle emissions of natural gas and coal are uncertain. Before authorizing a fundamental change in domestic energy markets, DOE/FE should seek out or commission efforts to resolve this uncertainty.

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[211] EIA Export Study, *supra* n.3, at 6; *see also id.* at 17 ("[H]igher natural gas prices lead electric generators to burn more coal and less natural gas.").

[212] *Id.* at 18.

[213] EPA, Air Emissions, http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html (last visited Dec. 12, 2012), attached as Exhibit 94.

[214] The NERA report did not examine shifts within the domestic power sector in detail, and the NERA study authors acknowledge that EIA uses a more sophisticated model that is better able to predict electricity sector responses to gas prices. The NERA report explains that "EIA's NEMS model has a detailed bottom-up representation of the electricity sector, while the electricity sector in the NERA model is a nested CES function with limited technologies. This means that NEMS allows for switching from natural gas-based generation to other technology types easily, while the possibility of switching out of natural gas is more limited and controlled in the NERA model." NERA Study, *supra* n.3, at 207 (appx. D, figs. 176-78 and accompanying text). Thus, although the NERA study predicts a smaller electricity sector response to gas prices than did the EIA, *id.*, DOE/FE should rely on the more sophisticated EIA predictions.

Table 2: Cumulative CO_2 Emissions from 2015 to 2035 With Various Export Scenarios[215]

Case	no added exports	low/slow	low/rapid	high/slow	high/rapid
Reference					
Cumulative carbon dioxide emissions	125,056	125,699	125,707	126,038	126,283
Change from baseline		643	651	982	1,227
Percentage change from baseline		0.5%	0.5%	0.8%	1.0%
High Shale EUR					
Cumulative carbon dioxide emissions	124,230	124,888	124,883	125,531	125,817
Change from baseline		658	653	1,301	1,587
Percentage change from baseline		0.5%	0.5%	1.0%	1.3%
Low Shale EUR					
Cumulative carbon dioxide emissions	125,162	125,606	125,556	125,497	125,670
Change from baseline		444	394	335	508
Percentage change from baseline		0.4%	0.3%	0.3%	0.4%
High Economic Growth					
Cumulative carbon dioxide emissions	131,675	131,862	132,016	131,957	132,095
Change from baseline		187	341	282	420
Percentage change from baseline		0.1%	0.3%	0.2%	0.3%

Source: U.S. Energy Information Administration, National Energy Modeling System, with emissions related to natural gas assumed to be consumed in the liquefaction process included.

b. Effects on Global Greenhouse Gas Emissions

As explained above, LNG exports will increase domestic greenhouse gas emissions, as a result of emissions from the production and liquefaction processes as well as by shifting electricity generation from gas to coal. LNG exports are likely to increase global greenhouse gas as well. DOE/FE must reject EOS's unsupported assertion that LNG exports will reduce global greenhouse gas emissions.

EOS's argument is premised on the assumption that countries importing LNG will substitute natural gas for coal. This assumption is unwarranted. The International Energy Agency's *Golden Rules for a Golden Age of Gas* report predicts that international trade in LNG and other measures to increase global availability of natural gas will lead many countries to use natural gas in place of wind, solar, or other renewables, displacing these more environmentally beneficial energy sources instead of displacing other fossil fuels, and that these countries may also increase their overall energy consumption beyond the level that would occur with exports.[216] In the United States alone, the IEA expects the gas boom to result in a 10% reduction in renewables relative

[215] From the *EIA Export Study*, *supra* n.3, at 19.
[216] International Energy Agency, *Golden Rules for a Golden Age of Gas*, Ch. 2 p. 91 (2012), available at http://www.iea.org/publications/freepublications/publication/WEO2012_GoldenRulesReport.pdf, attached as Exhibit 95.

to a baseline world without increased gas use and trade.[217] The IEA goes on to conclude that high levels of gas production and trade will produce "only a small net shift" in global greenhouse gas emissions, with atmospheric CO_2 levels stabilizing at over 650 ppm and global warming in excess of 3.5 degrees Celsius, "well above the widely accepted 2°C target."[218] Another recent study, prepared by the Joint Institute for Strategic Energy Analysis (JISEA), also modeled power sector futures resulting from increasing U.S. reliance on natural gas, concluding that increased use of gas for power generation in the US would significantly decrease the rate of growth in wind energy.[219] This dynamic likely applies elsewhere as well.

Second, even where importing countries do substitute gas for coal or fuel oil, this substitution is likely to cause little, if any, reduction in global greenhouse gas emissions. One reason for this is that LNG has life-cycle emissions that are significantly higher than other sources of natural gas. Liquefying natural gas is an energy intensive process. Additional energy is then consumed in the transportation of the LNG, with attendant greenhouse gas emissions. Finally, the LNG must be regasified at the import terminal, often through the use of heat generated by the burning of yet more natural gas. Paulina Jaramillo *et al.* have estimated that these operations drastically increase the lifecycle greenhouse gas emissions of LNG relative to traditionally delivered natural gas, adding between 13.85 and 51.7 pounds of CO_2e per MMBtu on top of the emissions inherent in gas production and the 120 pounds of CO_2e per MMBtu emitted by gas combustion.[220] Jaramillo's more narrow estimates put CO_2e the emissions attributable to LNG at 19% to

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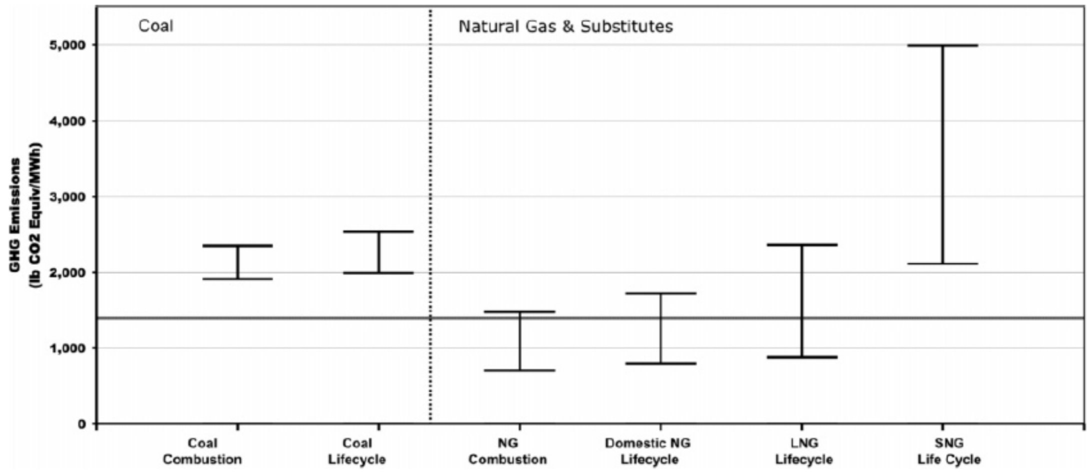
[217] *Id.* at 80.
[218] *Id.*
[219] Jeffrey Logan et al., Joint Inst. for Strategic Analysis, Natural Gas and the Transformation of the U.S. Energy Sector, at 98 (2012) ("JISEA report"), available at http://www.nrel.gov/docs/fy13osti/55538.pdf, attached as Exhibit 96
[220] Paulina Jaramillo, W. Michael Griffin, H. Scott Matthews, Comparative Life-Cycle Air Emissions of Coal, Domestic Natural Gas, LNG, and SNG for Electricity Generation, 41 Environ. Sci. Technol. 6,290 (2007) ("Jaramillo 2007"), *available at* http://www.ce.cmu.edu/~gdrg/readings/2007/09/13/Jaramillo_ComparativeLCACoalNG.pdf, attached as Exhibit 97. The cited estimate for the greenhouse gas emissions of liquefaction, transport, and regasification are derived by adding figures for these phases recorded in Figure 6S, p. 9 the supporting information for this article, which is available at http://pubs.acs.org/doi/suppl/10.1021/es063031o/suppl_file/ es063031osi20070516_042542.pdf, and is attached as Exhibit 98 ("Jaramillo Supporting Information"). An earlier, related report with some additional information is Paulina Jaramillo, W. Michael Griffin, H. Scott Matthews, *Comparative Life Cycle Carbon Emissions of LNG Versus Coal and Gas for Electricity Generation* (2005), available at http://www.ce.cmu.edu/~gdrg/readings/2005/10/12/Jaramillo_LifeCycleCarbonEmissionsFromLNG.pdf, and attached as Exhibit 99. A more recent study reached a similar conclusion, suggesting that U.S. LNG may be about 15% more carbon-intensive than ordinary gas. Testimony of James Bradbury, World Resources Institute, Before the U.S. House of Representatives, Energy and Commerce Subcommittee on Energy and Power (May 7, 2013) at 15 (drawing on data from recent life cycle assessments), attached as Exhibit 100, available at http://docs.house.gov/meetings/IF/IF03/20130507/100793/HHRG-113-IF03-Wstate-BradburyJ-20130507.pdf

23% higher than non-liquefied gas.[221] Using what are now out-of-date estimates of traditional gas's lifecycle emissions, Jaramillo concluded LNG's lifecycle greenhouse gas emissions can bring LNG into parity with coal:

Figure 2: Life-Cycle Emissions of LNG, Natural Gas, and Coal in Electricity Generation[222]



Jaramillo's analysis may understate LNG's lifecycle greenhouse gas emissions, because this analysis does not reflect recent studies that have raised estimates for emissions associated with natural gas production. Jaramillo used pre-shale-gas-boom estimates of gas's non-combustion, non-LNG-specific lifecycle emissions between 15.3 to 20.1 pounds CO_2e/ MMBtu.[223] Studies conducted since the shale gas boom estimate that domestic natural gas production (including conventional and unconventional production) releases on average at least 44 pounds of CO_2e per MMBtu, at least 24 pounds higher than Jaramillo's estimates. A report from the Worldwatch Institute and Deutsche Bank summarizes much of the recent work.[224] Specifically, the Worldwatch Report synthesizes three other reports that used "bottom-up" methodologies to estimate natural gas production emissions, prepared by Dr. Robert Howarth et al., of Cornell,[225] Mohan Jiang et al. of Carnegie-Mellon,[226] and Timothy Skone of NETL.[227] The

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[221] *See, e.g.*, Jaramillo Supporting Info, *supra* n.220, at 9.

[222] From Jaramillo 2007, *supra* n.220, at 6,295. "SNG," in the figure, refers to synthetic natural gas made from coal.

[223] Jaramillo Supporting Information, *supra* n.220, at 8.

[224] Mark Fulton *et al.*, *Comparing Life-Cycle Greenhouse Gas Emissions from Natural Gas and Coal* (Aug. 25, 2011) ("Worldwatch Report"), attached as Exhibit 101.

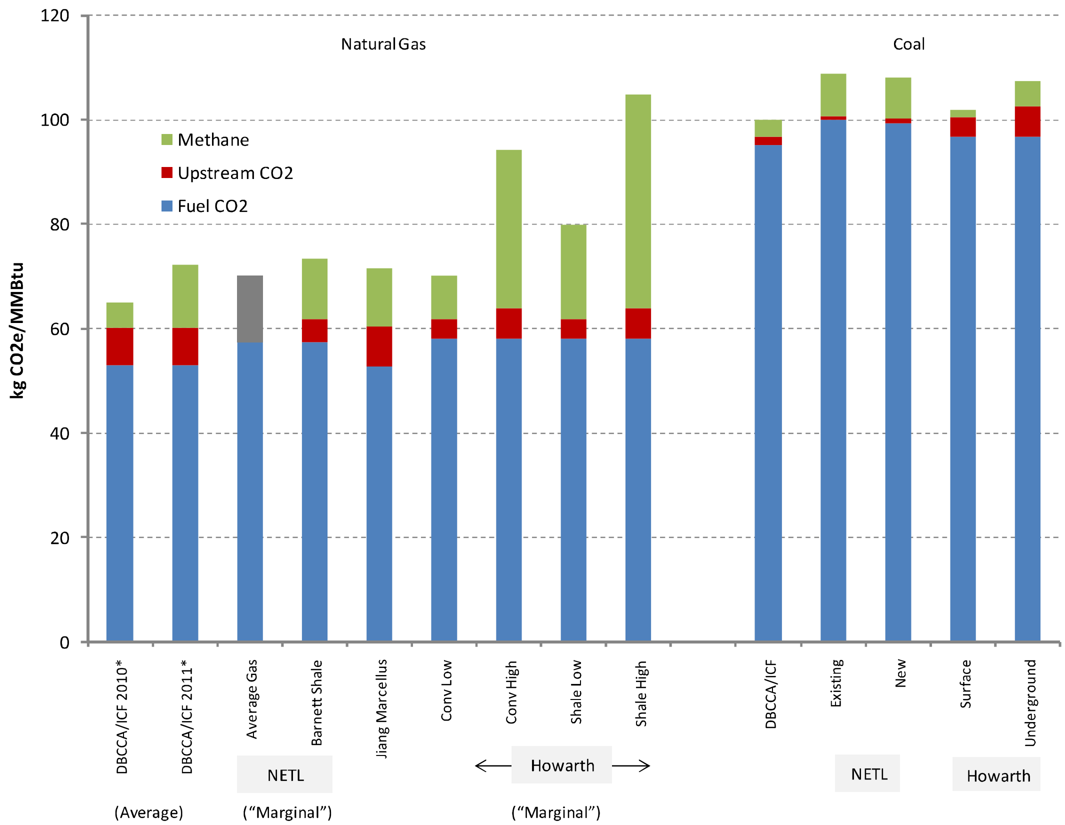
[225] Robert W. Howarth *et al*., *Methane and the greenhouse-gas footprint of natural gas from shale formations*, Climactic Change (Mar. 2011), attached as Exhibit 102.

[226] Mohan Jiang *et al.*, *Life cycle greenhouse gas emissions of Marcellus shale gas*, Environ. Res. Letters 6 (Aug. 2011), attached as Exhibit 103.

[227] Timothy J. Skone, *Life Cycle Greenhouse Gas Analysis of Natural Gas Extraction and Delivery in the United States*, Presentation to Cornell (May 12, 2011), attached as Exhibit 104. NETL has also published a fuller version of this analysis. *See also* Timothy J. Skone, *Life Cycle Greenhouse Gas Inventory of Natural Gas Extraction, Delivery and Electricity Production* (Oct. 24, 2011), attached as Exhibit 105.

Worldwatch Report separately derived a "top-down" estimate, which produced a result similar to the NETL estimate.[228] These various assessments are summarized in the following chart.

Figure 3: Comparison of Recent Life-Cycle Assessments[229]



Source: DBCCA Analysis 2011; NETL 2011; Jiang 2011; Howarth 2011. Note: NETL Average Gas study includes bar shaded grey due to inability to segregate upstream CO2 and methane values, which were both accounted for in the study. See page 10 for more information. *2011 EPA methodology compared to 2010.

As this figure demonstrates, although the 2011 studies differ, most of them estimate production greenhouse gas emissions (combined methane and "upstream CO_2") in a similar range. Synthesizing these studies, the Worldwatch Report estimated normalized life-cycle GHG emissions from domestic natural gas production (*i.e.*, excluding liquefaction, transport, and gasification of LNG) at approximately 20.1 kilograms, or over 44 pounds, of CO_2e/MMBtu,[230] beyond the 120 pounds of CO_2e/MMBtu emitted by gas combustion. Moreover, as the above figure shows, some studies estimate that production emissions are significantly higher. Two studies completed after the Worldwatch report provide further evidence that unconventional gas production has

[228] Worldwatch Report, *supra* n.224, at 9.
[229] *Id.* at 3.
[230] *Id.* at 15 Ex. 8.

high lifecycle emissions: one in line with the Worldwatch synthesis, finding that production adds approximately 23kg of CO_2e/MMbtu;[231] and another finding drastically higher emissions.[232] Updating Jaramillo's calculations to use these more recent lifecycle emissions estimates further erodes what little climate advantage Jaramillo found LNG to have over coal. Jaramillo estimated total life-cycle emissions for LNG at 149.6 to 192.3 lbs CO_2e/MMBtu.[233] Simply increasing these life-cycle estimates by 24 lbs CO_2e represents an additional 12% to 16% increase in total emissions.

To predict the effects of LNG exports, Worldwatch and Jaramillo's numbers must be increased even further because they consider the average of current U.S. production, but production induced by exports (like future increases in production generally) will include a higher proportion of unconventional gas than the current production mix, and these unconventional sources are likely to have higher greenhouse gas emissions. As noted above, the EIA Export Study predicts that extraction induced by exports will overwhelmingly be from shale gas sources.[234] Several studies have found that shale gas has higher production emissions than conventional sources. Notably, EPA recently estimated methane emissions from a conventional well completion at only 0.80 tons, while completion of a hydraulically fractured well yielded 158.55 tons of methane.[235] The possibility that unconventional production induced by exports could release substantial quantities of greenhouse gases highlights the need for a thorough study regarding the indirect and cumulative impacts of export prior to any DOE/FE authorization.[236] Further study is similarly needed to combine the analysis of export on fuel switching domestically with life-cycle emissions of LNG exports. In light of the evidence presented above, it is unlikely that LNG export will reduce global greenhouse gas emissions.

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[231] JISEA Report, *supra* n.219 (also expressing this figure as 78g CO_2e/kWh).
[232] J. Tollefson, *Methane leaks erode green credentials of natural gas*, *supra* n.85.
[233] *Id.*
[234] EIA Export Study, *supra* n.3, at 11.
[235] *See* 2011 TSD, *supra* n.82 at 4-7 (Table 4-2).
[236] Although JISEA recently found greenhouse gas emissions from unconventional production in the Barnett shale to be "similar to levels reported in the literature from conventional natural gas," JISEA, *supra* n.231, at 4, that study's estimates may be too low. First, the JISEA study used data from the Barnett Shale, which is located in an ozone nonattainment area where emissions are likely to be rigorously controlled. It is therefore possible that its results may not generalize well to production in other plays. Second, the study did not include emissions associated with liquids unloading, a practice that involves removal of liquids from the well and consequent release of greenhouse gases, based on the assumption that liquids unloading is not frequently practiced in unconventional production. A recent industry survey suggests that liquids unloading is in fact practiced in unconventional production, however, so it may be appropriate to add emissions from liquids unloading to JISEA's life-cycle emissions total. Adding emissions associated with liquids unloading would contribute an additional 6 to 28 grams of CO2e/kWh, or even 100g under low-recovery conditions. JISEA, *supra* n.231, at 29 (citing Terri Shires & Miriam Lev-On, Characterizing Pivotal Sources of Methane Emissions from Unconventional Natural Gas Production 11-14 (2012), attached as Exhibit 106).

Third and finally, we note that a course of action that leads other countries to build additional gas infrastructure to use imported LNG, which would likely entrench gas use for decades to come, is not the sort of action necessary to avoid serious climate impacts. Even if, contrary to IEA's predictions, imported LNG displaces other fossil fuels, the resulting emission reductions will be much less than those needed to stabilize atmospheric greenhouse gases below a catastrophic level.[237] DOE/FE must investigate policy options that would encourage the emissions reductions necessary to avert climate disaster, such as installation of infrastructure for renewables rather than fossil fuels. Merely slowing the rate of greenhouse gas emission growth, rather than causing emission reduction, will not avert the crisis.

4. Economic Impacts

a. Gas Price and Supply Impacts

Natural gas exports will increase domestic gas prices, and these prices will be significant enough to harm American consumers and drive shifts in domestic gas use. DOE/FE must reject EOS's assertion that the impact on prices will be "minimal[]." Exports will cause the public and domestic industry to pay significantly more for gas, but without delivering any benefit to the public in exchange for these higher prices.

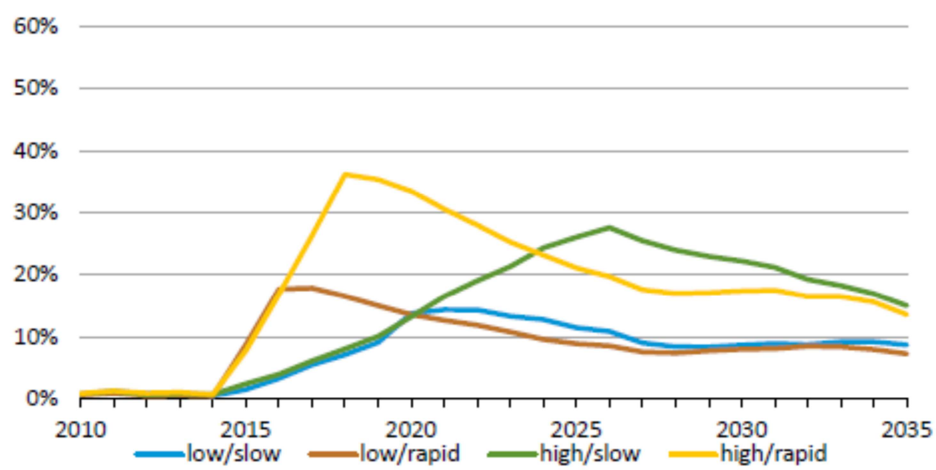
EOS's discussion of price impacts consists of unsupported and uncited assertions, with only minimal connection to EOS's actual proposal. EOS's position is also unclear. EOS ultimately acknowledges this fact, arguing that "the price impact of the Export Authorization" will be "small," and that "consumers [will] modify their behavior in response to price changes," contradicting EOS's initial assertion that "The United Stateshas natural gas resources available to meet domestic needs, as well as supply natural gas for the Export Authorization, without increasing prices over the entire 25 year period for which EOS has requested authorization." EOS App. at 21-22. EOS's contention that impacts will be small apparently rests on a study by Deloitte Marketpoint, which EOS neither provides nor cites. EOS represents that this study predicts a $0.22/MMBtu increase in Henry Hub prices in response to 6 bcf/d of LNG exports from three gulf coast terminals. *Id.* DOE/FE must reject EOS's argument, because EOS provides no basis to support this $0.22/MMBtu forecast, no basis for extrapolating from this forecast, regarding 6 bcf/d of exports, to any scenario in which EOS's proposed exports would occur, and no basis for concluding that a $0.22/MMBtu increase, or any increase to which EOS's exports contributed, would be "small." On the contrary, well supported estimates by the EIA project much larger price increases and

[237] Tom Wigley, *Coal to gas: the influence of methane leakage*, 108 Climatic Change 601, 602 (2011), Exhibit 107 http://www.usclimatenetwork.org/resource-database/report-coal-to-gas-the-influence-of-methane-leakage; Myhrvold & Caldeira, *Greenhouse gases, climate change and the transition from coal to low-carbon electricity*, 7 Environmental Research Letters (2012); Exhibit 108 http://iopscience.iop.org/1748-9326/7/1/014019/pdf/1748-9326_7_1_014019.pdf

demonstrate that these increases are large enough to significantly and adversely impact the public interest.

First, we note that even in 6 bcf/d export scenarios like the one EOS posits, the $0.22/MMBtu Henry Hub price increase EOS asserts is less than half what EIA predicts.[238] EIA considered several combinations of conditions of shale gas export rates and economic circumstances. It considered a "low" export case of 6 bcf/d, phased in either quickly or slowly starting in 2015, and a "high" case of 12 bcf/d, again phased in quickly or slowly.[239] These various export scenarios were also considered in four background scenarios: the EIA's Annual Energy Outlook ("AEO") 2011 reference case, cases where shale recoveries were 50% higher or lower than in the reference case, and a high economic growth reference case.[240] Models were run from 2015 (the year in which the first exports were presumed to begin) through 2035.[241] EIA forecast effects of export on wellhead gas prices, on various gas consumers, and on residential electricity bills.[242] The study summarizes its results for its four export scenarios on the reference economic case as follows:

Figure 4:[243] Natural Gas Wellhead Price Percentage Increases from the AEO 2011 Baseline under Four Export Scenarios



These reference case scenarios predict 2025 Henry Hub price increases of 10 to 13 percent for 6 bcf/d of exports 14 to 26 percent for 12 bcf/d.[244]

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[238] *EIA Export Study*, *supra* n.3, at Table B4. For other export scenarios in the reference case, EIA's estimates range from $0.40 to $1.59. *Id.*
[239] *EIA Export Study*, *supra* n.3, at 1.
[240] *Id.*
[241] *Id.*
[242] *Id.* at 6-16.
[243] *Id.* at 8.

Second, while EOS discusses a purported forecast based on 6 bcf/d of exports, EOS provides no basis for concluding that this discussion is applicable to any scenario in which EOS's proposed exports occur. Indeed, even the EIA Study underestimates the likely effect of EOS's exports. This is for two reasons: EOS's exports would require exports at higher volumes than those considered, and EIA has decreased its estimates of available gas supply. On the first issue, as the various export models have shown, higher total export volumes cause higher price increases.[245] EOS does not dispute that its exports must be considered in the context of the cumulative effect of all export proposals.[246] Since the EIA study was released, EIA has increased its estimates for likely volumes of LNG exports in each of the 2012, 2013, and (early release) 2014 Annual Energy Outlooks.[247] Even the EIA Study's "high" scenarios of 12 bcf/d fall short of the 35.58 bcf/d of exports for which applications have been approved or are presently pending before DOE/FE.[248] For perspective, 35.58 bcf/d is almost 43% of current domestic gas production.[249] Even looking only at applications filed prior to EOS's, which are likely to be processed and potentially enter operation prior to EOS,[250] EOS's exports would follow 23.21 bcf/d of other LNG exports,[251] bringing the total well beyond the scope of EIA's 6 and 12 bcf/d modeling.[252] A second reason why the EIA Study likely understates the price impact of exports was that it was based on an estimate of total gas reserves that EIA has now concluded was too high. The EIA Study was based on EIA's 2011 Annual Energy Outlook, which assumed total domestic reserves in excess of 2,500

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[244] EIA Export Study at table B1.

[245] *See* Part III.B.2, *supra*.

[246] *See* Part III.B.2, *supra*.

[247] *See, e.g.* EIA, Annual Energy Outlook 2014 Early Release Overview, at 17 (comparing 2014 and 2013 forecasts), *available at* http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2014).pdf, attached as Exhibit 109. *See also id.* at 2 (forecasting 3.5 tcf per year, or 9.6 bcf/d, of LNG exports by 2029), Bryan Walsh, *More Oil, More Gas and Less Driving: Predicting America's Energy Future,* Time Magazine (Dec. 17, 2013). Available at http://science.time.com/2013/12/17/more-oil-more-gas-and-less-driving-predicting-americas-energy-future/#ixzz2rAswtQNH and attached as Exhibit 110.

[248] Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of Jan. 22, 2014), *supra* n.18.

[249] EIA, Monthly Natural Gas Gross Production Report (January 7, 2014), available at http://www.eia.gov/oil_gas/natural_gas/data_publications/eia914/eia914.html and attached as Exhibit 111. This report states that, for the month of October 2013, gross U.S. withdrawals (not limited to the lower 48) were 83.03 Bcf/d.

[250] NERA forecast low price increases because it assumed a low total volume of exports. However, there is no evidence indicating that any scenario involving these low export volumes would also include exports from the pending EOS application.

[251] Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of Jan. 22, 2014), *supra* n.18.

[252] *EIA Export Study*, *supra* n.3, at 1. Note that the EIA price scenarios look at the demand created by exports (i.e., the gas exported as well as the gas used in operating liquefaction equipment, typically an extra 10% of the exported volume), whereas the DOE/FE figure for total volume of proposed exports provided above only considers the gas actually exported. Thus, potential demand resulting from exports could be 10% higher than the 35.58 bcf/d figure DOE/FE provides.

tcf of natural gas, but EIA's subsequent 2013 Annual Energy Outlook reduced this estimate by nearly 7%, to 2,335 tcf.[253] Thus, both the EIA Study and EOS's discussion of price impacts assumes that there will be fewer demands placed on more gas.

The final reason why DOE/FE must reject EOS's discussion of price is that EOS provides no basis for characterizing price increases as "small." The EIA Study explained that the price increases it modeled—which, as we have explained, are too low—would be high enough to cause significant changes in the US. EIA predicts that all consumers of natural gas—residential, commercial, industrial, and electricity generating users—would respond to modeled price increases by decreasing consumption. EIA Study at 11, 15. Despite decreased consumption, each consumer type would pay a higher total gas bill. Across the 20 year period, residential consumers would face annual gas expenditure increases of 3.2% to 7.0% despite consuming less gas, using EIA's reference case and range of export scenarios. *Id.* at 15. Industrial consumers would pay 6.4% to 14.6% more annually. *Id.*

These increases in gas prices will harm residential consumers and limit manufacturing jobs. The *EIA Study* explains that:

> Even while consuming less, on average, consumers will see an increase in their natural gas and electricity expenditures. On average, from 2015 to 2035, natural gas bills paid by end-use consumers in the residential, commercial, and industrial sectors combined increase 3 to 9 percent over a comparable baseline case with no exports, depending on the export scenario and case, while increases in electricity bulls paid by end-use customers range from 1 to 3 percent. In the rapid growth cases, the increase is notably greater in the early years relative to the later years. The slower export growth cases tend to show natural gas bills increasing more towards the end of the projection period.

EIA Study at 6. These percentage increases are very large in absolute terms. In the low/slow scenario, gas and electricity bills increase by $9 billion *per year*, and this increase grows to $20 billion per year in other scenarios. *EIA Study* at 14. Industries particularly dependent on natural gas—such as farming, steel production, fertilizer manufacturing, and chemical manufacturing—will all be particularly impacted by these increases. *Drill Here, Sell There, Pay More* at 9-13. Increased costs to these industries will likely result job losses, or at least stymied job growth, offsetting job growth exports

[253] *See* DOE/FE Order 3357 at 118 (summarizing AEO 2011 and AEO 2013 data). EOS also relies on this outdated supply data. EOS App. at 23.

would create in the natural gas production industry, as we explain in the following section.

Thus, it is clear that EOS's proposed exports, like all LNG exports, will increase domestic gas prices, and that this increase will be contrary to the public interest. Moreover, it is clear that, although DOE/FE has relied on functioning markets to indicate a domestic need for gas in the import context, the converse is not true in the export context: the fact that a foreign buyer is willing to pay more than a domestic buyer for gas does not demonstrate that there is not a domestic "need" for that gas.

As one final note, we emphasize that price increases in response to demand for exports differ from price increases in response to imposition of environmental, worker safety, or other regulation. What the public pays a higher price attributable to environmental regulation, for example, the public "buys" increased environmental protection against the harms that would otherwise have been caused by production of the gas being used. Regulation also avoids emergency cleanup, public health care, and emergency costs resulting from environmental harm related to drilling, ultimately saving public tax dollars. In contrast, when prices increase because of exports, the public doesn't receive anything in exchange for paying increased prices. Indeed, whereas higher prices resulting from less environmentally destructive practices lessen the environmental impacts borne by the public, higher prices resulting from competition with exports increase the environmental harm the public suffers, by stimulating increases in overall production and consumption and thus increases in environmental impacts such as emissions of greenhouse gases and traditional air pollutants.

b. Employment Impacts

EOS claims that its export proposal will create thousands of jobs, primarily as a result of additional gas production. EOS App. at 16. As with EOS's discussion of price impacts, this claim is is unsupported by evidence or citation. It also rests on a flawed method of analysis that ignores the jobs that will be lost in manufacturing and other energy intensive industries as a result of the increase in gas prices exports would cause. Consideration of these impacts indicates that exports are likely to cause a net jobs decrease. Moreover, empirical analysis of communities where gas production occurs demonstrates that even in these communities, gas production is not the boon EOS holds it out to be. Thus, DOE/FE must reject EOS's flawed and unsupported assertions of job creation benefits resulting from the proposed project.

Beginning with EOS's assertions, these are internally inconsistent, unsupported, and—insofar as they rest on any discernable method of analysis at all—only consider a narrow slice of the picture. EOS argues that the primary benefit of the project will be "the total number of new jobs created by the increased production of natural gas required for the Export Authorization," claiming that this benefit wil "dwarf[]" the other benefits. EOS App. at 16. EOS asserts that this exploration and production "will require direct expenditures of approximately $1.0 Billion per year," and then, two paragraphs later, discusses "the estimated $10.8 billion of annual direct expenditures required to produce the source gas," with no explanation or even acknowledgement of the order of magnitude discrepancy between these figures. EOS App. at 16. Nor does EOS provide any hint of evidence to support either figure. Accordingly, DOE/FE cannot accept EOS's assertion regarding direct investment in exploration and production. Indeed, while Sierra Club agrees that with EOS's premise the exports will induce significant additional production, EOS appears not to recognize that not all of the gas it seeks to export will come from new production—according to EIA estimates, roughly 37% of gas demand created by LNG exports would have been produced anyway.

EOS goes on to argue that it is possible to estimate the number of jobs "created" by this production by multiplying the direct expenditures (whatever they may be) by some figure, and that total economic benefit can be similarly estimated by multiplying direct investment by a "multiplier effect." EOS asserts that various studies have "borne out" this multiplier effect, but EOS does not provide or fully identify these studies. As such, it is impossible to determine, for example, whether these studies merely applied a multiplier approach or instead attempted to verify the validity of this approach. This is an important question, because the flaws and limits of a multiplier or input-output based approach are well known. This approach does not consider counterfactuals, and therefore cannot determine how many jobs would have existed anyway (e..g, the 37% of production that would occur absent exports, which may be "supported" by exports but cannot meaningfully be said to be "created" by exports) or the jobs that would be lost as a result of higher gas prices. It relies on assumptions about spending patterns that may be inaccurate. It also fails to capture important qualitative effects, such as continuity of jobs from year to year (instead merely estimating aggregate "job years") or community disruption as a result of rapid changes—disruption that has played out in housing, public safety, and other impacts in areas experiencing gas booms. Multiple studies have catalogued these defects.[254]

DOE/FE's public interest analysis must look beyond EOS's cabined, unsupported argument to consider net employment impacts. Available evidence, including the NERA study DOE commissioned, indicates that the exports EOS proposes will decrease wages and make most US families worse off. As we have explained in comments on the NERA study, the project will likely cause net economic harm even if environmental impacts are excluded from consideration (although they must not be). Domestic gas price increases that will result from exports will have far-reaching effects on the U.S. economy. Employment and wages in energy-intensive industries such as manufacturing will

[254] See, e.g., Amanda Weinstein and Mark D. Partridge, The Economic Value of Shale Natural Gas in Ohio, OHIO STATE UNIVERSITY, Swank Program in Rural-Urban Policy Summary and Report (December 2010), attached as Exhibit 112; David Kay, The Economic Impacts of Marcellus Shale Gas Drilling: What Have We Learned? What are the Limitations? (Apr. 2011), attached as Exhibit 113.

decline because of increased gas prices. Although the NERA Study was not designed to capture this effect, NERA provides some indication of it, by assessing aggregate wage income in each scenario, and this wage assessment can be translated into losses of job equivalents (as NERA has done using the same model elsewhere). Every NERA scenario predicts declines in wage income. Thus, NERA strongly implies that exports will cause these industries to suffer job losses in the tens to hundreds of thousands.[255] This is true even if EOS's exports are considered in isolation. The proposed 1.6 bcf/d in LNG exports, with the gas required to run liquefaction equipment, will likely represent 642.4 bcf/y of new demand. Many of NERA's scenarios considered export-created demand of only 370 bcf/y by 2015.[256] NERA predicts that even this minimal level of export would cause a net decrease in wage income equivalent to between 15,000 and 31,000 jobs by that time.[257] Notably, NERA's forecast concerns changes in *net* wage income, and therefore attempts to include the offsetting effects of job creation in gas production, terminal construction, and other industries. For reasons we detail in our comments on the NERA Study, the actual consequences are likely to be even worse. Moreover, as we explain in part III.B above, DOE/FE cannot consider EOS's proposal in isolation. Research on the effects of LNG export in Australia, which has already accumulated experience with gas exports, demonstrates the adverse effects exports can have on domestic industry.[258]

Even in regions where export spurs additional gas production, temporary growth in jobs will likely lead to long-term economic decline, as these regions suffer from the "resource curse" and boom-bust cycle that plagues extractive economies. One of the most comprehensive surveys, by Professors Freudenburg and Wilson, of economic studies of "mining" communities (including oil and gas communities) concludes that the long-term economic outcomes are "consistently and significantly negative."[259] Headwaters Economics performed a similar study in 2009, documenting this trend in western U.S counties which focused on resource extraction rather than more durable economic growth strategies. The Headwaters study looked at the performance of "energy-focusing" regions compared to comparable counties over the decades since 1970.[260] It concludes that "counties that have focused on energy development are underperforming economically compared to peer counties that have little or no energy development."[261] A third study, by Amanda Weinstein and Professor Mark Partridge of

[255] Sierra Club Initial NERA Comments, *supra* n.3, at 8, Ex. 5 (Synapse Report) at 5.
[256] NERA Study, *supra* n.3, at 38.
[257] Synapse Report at 5.
[258] National Institute of Economic and Industry Research, "*Large scale export of East Coast Australia natural gas: Unintended consequences." A report to the Australian Industry Group and the Plastics and Chemicals Industries Association*, October 2012, attached as Exhibit 114(full document), Exhibit 115 (summary).
[259] W.R. Freudenburg & L.J. Wilson, *Mining the Data: Analyzing the Economic Implications of Mining for Nonmetropolitan Regions*, 72 Sociological Inquiry 549 (2002) at 549, attached as Exhibit 116.
[260] Headwaters Economics, *Fossil Fuel Extraction as a County Economic Development Strategy: Are Energy-Focusing Counties Benefiting?* (revised. July 2009), attached as Exhibit 117.
[261] *Id.* at 2.

Ohio State University, found this general trend to apply specifically to communities where shale gas extraction is occurring.[262] Using Bureau of Economics Analysis statistics, the Ohio study directly compared employment and income in counties in Pennsylvania with significant Marcellus drilling and without significant drilling, and before after the boom started. As summarized by a fourth study, from Cornell, "a growing body of credible research evidence in recent decades shows that resource dependent communities can and often do end up worse than they would have been without exploiting their extractive reserve."[263]

Thus, communities where resource extraction occurs will suffer further harms not captured by these examinations of job statistics. Raw numbers of jobs or job-equivalents failure to capture the continuity or quality of jobs. Gas production jobs that exports will create are typically short-term jobs, whereas the manufacturing and energy-intensive industry jobs it will eliminate are typically stable and long-term.[264] DOE/FE's public interest analysis must appropriately weigh the fact that export will reduce net jobs, and that it in addition to this net reduction, it will replace stable, high-quality manufacturing jobs with short term jobs that may ultimately disrupt the communities where production occurs.

c. Distributional and GDP Impacts

These adverse effects on rate payers, employees in energy intensive industries, and communities where production occurs mean that exports will have grave distributional effects, as they harm wage-earning households and reduce employment while providing benefit to the relatively few shareholders in gas industries.[265] The NERA study attempts to downplay this fact by arguing that benefits realized by gas production companies are realized by "consumers" generally, because "[c]onsumers own all production processes and industries by virtue of owning stock in them."[266] As Sierra Club explained, however, only about half of American families own any stock at all, and only a small subset of stock owners own stocks in the gas production companies that will benefit from exports.[267] Moreover, the NERA study wrongly assumes that gas production and liquefaction service companies are American owned, but as Sierra Club explained in its comments on the NERA study, this assumption is incorrect.[268] Thus, in describing who

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[262] Amanda Weinstein and Mark D. Partridge, *The Economic Value of Shale Natural Gas in Ohio*, OHIO STATE UNIVERSITY, Swank Program in Rural-Urban Policy Summary and Report (December 2010), attached as Exhibit 118.

[263] Susan Cristopherson, CaRDI Reports, *The Economic Consequences of Marcellus Shale Gas Extraction: Key Issues*, at 6 (Sept. 2011), attached as Exhibit 119.

[264] Sierra Club Initial NERA Comment at 20-21.

[265] *See, e.g.,* Sierra Club Initial NERA Comments, *supra* n.3, at 10.

[266] NERA Study, *supra* n.3 at 55 n.22.

[267] Sierra Club Initial NERA Comment, *supra* n.3, Ex. 5, 9-10.

[268] Exhibit 120, Foreign investment in wells. http://bridgemi.com/2013/06/canadian-firm-plans-fracking-campaign-that-could-require-4-billion-gallons-of-michigan-water/

will economically benefit from exports, NERA overstates both the extent to which benefits will accrue to most Americans and the extent to which benefits will accrue to Americans at all. Of course, as the NERA study indicates, exports will have winners and losers. It may be that, because foreign investors already own shares of gas companies, this has freed up American investment money for other industries, but the NERA study provides no indication that those other industries will receive the same benefits the foreign owners of gas companies will receive as a result of exports. For all these reasons, most Americans will not share in the benefits of LNG exports.

Because LNG exports will cause all Americans to pay higher energy rates, they will cause many Americans to lose their jobs, and they will benefit only a few Americans, who are generally already wealthy and who own shares of companies in a few industries, it is clear that most Americans will be worse off with LNG exports than they would be without them. The Obama Administration has repeatedly emphasized the need to avoid regressive policies that transfer wealth from the middle classes to the wealthy.[269] The President explained that "Our economic success has never come from the top down; it comes from the middle out. It comes from the bottom up."[270] Similarly, the President has warned against short-sighted management of wealth. As he explained in the 2009 State of the Union address, the nation erred when "too often short-term gains were prized over long-term prosperity, where we failed to look beyond the next payment, the next quarter, or the next election."[271] DOE/FE must not allow a "surplus [to] bec[o]me an excuse to transfer wealth to the wealthy instead of an opportunity to invest in our future."[272] Thus, LNG exports are at odds with fundamental aspects of executive policy.

The NERA Study's broad conclusion that the US would be better off with exports, or that the net effect of exports is positive, rests almost entirely on a forecast of net GDP growth as a result of exports. Even on this narrow issue, however, the NERA Study's conclusion is contradicted by other available studies, such as the comprehensive model of LNG exports' impacts conducted recently by Purdue University economists Kemal Sarica and Wallace E. Tyner.[273] The Tyner study found that exports would cause a net reduction in GDP, and acknowledged that its methodology, like NERA's, excluded numerous other factors that would further drive down GDP.

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[269] See, e.g., State of the Union Address (January 24, 2012), attached as Exhibit 121, available at http://www.whitehouse.gov/the-press-office/2012/01/24/remarks-president-state-union-address

[270] Remarks by the President at the Daimler Detroit Diesel Plant, Redford, MI (Dec. 10, 2012), attached as Exhibit 122 and available at http://www.whitehouse.gov/the-press-office/2012/12/10/remarks-president-daimler-detroit-diesel-plant-redford-mi

[271] State of the Union Address (Feb. 24, 2009), attached as Exhibit 123, available at http://www.whitehouse.gov/the_press_office/Remarks-of-President-Barack-Obama-Address-to-Joint-Session-of-Congress

[272] *Id.*

[273] *See* Kemal Sarica & Wallace E. Tyner, *Economic and Environmental Impacts of Increased US Exports of Natural Gas* (Purdue Univ., Working Paper, 2013) (available from the authors) [hereinafter Purdue Study].

Among these excluded factors are the environmental impacts of gas production, and of the failure to regulate it. These impacts must be factored into assessment of exports' net and distributional impacts. In terms of net impacts, the economic cost of environmental harm, such as the cost of increased air emissions, erodes (if not entirely erases) the net benefit NERA purports to find. Although DOE/FE cannot limit its consideration of environmental impacts to those that are easily monetizable, DOE/FE must, at a minimum, apply available tools to estimate the economic impacts of environmental harms. For example, under the USREF_SD_LR scenario, NERA predicts 2.19 tcf/y of exports in 2035, with a $2 billion GDP increase relative to the baseline.[274] Consideration of just one environmental impact of that level of exports—the contribution to global warming from methane leakage associated with induced gas production and transportation to export terminals—erodes a significant fraction of that value. Using EIA estimates of the share of exports that will result from induced production (63%) and a modest estimate of the leak rate for gas production (1.5%), the Sierra Club estimated that 2.19 tcf/y of exports will release an additional 431,000 tons of methane per year just from fugitives associated with gas production and transport to the terminal site.[275] The social cost of a ton of methane emissions in 2035 can be roughly estimated as $1,904.[276] Thus, a rough estimate of the social cost of the production-side methane *leaks* alone is $821 million[277] displacing more than 41% of the GDP increase NERA predicts under this scenario. Liquefaction, processing, and combustion of natural gas further adds to greenhouse gas emissions. Other environmental impacts also impose monetizable costs, all of which must be added to any calculation of net impacts and thus further erase the claimed benefit.

Thus, there is significant doubt as to whether, when all things are considered, the net effect of export would be positive. Thus, even putting aside the serious distributional concerns identified in the previous section, and the environmental and other effects that can be difficult to monetize, exports may cause a net decrease in GDP. DOE/FE

[274] *Compare* NERA Study, *supra* n.3, at 179 *with* Sierra Club Initial NERA Comment, *supra* n.3, at 186.

[275] *See* Sierra Club Initial NERA Comment, *supra* n.3, at 31-32, for methodology.

[276] As explained *supra* n.91 and in accompanying text, the Intergovernmental Panel on Climate Change estimates methane's 100 year global warming potential as 34. The federal estimate of social cost of a ton of carbon dioxide emissions in 2035 is $56, using the middle of the three discount rates provided. Interagency Working Group on Social Cost of Carbon, United States Government, *Technical Support Document: - Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866*, at 3, 13, 18 (May, 2013), *available at* http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf and attached as Exhibit 124. Admittedly, estimating the social cost of methane by multiplying the social cost of carbon by methane's global warming potential is imperfect, because the social cost of carbon incorporates some effects which methane will not have until it degrades to carbon dioxide (such as effects on ocean acidification), and methane imposes other social costs beyond its contribution to global warming (such as increasing ozone formation). Nonetheless, using an imperfect estimate such as this is more accurate than disregarding the cost of methane entirely.

[277] *I.e.,* (34)($56/ton)(431,000 tons). For more background on these estimates, *see* Sierra Club Initial NERA Comment, *supra* n.3, at 33-34.

therefore cannot use the NERA Study's prediction of an increase in GDP as evidence that exports will in fact be consistent with the public interest.

D. DOE/FE Cannot Rationally Approve EOS's Export Plan On the Record Before It

The NGA, and subsequent DOE delegation orders and regulations, charge DOE/FE with determining whether or not a gas export application is in the public interest. *See, e.g.* 15 U.S.C. § 717b(a). DOE/FE must make this decision on the record before it. This means that, regardless of DOE/FE's decision to presume, initially, that an application should be granted, this presumption does not, and cannot, absolve DOE/FE of its duty to make its *own* determination. *Panhandle Producers and Royalty Owners Ass'n*, 822 F.2d at 1110-11. Simply put, "the *agency* must examine the relevant data and articulate a satisfactory explanation for its action including a rational connection between the facts found and the choice made." *Motor Vehicle Mfrs. Ass'n of the United States v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (emphasis supplied). DOE/FE cannot rationally find for EOS on the record in this case.

Sierra Club, on the other hand, has shown that the gas and electricity price increases associated with exports will add billions of dollars in costs to consumers. These costs will propagate through the economy, retarding growth. We have also shown that the economic benefits, if any, associated with gas production increases may actually do long-term damage to the U.S. economy by plunging large regions of the country into a boom-and-bust extractive cycle. Further, we have shown that gas extraction and export have major environmental (and, hence, additional economic) costs, which EOS has failed to even acknowledge.

On this record, DOE/FE cannot approve export. Were it do so, it would be violating basic norms of agency record rulemaking, as well as its own rules. *See, e.g.*, 5 U.S.C. § 706; 10 C.F.R. § 590.404 (requiring DOE/FE to base its final opinion "solely on the official record of the proceeding" and to impose terms "as may be required by the public interest" after record review).

E. If DOE/FE Does Move Forward, It Must Impose Rigorous Monitoring Conditions

If DOE/FE nonetheless approves EOS's application, it must recognize its continuing duty to protect the public interest, as it explained in its earlier *Sabine Pass* decision. This duty is of crucial importance in the context of LNG export, where circumstances are rapidly changing. DOE/FE therefore announced its intention to monitor environmental, economic, and other relevant considerations. *Sabine Pass* at 31-33. Such a monitoring provision must be imposed here, as well, but must be significantly expanded.

Specifically, although *Sabine Pass* announces an intention to monitor many different considerations, it most clearly states that the agency will act if there is a "reduction in the supply of natural gas needed to meet essential domestic needs." *Id.* at 32. This consideration is undoubtedly of great importance, but it is not the only way in which changing circumstances could imperil the public interest.

On the contrary, as we have demonstrated at length in these comments, there is strong evidence that the public interest will be impaired by gas exports. These impairments include (1) regional and national economic dislocations and disruptions caused by natural gas extraction, including by the industry's boom-and-bust cycle, (2) national increases in gas and electricity prices and resulting shifts to more polluting fuels, (3) and environmental impacts of many sorts. Any one of these categories of interests could be impaired by gas export. DOE/FE must therefore state that it will monitor each of these areas, providing specific monitoring terms and thresholds which will trigger agency actions of various types, ranging from further study through reductions in export volume or changes in timing to a revocation of DOE/FE's approval.[278]

If DOE/FE fails to include such provisions in any final approval, it will fail to fulfill its "continuing duty to protect the public interest," *id.* at 31, and so violate the Natural Gas Act. Because neither EOS nor DOE/FE have described or proposed such terms, Sierra Club protests this application to the extent that DOE/FE fails to develop adequate monitoring terms of the sort we have described.

IV. Conclusion

Sierra Club therefore moves to intervene, offers the above comments, and protests EOS's export proposal for the reasons described above. EOS's application is not consistent with the public interest and must be denied.

Respectfully submitted,

Nathan Matthews
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[278] Providing a clear monitoring plan of this sort will also benefit EOS, which will be better able to determine when and how DOE/FE may act, improving the company's ability to plan its actions and investments.

UNITED STATES OF AMERICA
DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

IN THE MATTER OF	)	
	)	
EOS LNG LLC	)	**FE DOCKET NO. 13-116-LNG**
	)	

CERTIFIED STATEMENT OF AUTHORIZED REPRESENTATIVE

Pursuant to C.F.R. § 590.103(b), I, Nathan Matthews, hereby certify that I am a duly authorized representative of the Sierra Club, and that I am authorized to sign and file with the Department of Energy, Office of Fossil Energy, on behalf of the Sierra Club, the foregoing documents and in the above captioned proceeding.

Dated at San Francisco, CA, this 7th day of February, 2014.

____

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UNITED STATES OF AMERICA
DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

IN THE MATTER OF	)	
	)	
EOS LNG LLC	)	**FE DOCKET NO. 13-116-LNG**
	)	

CERTIFICATE OF SERVICE

I hereby certify that I caused the above documents to be served on the applicant and all others parties in this docket, in accordance with 10 C.F.R. § 590.017, on February 7, 2014.

Dated at San Francisco, CA, this 7th day of February, 2014.

____

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UNITED STATES OF AMERICA
DEPARTMENT OF ENERGY
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IN THE MATTER OF	)	
	)	
EOS LNG LLC	)	FE DOCKET NO. 13-116-LNG
	)	

VERIFICATION

SAN FRANCISCO	§
	§
CALIFORNIA	§

Pursuant to C.F.R. §590.103(b), Nathan Matthews, being duly sworn, affirms that he is authorized to execute this verification, that he has read the foregoing document, and that facts stated herein are true and correct to the best of his knowledge, information, and belief.

Nathan Matthews
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Subscribed and sworn to before me this 5th day of February, 2014.

Notary Public

MARK DAVID BOSLER
Commission # 1977496
Notary Public - California
San Francisco County
My Comm. Expires Jun 3, 2016

My commission expires: 6-3-16