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**Subject:** Initial Comments of Southern LNG Company, L.L.C.  
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**Attachments:** [Southern LNG Comments on DOE LNG Export Studies \(Final\).pdf](#)

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Pursuant to the Federal Register Notice issued December 11, 2012, attached please find the Initial Comments of Southern LNG Company, L.L.C. on the Department of Energy LNG Export Study.

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**UNITED STATES OF AMERICA  
BEFORE THE  
DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY**

**INITIAL COMMENTS OF SOUTHERN LNG COMPANY, L.L.C. ON  
THE DEPARTMENT OF ENERGY LNG EXPORT STUDY**

Pursuant to the Department of Energy's ("DOE") notice and invitation to comment,<sup>1</sup> Southern LNG Company, L.L.C. ("SLNG") hereby submits its comments on (1) the Energy Information Administration's ("EIA") study titled *Effect of Increased Natural Gas Exports on Domestic Energy Markets* ("EIA Study") that was issued in January 2012; and (2) the NERA Economic Consulting ("NERA") study titled *Macroeconomic Impacts of Increased LNG Exports From the United States* ("NERA Study") published in December 2012 (together with the EIA Study, "LNG Export Study").

SLNG presently operates a liquefied natural gas ("LNG") terminal located in Chatham County, Georgia ("Elba Island Terminal"), and SLNG has been granted authorization to import LNG.<sup>2</sup> On August 31, 2012, SLNG filed an application pursuant to Section 3 of the Natural Gas Act ("NGA")<sup>3</sup> with the DOE, Office of Fossil Energy ("DOE/FE") for long-term, multi-contract authorization to export to non-free trade agreement ("FTA") countries up to 4 million tons per annum of LNG, which is approximately equal to 0.5 billion cubic feet of gas per day ("Bcf/d"), produced from domestic sources for a 20-year period commencing on the earlier of the date of the first export or ten years from the date the authorization is granted. SLNG requested the

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<sup>1</sup> 77 Fed. Reg. 73,628 (Dec. 11, 2012) ("December 11 Notice").

<sup>2</sup> See *Columbia LNG Corp.*, 47 FPC 1624 (1972) ("Opinion No. 622"), modified, 48 FPC 723 (1972) ("Opinion No. 622-A"); *Southern LNG Inc.*, 90 FERC ¶ 61,257 (2000); *Southern LNG Inc.*, 103 FERC ¶ 61,029 (2003); *Southern LNG, Inc.*, 120 FERC ¶ 61,258 (2007), *aff'd*, 122 FERC ¶ 61,137 (2008), *aff'd sub nom. Anderson v. FERC*, No. 08-1131 (D.C. Cir. 2009), 2009 WL 1455824.

<sup>3</sup> 15 U.S.C. § 717b (2006).

authorization both on its own behalf and as agent for other parties who themselves hold title to the LNG at the time of export. This application was submitted as a companion to SLNG's application for authorization to export LNG to FTA countries. The DOE/FE granted authorization to export LNG to FTA countries in Order No. 3106.<sup>4</sup>

## **I. BACKGROUND**

When granting Sabine Pass Liquefaction, LLC the conditional authorization to export LNG to non-FTA countries, the DOE cautioned that it has a continuing duty to monitor supply and demand conditions in the U.S. to ensure that "any future authorization of natural gas exports do not subsequently lead to a reduction in the supply of natural gas needed to meet essential domestic needs."<sup>5</sup> In response to this obligation and the numerous subsequent applications for authorization to export LNG to non-FTA countries, the DOE initiated a study, the LNG Export Study, to examine the economic impacts of granting LNG export authorizations to non-FTA countries. The LNG Export Study was conducted in two separate parts.

First, the EIA Study analyzed how specified scenarios of increased natural gas exports could affect domestic energy markets. The scenarios "were not forecasts of either the ultimate level, or rates of increase, of exports; instead, these scenarios were established to set a wide range of potential LNG export scenarios...."<sup>6</sup> The EIA Study did not evaluate the macroeconomic impacts of natural gas exports on the U.S. economy, and more specifically, the EIA Study modeling system did not account for the impact of energy price changes on the global

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<sup>4</sup> SLNG has received authorization from the DOE to export LNG to FTA countries. *Southern LNG Company, L.L.C.*, FE Docket No. 12-54-LNG, Order No. 3106 (June 15, 2012).

<sup>5</sup> *Sabine Pass Liquefaction, LLC*, FE Docket No. 10-111-LNG, Order No. 2961 at 32 (May 20, 2011 ("DOE/FE Order No. 2961")).

<sup>6</sup> December 11 Notice at 73,628.

utilization pattern for existing capacity or the siting of new foreign or domestic capacity in energy-intensive industries.<sup>7</sup>

Second, the NERA Study consisted of a macroeconomic analysis and a feasibility analysis of exporting LNG at volumes identified in the EIA Study. The NERA Study also addressed a range of additional global scenarios, including the situation in which the DOE imposed no export constraints.

With the issuance of the LNG Export Study, the DOE has now invited comments that it anticipates will aid in the DOE's evaluation of the pending LNG export applications under the public interest standard, the standard under which it evaluates LNG export applications.<sup>8</sup> The DOE requested that initial comments be submitted by January 24, 2013.<sup>9</sup> Reply comments are to be submitted no later than February 25, 2013.

## II. INITIAL COMMENTS

SLNG, in conjunction with Navigant Consulting, Inc. and Navigant Economics (together, "Navigant"), has reviewed the LNG Export Study and generally concurs with the NERA Study's broad conclusion, that "the U.S. was projected to gain net economic benefits from allowing LNG exports."<sup>10</sup> In fact, Navigant has conducted a detailed review and analysis of DOE's LNG Export Study and has concluded that the use of updated natural gas production

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<sup>7</sup> *Id.*

<sup>8</sup> *See* 15 U.S.C. § 717b(a) (2006).

<sup>9</sup> The DOE has solicited comments addressing "domestic energy consumption, production, and prices, and particularly the macroeconomic factors identified in the NERA analysis, including Gross Domestic Product (GDP), welfare analysis, consumption, U.S. economic sector analysis, and U.S. LNG export feasibility analysis, and any other factors included in the analyses. In addition, comments can be directed toward the feasibility of various scenarios used in both analyses." December 11 Notice at 73,629. The DOE also stated that it may disregard comments that are not germane to the above inquiry. *Id.*

<sup>10</sup> NERA Study at 1.

information would further strengthen conclusions that show net benefits associated with allowing unlimited LNG exports (see Appendix A hereto).

In light of the findings in the DOE LNG Export Study as supplemented by Navigant's further analysis in Appendix A, SLNG below urges DOE to establish a generic LNG export policy that allows the market to determine which LNG export facilities will become operational and does not place any artificial limits on the volume of LNG to be exported to non-FTA countries. Studies show that such constraints are unnecessary to protect natural gas consumers from significant increases in the price of domestic natural gas. Indeed, artificial constraints on LNG exports could have the unintended consequence of limiting U.S. natural gas production, which could lead increased supply volatility and higher natural gas prices at home.<sup>11</sup>

A. The Global LNG Market Should Determine the Level of U.S. LNG Exports

DOE should not impose artificial or arbitrary limits on LNG export volumes, and instead DOE should allow competitive market forces to decide the overall quantities of LNG export volumes for three principal reasons. First, the domestic supply of natural gas is comparatively enormous,<sup>12</sup> a crucial fact often overlooked by other commenters, and means that over the expected time horizon of LNG export authorizations, LNG exports will not “lead to a reduction in the supply of natural gas needed to meet essential domestic needs.”<sup>13</sup> Second, the expected impacts to domestic natural gas prices will be sufficiently minimal.<sup>14</sup> Finally, establishing arbitrary regulatory caps on LNG export volumes contravenes the market-driven principles,

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<sup>11</sup> See Navigant Consulting, Inc., *Southern LNG Export Project Market Analysis Study* at 1, 9 (Aug. 31, 2012) (“SLNG Market Analysis Study”) (submitted as Appendix A to SLNG’s August 31, 2012 application to the DOE for export authorization to non-FTA countries).

<sup>12</sup> *Id.* at 1-2.

<sup>13</sup> *Sabine Pass Liquefaction, LLC*, FE Docket No. 10-111-LNG, Order No. 2961 at 29, 32 (May 20, 2011 (“DOE/FE Order No. 2961”). DOE/FE Order No. 2961 also notes that DOE considers “whether the proposed exports pose a threat to the security of domestic natural gas supplies.” *Id.* at 29.

<sup>14</sup> SLNG Market Analysis Study at 1-2.

previously relied upon by DOE,<sup>15</sup> used to determine whether LNG export applications are in the public interest.

*1. Domestic Natural Gas is Plentiful and the Domestic Supply is Underestimated by AEO2011 Data*

The U.S. is enjoying an unprecedented expansion in the supply of domestic natural gas. While the precise magnitude of the domestic natural gas reserves may be difficult to measure exactly, the scale of such reserves is unquestionably large and more than supports LNG exports at market-driven volumes.<sup>16</sup>

Critics of the NERA Study frequently complain that the NERA Study relies on outdated data, namely the EIA's Annual Energy Outlook for 2011 ("AEO2011").<sup>17</sup> Because of the NERA Study's reliance on this data, critics suggest that the NERA Study fails to include increased natural gas *demand* from (1) further changes in the power generation industry from coal to natural gas-fired generation, (2) shifts to natural gas as a transportation fuel; (3) growth in the industrial consumption of natural gas; (4) natural gas consumption during the gas-to-LNG conversion process.<sup>18</sup> However, these concerns selectively address only the demand side of the demand-supply equation.

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<sup>15</sup> DOE/FE Order No. 2961 at 32.

<sup>16</sup> Acting EIA Administrator Howard Gruenspecht has testified that EIA's reduction in the reserve estimates is not material to its 25-year projections. He stated that "Whether the U.S. has 100 years of total recoverable resources at current rates or 90 years of total recoverable resources estimated at current rates, I just don't think it has much of an effect." Conway, Irwin, *EIA Downplays Marcellus Reserve Revision*, Interfax Energy (Feb. 1, 2012), available at <http://interfaxenergy.com/natural-gas-news-analysis/north-america/marcellus-reserve-revision-not-the-issue-for-us-gas/>.

<sup>17</sup> See, e.g., Letter from R. Wyden, U.S. Senator, to Secretary Dr. Steven Chu, Secretary, U.S. Department of Energy (Jan. 10, 2013) (comments on the NERA study filed with the DOE), available at [http://www.fossil.energy.gov/programs/gasregulation/authorizations/export\\_study/export\\_study\\_initial\\_comments.html](http://www.fossil.energy.gov/programs/gasregulation/authorizations/export_study/export_study_initial_comments.html) ("Wyden Letter").

<sup>18</sup> *Id.*

The NERA Study actually vastly underestimates the supply of domestic natural gas, and use of the EIA more recent Annual Energy Outlook 2013 (“AEO2013”) data would only strengthen the NERA Study’s conclusions that LNG exports will provide a net economic benefit to the U.S. economy. As explained in Navigant’s analysis found in Appendix A, the AEO2011 shale gas production volumes were too low as compared to then-existing production levels, a more relevant indicator of available natural gas supply. The continuing strong growth in actual production levels has outpaced EIA’s forecasts. In fact, the AEO2011 production levels were already eclipsed by actual production mid-way through 2010.<sup>19</sup> Production levels have continued to exceed EIA expectations, as exemplified by the year-end 2012 production levels that were over 50 percent higher than the AEO2011 forecast for 2013.<sup>20</sup> Tellingly, a comparison of the AEO2011 data and the AEO2013 data shows an increase in forecasted *demand* of 5.6 percent, whereas the increase in forecasted *supply* rose by 16 percent.<sup>21</sup> Focusing on the marginal increase in demand while ignoring the more significant increase in supply neglects the fundamental shift in the domestic supply-demand balance.

This fundamental shift in the supply-demand balance is exemplified by the role reversal of LNG. The AEO2011 data forecasted domestic consumption exceeding total production, resulting in shortfall that was to be filled by pipeline and LNG imports. Conversely, the AEO2013 data reflects a reversal of the AEO2011 paradigm and predicts a period of production surpluses, even with LNG exports ramping up from approximately 0.7 Bcf/day to an average of 3.4 Bcf/day during 2022 through 2035.<sup>22</sup> This bears significant implications for the NERA

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<sup>19</sup> Appendix A at 8.

<sup>20</sup> *Id.* at 9.

<sup>21</sup> *Id.*

<sup>22</sup> *Id.*

Study. If the NERA Study had utilized the AEO2013 data, the net economic benefits to the U.S. would likely be even larger than anticipated due to higher supply and production estimates in the AEO2013 data and the corresponding drop in domestic natural gas prices.<sup>23</sup> Importantly, this fundamental shift in the supply-demand balance supports a policy that allows unlimited LNG exports.

2. *The LNG Export Study's Methodology Is Sound but It Overestimates the Price Impacts on Domestic Natural Gas*

The EIA Study's modeling approach adequately reflects the impacts of differing potential levels of U.S. LNG exports on the U.S. natural gas market and on the U.S. economy. However, as recognized by DOE, the National Energy Modeling System ("NEMS") used in the EIA Study would overstate the amount of LNG exports under the scenarios evaluated because the NEMS model was incapable of modeling the global demand for LNG and the effect of the U.S. entrance into that market.<sup>24</sup> This shortcoming was remedied by the NERA Study. The NERA Study also rectified another EIA Study shortcoming in that the EIA Study's NEMS modeling could not determine the economy-wide impact of U.S. LNG exports. As explained in Appendix A, the NERA and EIA modeling approaches produced a proper assessment of the effects of U.S. LNG exports on the U.S. natural gas market and on the U.S. economy.<sup>25</sup>

As mentioned above, critics have suggested that the LNG Export Study is flawed because it relies on AEO2011 data, instead of more recent data, such as the AEO2013 data, which forecasts somewhat higher natural gas demand, but significantly higher natural gas supplies. These criticisms focus on changes in forecasted demand, but ignore the more substantial effect of higher natural gas supplies, which has significant impact on domestic natural gas prices and the

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<sup>23</sup> *Id.* at 10.

<sup>24</sup> *Id.* at 2.

<sup>25</sup> *Id.* at 2-3, Attachment 1 to Appendix A.



relative price elasticity. This linkage was expressly identified in the NERA Study, which stated, “[t]he natural gas price path and its response in the scenarios with LNG exports will depend on the availability and accessibility of natural gas resources.”<sup>26</sup>

A closer look at the AEO2013 data reveals that even after including LNG exports (ramping from 0.6 Bcf/day in 2016 to 4.5 Bcf/day in 2027),<sup>27</sup> that Henry Hub natural gas prices are expected to be 20 percent lower as compared to the AEO2011 price projections.<sup>28</sup> The logical inference suggests that if the NERA Study had utilized the AEO2013 data, then it too would have projected substantially lower domestic natural gas prices.

In addition, the NERA Study’s High Estimated Ultimate Recovery (“EUR”) production case included production levels that approach those forecasted in the AEO2013 data. In fact, the results produced by the LNG Export Study under the AEO2011 high shale EUR natural gas production case are consistent with the results seen in current U.S. natural gas production forecasts.<sup>29</sup> Under this scenario, the NERA Study concluded that LNG exports were economical under all demand scenarios, exports made a net positive contribution to the U.S. economy, and natural gas prices remained relatively low even under the highest LNG export levels.<sup>30</sup> Notably, the largest net positive economic impact under the high shale EUR production scenario occurred when there was no constraint on U.S. LNG exports.<sup>31</sup> Therefore, use of more realistic supply forecasts, like that of the AEO2013 data (as roughly corresponding to the high EUR case), means that the impacts of LNG exports on domestic natural gas prices will be lower than estimated in

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<sup>26</sup> NERA Study at 48.

<sup>27</sup> AEO2013 Data at 11.

<sup>28</sup> Appendix A at 9-10.

<sup>29</sup> *Id.* at 10-11.

<sup>30</sup> *Id.* at 11-12.

<sup>31</sup> *Id.*

both the Low EUR case and the Reference case and likely lower than those projected in the High EUR case.<sup>32</sup>

Once the more realistic and accurate natural gas supply projections are incorporated and the resultant lower domestic natural gas prices are understood, concerns related to higher natural gas prices become less significant. For example, several critics have faulted the NERA Study for not examining in detail the effects of higher natural gas prices on certain domestic manufacturing sectors, disproportionate effects on certain socioeconomic groups, and possible reductions in labor and tax income.<sup>33</sup> Yet, under the High EUR case with unconstrained LNG exports, any potential price impacts are expected to be relatively minimal.<sup>34</sup> In comparison, the relative net economic gains to the U.S. from LNG exports are expected to be the most substantial.<sup>35</sup>

### 3. *DOE Should Not Set Arbitrary Caps on LNG Exports*

Unlike the EIA Study, which used static, pre-determined LNG export volumes, the NERA Study determined the LNG export levels within its global natural gas model and found that in many of the scenarios, “the world natural gas market would not accept the full amount of exports assumed in the EIA scenarios at export prices high enough to cover the U.S. wellhead domestic prices calculated by the EIA.”<sup>36</sup> For example, the LNG exports as projected by the NERA Study for the EIA’s Low Shale case never exceed 2.5 Bcf/day, which is well below the 6 Bcf/day and 12 Bcf/day assumptions utilized in the EIA price forecasts.<sup>37</sup> Thus, EIA’s projected

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<sup>32</sup> *Id.* at 11, 12; *see* NERA Study at 48.

<sup>33</sup> Wyden Letter at 3-4.

<sup>34</sup> Appendix A at 11-12.

<sup>35</sup> *Id.* at 12.

<sup>36</sup> NERA Study at 3.

<sup>37</sup> Appendix A at 4.

average wellhead price increase, a 20 percent increase, drops to less than 3 percent in the NERA Study when global supply and demand factors are considered.<sup>38</sup>

As shown by the NERA Study, competitive global market forces significantly impact potential U.S. LNG exports, meaning the project proponents are better suited to optimizing the level of LNG exports rather than a centralized regulatory construct setting what could only be arbitrary limits. Creating a cap on LNG exports also creates a static barrier, insensitive to competitive market forces, unless DOE is frequently evaluating current global LNG market conditions and U.S. supply projections, which EIA has frequently underestimated. Without regular adjustment, a cap could serve to under-permit and dis-incentivize further production, thus stalling investment and increasing natural gas price volatility.<sup>39</sup> The risks associated with over-permitting, *i.e.*, declining to cap LNG exports, are small because, as mentioned above, global competitive forces will dictate (and curb) U.S. LNG exports while leaving the risk of over-construction with the project proponent, the entity best-suited and most interested in assuring market efficiency. Moreover, companies routinely make their final investment decisions only after the conclusion of important regulatory proceedings. Accordingly, the NERA Study is justified in concluding that expected LNG exports will be far less than the current aggregate of authorization applications awaiting DOE approval and that the unconstrained scenario will produce the greatest net economic benefit to the U.S.

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<sup>38</sup> *Id.*

<sup>39</sup> *Id.* at 6-7.

B. Regional Impacts Should Be Reviewed in Project-Specific Proceedings; Not When Setting Generic LNG Export Policy

Critics fault the NERA Study for its failure to analyze exactly where LNG terminals may be located and how LNG exports may impact certain regional economies.<sup>40</sup> This criticism is unjustified because it falls outside the scope of NERA's tasking. NERA was tasked to use its model to evaluate the macroeconomic impact of the LNG exports.<sup>41</sup> This approach necessarily required aggregating originations of U.S. LNG exports as a whole, and, as the NERA Study notes, it lacked sufficient information and was confined to the assumptions made by the EIA Study; it could not estimate regional impacts.<sup>42</sup>

Furthermore, the review of regional impacts associated with LNG export projects (both the positive and negative impacts) are more appropriately considered by DOE during its review of the individual LNG export authorization applications. In this regard, individual applicants, such as SLNG, have submitted detailed studies and analyses identifying the regional economic impacts of their LNG export projects.<sup>43</sup> These project-specific studies are better suited to examining regional economic impacts and will provide the necessary information for DOE to determine whether any individual request for export authorization would not be in the public interest in accordance with Section 3 of the NGA.

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<sup>40</sup> Wyden Letter at 4.

<sup>41</sup> NERA Study at 3.

<sup>42</sup> NERA Study at 210 (noting that because the EIA assumed that all of the demand for domestic production associated with LNG exports was located in the Gulf region, NERA could not examine regional impacts).

<sup>43</sup> SLNG submitted two economic studies with its August 31, 2012 application for export authorization to non-FTA countries: Navigant Consulting, Inc. *Southern LNG Export Project Market Analysis Study*; and Navigant Economics, *Southern LNG Export Project Economic Impact Assessment Study* (Aug. 31, 2012).

**WHEREFORE**, in consideration of the foregoing, Southern LNG Company, L.L.C. respectfully requests that the DOE accept and consider these initial comments when considering LNG export policies and when issuing individual orders for LNG export authorization. The LNG Export Study as supplemented by Navigant's analysis attached here as Appendix A clearly shows that the benefits resulting from granting unlimited authorizations to export LNG to non-FTA countries exceed any potential negative impact from minimal price increases associated with exporting domestic natural gas. Rather, a policy that allows unlimited LNG exports would continue to create production incentives which will decrease supply and price volatility and lead to the overall growth of the U.S. economy to the benefit of the entire country.

Respectfully submitted,

*/s/ Patricia S. Francis*

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January 24, 2013

# **Appendix A**



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January 24, 2013

Mr. David Porco  
Southern LNG Company, LLC  
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**Re: Navigant Analysis of the Department of Energy's LNG Export Study**

Dear Mr. Porco:

As you requested, Navigant Consulting, Inc. and Navigant Economics (together, "Navigant") have reviewed the Department of Energy's ("DOE") LNG Export Study, which is comprised of the following two studies: (1) the Energy Information Administration's ("EIA") study titled Effect of Increased Natural Gas Exports on Domestic Energy Markets ("EIA Study") that was issued in January, 2012; and (2) the NERA Economic Consulting ("NERA") study titled Macroeconomic Impacts of Increased LNG Exports From the United States ("NERA Study") published in December, 2012 (together with the EIA Study, "LNG Export Study"). This letter provides Navigant's analysis of DOE's LNG Export Study.

Navigant has been involved in a number of LNG export projects, including the Southern LNG Company, LLC Project ("Southern LNG"). Specifically, Navigant has provided assistance to LNG project developers in preparing their applications to DOE for export of LNG to Non-Free Trade Agreement countries. Our involvement with the projects including Southern LNG has been primarily to assess the market impact of individual export projects as well as to investigate the pipeline infrastructure and natural gas supply that will be used to serve the requirements of the liquefaction terminals as proposed by the projects. In our analysis, we used Navigant's North American market model built on architecture provided by GPCM® to perform analysis of the impact upon the existing market including prices over the long term.

Based on Navigant's extensive experience in performing such analysis for Southern LNG as well as other projects located on both coasts and in the Gulf of Mexico, Navigant provides the following analysis of the LNG Export Study commissioned by the DOE.

### **1. The modeling approach used in the DOE's LNG Export Study Is Sound.**

Navigant has reviewed the sophisticated modeling approach employed in the DOE's LNG Export Study. On the basis of our review, we have determined that this modeling approach produced a proper assessment of the impacts of differing potential levels of U.S. LNG exports on the U.S. natural gas market and on the U.S. economy under the assumed U.S. natural gas production scenarios. The DOE's modeling approach involves EIA's National Energy Modeling System ("EIA's NEMS"), NERA's Global Natural Gas Model ("NERA's GNGM"), and NERA's U.S. macroeconomic model ("NERA's N<sub>ew</sub>ERA"). EIA's NEMS considers only the U.S. natural gas market and does not project world market natural gas prices (i.e., the U.S. natural gas market is modeled in isolation). The DOE instructed the EIA to use NEMS to evaluate the effects of different assumed levels of U.S. LNG exports on the U.S. natural gas market under alternative U.S. natural gas production scenarios based on the AEO 2011 forecast: (1) the reference case scenario which was the AEO 2011 forecast; (2) a low shale expected ultimate recovery ("EUR") scenario; and (3) a high shale EUR scenario.

The DOE recognized that the results produced using just the EIA's NEMS might overstate the amount of LNG exports that would occur under these scenarios because NEMS was incapable of modeling the global demand for LNG and the effect that any increase in U.S. natural gas prices in response to increased U.S. LNG exports would have on the global demand for U.S. produced LNG. To rectify this shortcoming, the DOE engaged NERA to use its global natural gas market model, in conjunction with the U.S. natural gas market model included in EIA's NEMS, to model the global demand for U.S. produced LNG under each of the three U.S. natural gas production scenarios. In this context, the assumed LNG export volumes became upper end constraints on actual U.S. export volumes. Under each of the three U.S. natural gas production scenarios, actual U.S. exports of LNG were set to the lesser of global demand for these exports as determined by NERA's GNGM and this upper end constraint. NERA also evaluated an unconstrained U.S. LNG export scenario where U.S. exports of LNG were set equal to the global demand for these exports as determined by NERA's GNGM.

The DOE also recognized that EIA's NEMS could not determine the economy-wide economic impacts of increased U.S. LNG exports. To determine these economy-wide economic impacts, the DOE engaged NERA to use its U.S. macroeconomic model ("NERA's N<sub>ew</sub>ERA"). Based on the level of U.S. exports that NERA determined could be sold into the global marketplace and the effects of these exports on the U.S. natural gas market that were



calculated based on EIA's NEMS and NERA's GNGM, NERA used its NewERA model to estimate the net economic impact on the U.S. economy of both the positive and negative impacts of increased U.S. LNG exports. The positive impacts would be the result of the construction and operation of the LNG export facilities and of higher U.S. natural gas production. The negative impacts would stem from increases in U.S. natural gas prices. NERA's NewERA model captures both types of effects on the U.S. economy.

Attachment 1 to this letter report provides a more detailed discussion of the NERA and EIA models that were employed in performing the DOE LNG Export Study. Our detailed review of these models, which is summarized in Attachment 1, is the basis for our conclusion that the DOE's modeling approach produced a proper assessment of the effects of U.S. LNG exports on the U.S. natural gas market and on the U.S. economy.

## **2. The global natural gas market should determine the 'appropriate' level of U.S. LNG exports.**

Rather than relying on any artificially-imposed limits on LNG export volumes, the DOE should allow the global natural gas marketplace to determine how much LNG export capacity should be built, who should build it, where it should be built, and ultimately what volumes of LNG exports should occur. The detailed, macroeconomic component of the DOE's LNG Export Study<sup>1</sup> analyses supports this approach. Specifically, the NERA analysis serves to confirm that LNG exports will provide positive net economic benefits to the U.S. under all modeled scenarios, with increasing benefits associated with the increasing levels of LNG exports that result under the unconstrained export scenarios.<sup>2</sup>

**Arbitrary export level assumptions can yield infeasible study results.** Whereas the EIA analysis incorporated static, *a priori* assumptions on LNG export volumes, the subsequent NERA analysis component of DOE's LNG Export Study determined the LNG export levels within its global natural gas market model. As noted by the NERA analysis, "... in many cases, the world natural gas market would not accept the full amount of exports assumed in the EIA scenarios at export prices high

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<sup>1</sup> DOE uses the term "LNG Export Study" to refer to two reports prepared at its direction: 1) the January 2012 EIA analysis entitled "Effect of Increased Natural Gas Exports on Domestic Energy Markets," requested by the DOE's Office of Fossil Energy in August 2011 ("EIA analysis"); and 2) the December 2012 NERA analysis entitled "Macroeconomic Impacts of LNG Exports from the United States," commissioned by DOE under contract ("NERA analysis").

<sup>2</sup> NERA analysis, p. 1.

enough to cover the U.S. wellhead domestic prices calculated by the EIA.”<sup>3</sup> Thus, “[b]ecause the [NERA] study [in some cases] estimated lower export volumes than were specified by [DOE] for the EIA study, U.S. natural gas prices [projected by NERA] do not reach the highest levels projected by EIA.”<sup>4</sup>

For example, LNG exports as projected by the NERA analysis for the EIA Low Shale case never exceed 2.5 bcf/d (well below both the 6 bcf/d and the 12 bcf/d export assumptions driving the EIA price forecasts), and this is the case that produced the most extreme pricing and price change results in the EIA analysis.<sup>5</sup> Thus, EIA’s projected average wellhead price increase of 20% over the 20-year study for the 12 bcf/d export level in the Low Shale case drops to less than 3% in NERA’s analysis where global gas market modeling results in only achievable LNG export levels.

- **Even if DOE were to permit all the pending applications, the market will decide which facilities get built.**

Obtaining a permit to export LNG to non-FTA countries is no guarantee that an export facility will be built. Companies routinely make their “final investment decision” subsequent to permitting activities. More importantly, market participants (investors, producers, consumers) will optimize project development activities more efficiently than would any centralized policy or planning direction via regulatory processes. This reality is confirmed by DOE in its 2011 Order conditionally granting export authorization for the Sabine Pass LNG project, in which DOE reiterated that its policy goals include “minimizing federal control and involvement in energy markets” so as to “minimiz[e] regulatory impediments to a freely operating market”.<sup>6</sup>

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<sup>3</sup> NERA analysis, p. 3.

<sup>4</sup> NERA analysis, p. 10.

<sup>5</sup> For example, the Low Shale EUR case with the rapid introduction of 12 bcf/d of exports resulted in a 54% increase versus the baseline wellhead price for the Low Shale EUR case in 2018 (EIA, p. 9), and the Low Shale EUR case baseline average wellhead price over the term of the analysis was itself 40% higher than in the Reference case, at \$7.37 versus \$5.28/MMBtu (EIA analysis, Table B5).

<sup>6</sup> See DOE/FE Order No. 2961 (Opinion and Order Conditionally Granting Long-Term Authorization to Export Liquefied Natural Gas from Sabine Pass LNG Terminal to Non-Free Trade Agreement Nations), May 20, 2011, at 28.

- **The NERA Study shows that a U.S. policy that supports unconstrained LNG exports will not result in significant increases to domestic natural gas prices under realistic supply-demand assumptions.**

NERA's modeling effort indicates competitive export levels (that is, LNG export levels that result from the free interplay of supply and demand conditions) could be more or less than the EIA assumptions, but that price levels would remain in a competitive long-term equilibrium range, not linked to oil prices.

NERA's analysis shows that even with no constraints on the upper end of LNG exports, there would not be any LNG exports in the Low Shale case (with its higher price forecasts in the EIA analysis) except for in NERA's Supply Shock plus Demand Shock international scenario, where exports peak at only 2.5 bcf/d (in 2025).

With plentiful gas supplies (e.g. High Shale case), while exports could exceed the 12 bcf/d assumed by EIA, the U.S. price levels themselves still stayed below \$6.00/MMBtu by 2035 for all NERA's international scenarios. Even NERA's Supply Shock plus Demand Shock international scenario, with average exports of about 17 bcf/d, resulted in average wellhead prices over the 20-year study term of only \$5.23/MMBtu.

Under the EIA's U.S. Reference case, the only scenario where unconstrained exports ever exceeded 12 bcf/d is the Supply Shock plus Demand Shock international scenario, where the average wellhead prices from 2015 through 2035 were still less than \$6.30/MMBtu (and about \$0.10/MMBtu less than for the EIA's Reference Case at a constant 12 Bcf/d).

- **Regardless of modeling estimates, there are likely practical and competitive limits to how much new LNG capacity will be located in the U.S.**

The global LNG market size in 2010 was about 27 bcf/d in imports and exports<sup>7</sup>, and this market is estimated by the International Energy Agency to roughly double in size by 2035. Assuming new U.S. capacity of about half the worldwide growth would be highly optimistic. Even in the event that DOE were to authorize all pending LNG export applications to non-FTA countries, Navigant's market view is that U.S. LNG export capacity that will be built and operational likely will range

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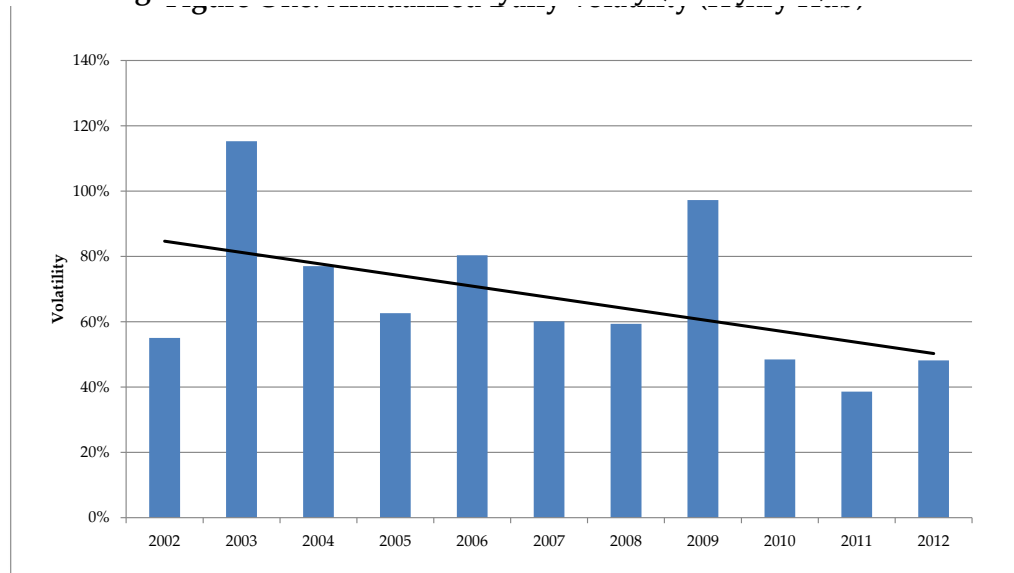
<sup>7</sup> See NERA analysis, p. 19.

from six to eight bcf/d. We also suggest that U.S. export opportunities may be time sensitive, and rather than increasing in the future, U.S. LNG export markets may decrease due to supply capacity coming on line in other areas around the world.

- **There are drawbacks that would result from under-permitting by DOE.**

In addition to the economic benefits of LNG exports, as detailed in the NERA analysis, LNG exports, to the extent they are permitted, will help foster the increasing stability of the domestic natural gas market. Because of the lower exploration and production risk associated with shale gas production resulting from the manufacturing-like nature of shale gas production once shale plays have been identified, increasing levels of shale gas production should help to lower the volatility of the domestic gas market. LNG exports that increase natural gas demand thus provide two important benefits. First, new demand will help stabilize the current over-supply conditions in the domestic marketplace towards a market where supply and demand are in equilibrium. And second, new demand will increase the size of the natural gas market, leading to a continued increase in shale gas' share of total natural gas production, which will lower the price volatility of the gas market by increasing the overall supply responsiveness of the market. As shown in Figure One, below, recent data seems to support decreasing levels of gas price volatility that correspond to the recent increases in shale gas production levels. Artificially limiting the amount of U.S. LNG exports would be seen to slow the development of shale gas resources, and thus also slow potential future reductions in market price volatility.

**Figure One. Annualized Daily Volatility (Henry Hub)**



Source: Navigant, EIA

With respect to market policy, a restrictive approach to LNG export approval (*i.e.*, potential under-permitting by DOE) would be inconsistent with the DOE's stated preference<sup>8</sup> for free-market approaches to regulatory oversight. An LNG export authorization process that implies the picking of winners by the regulatory process itself, as opposed to the marketplace, would limit competitive forces and not result in the optimization of project development.

**3. The 2011 Reference Case U.S. natural gas supply volume assumptions used in DOE's LNG Export Study are now drastically understated, and updated assumptions would only strengthen the showing of LNG export benefits.**

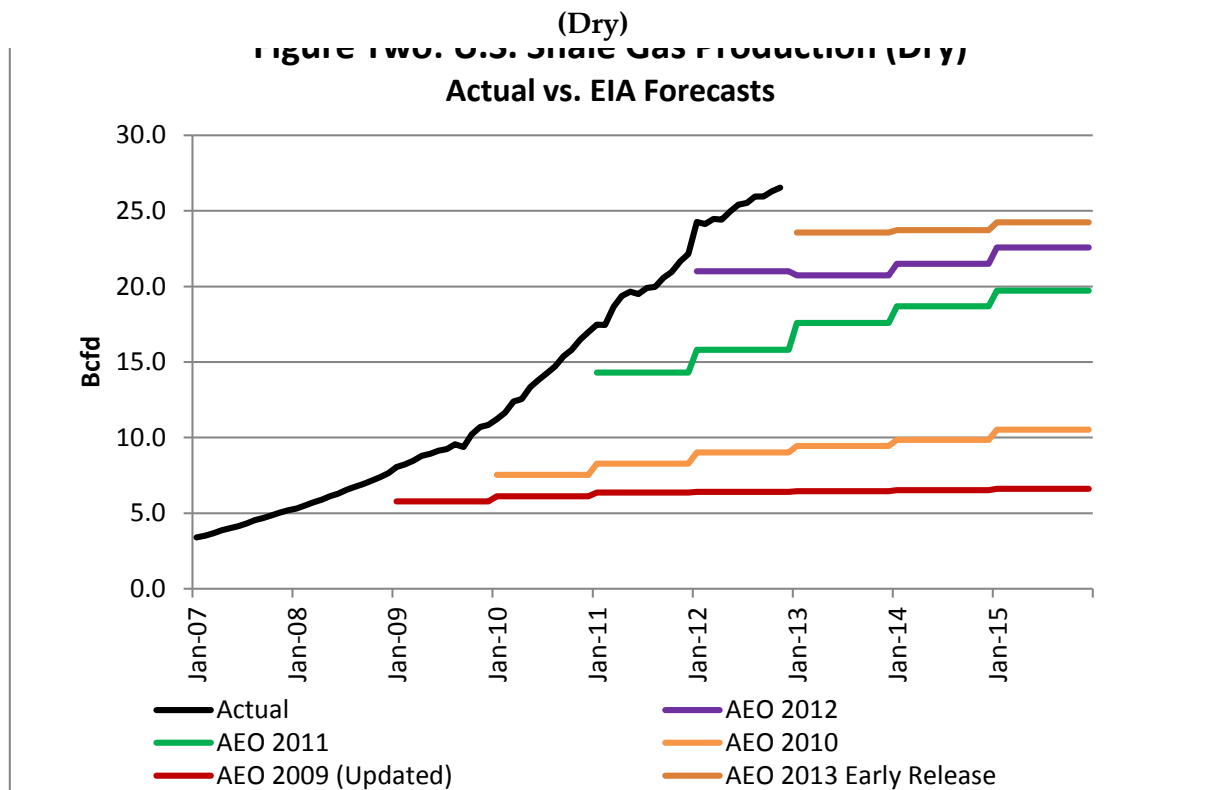
The 2011 reference case supply assumptions used in both the EIA and NERA analyses drastically understate the reality of today's abundant supply of shale gas. The 2011 reference case used was the AEO 2011 forecast shown in Figure Two below. While the AEO 2011 shale gas production forecasts were already too low with respect to then-existing production levels when made, the continuing strong growth in actual production levels has made the forecast shortfall even larger for subsequent forecast years.

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<sup>8</sup> See note 6, *supra*.

As illustrated in Figure Two, below, the AEO 2011 forecast for 2011 shale gas production (14.3 bcf/d) was already eclipsed by actual shale production levels mid-way through 2010; at year-end 2010, actual production levels exceeded the AEO 2011 forecast for 2011 by more than 18%. In fact, the AEO 2011 forecast for 2013 shale gas production (17.6 bcf/d) was already eclipsed by actual production levels in early 2011. As actual production levels have steadily continued their strong increases, year-end 2012 production levels of 26.5 bcf/d were over 50% higher than the AEO 2011 forecast for 2013.

**Figure Two: U.S. Shale Gas Production**

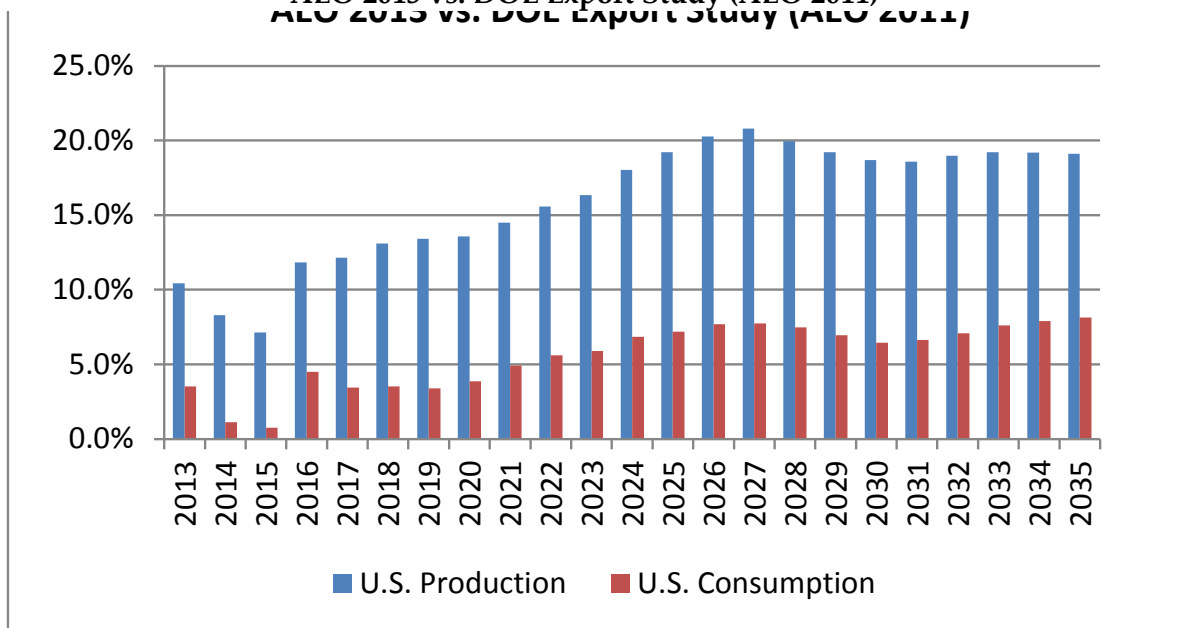


Source: Navigant, EIA

While some criticisms of the DOE’s LNG Export Study have focused on the fact that the AEO 2011 demand assumptions have been surpassed by those of the AEO 2013, it is important to note that the increase in projected total natural gas consumption has been far outpaced by the increase in the AEOs’ natural gas production forecast, as shown in Figure Three, below. For the period 2013-2035, there was an average percentage increase in

projected total domestic natural gas consumption between AEO 2011 and AEO 2013 of 5.6%, while the increase in projected total natural gas production was 16%. This comparison helps explain why the more recent AEO 2013 projections help demonstrate the beneficial market impacts from LNG exports (*i.e.*, natural gas demand growth has fallen short of natural gas supply growth which LNG exports will help alleviate).

**Figure 3. Percent Increase in Forecasted U.S. Natural Gas Production and Consumption, AEO 2013 vs. DOE Export Study (AEO 2011)**



Source: Navigant, EIA

Comparing the AEO 2013 forecast to the AEO 2011 forecast illustrates an interesting shift in the domestic supply-demand balance. While the entire forecast period of AEO 2011 was characterized by domestic consumption exceeding total production, with a shortfall averaging about 4.0 bcf/d from 2013 through 2035 being made up by LNG and pipeline imports to the U.S., in AEO 2013 that situation reverses itself by 2020. More specifically, an initial period of production shortfalls, averaging about 2.7 bcf/d, becomes a period of production surpluses averaging about 4.9 bcf/d from 2020 through 2035. This period of production surplus, relative to domestic total consumption, coincides generally with the ramping up of LNG exports from about 0.7 bcf/d to an average of 3.4 bcf/d during 2022 through 2035. Furthermore, the AEO 2013 assumptions of increasing natural gas

production relative to domestic consumption and increasing LNG exports, relative to AEO 2011, are associated with a 20% lower average natural gas price level from 2013 through 2035 as measured at Henry Hub under AEO 2013 than under AEO 2011.

Thus, the use of a supply forecast more in line with current actual production levels than is the reference case (*e.g.*, the AEO 2013 projection) would be expected to result in lower domestic gas prices than estimated in NERA's analysis, and consequently increased LNG export volumes to global markets, which would lead to even higher economic benefits to the US.

**4. Continued increases in domestic natural gas production forecasts reflect the abundance of the U.S. natural gas supply resource.**

In any discussion of natural gas production forecasts, it is always instructive to note the key underlying factor behind the continually more optimistic and impressive production forecasts, and that is the reality of today's shale gas boom. The development of horizontal drilling and hydraulic fracturing, existing technologies which were combined and have been continually improved, has yielded dramatically increased production and fundamentally changed the North American natural gas supply outlook. With U.S. shale gas resources estimated at up to 35 years of annual U.S. natural gas consumption at current levels<sup>9</sup>, pushing U.S. total natural gas resource estimates up to more than 90 years of supply, it is evident that a new era of natural gas sufficiency has arrived. Other estimates of the U.S. and North American natural gas resource base that have been prepared by other industry associations and government institutions are even higher.

**5. NERA's use of AEO 2011 high shale EUR production numbers better reflects today's high domestic natural gas production output.**

DOE's LNG Export Study has been criticized because it is based on a dated forecast of the U.S. natural gas market (AEO 2011).<sup>10</sup> As discussed above, the most recent EIA forecast of the U.S. natural gas production (AEO 2013) is substantially higher than the U.S. natural gas production in AEO 2011. *See* Figure 2 above. If the DOE LNG Export Study results were

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<sup>9</sup> *See e.g.* "Golden Rules for a Golden Age of Gas", International Energy Agency, Special Report, May 29, 2012, Table 3.1, putting U.S. shale gas recoverable resources at 24 tcm, or 840 tcf.

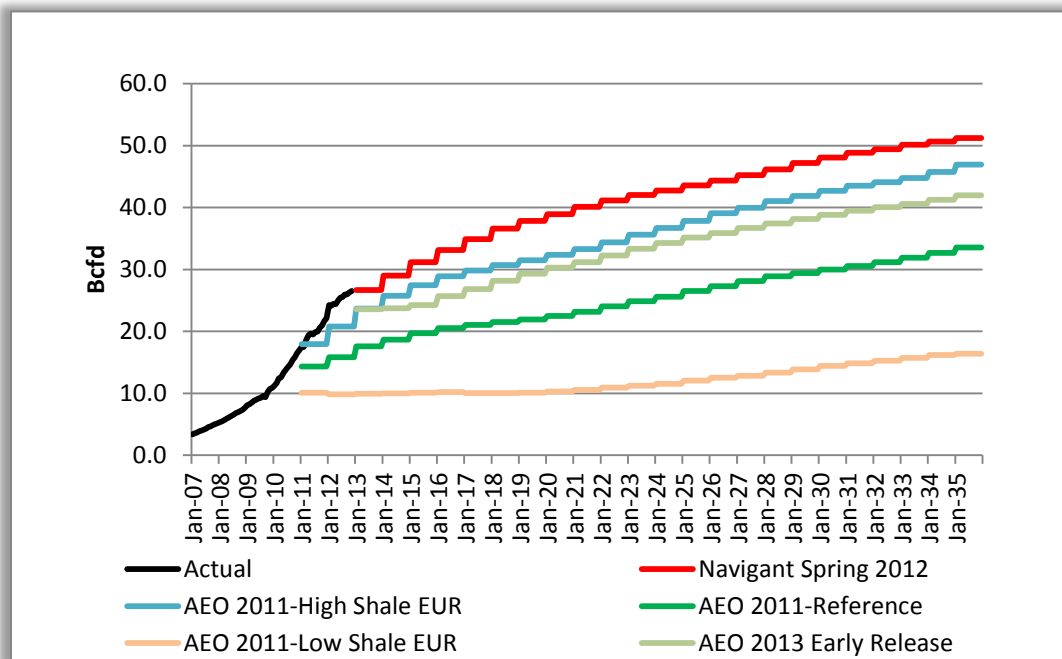
<sup>10</sup> For example, *see* Law360, "Senate Energy Chairman Rips DOE LNG Export Study," January 10, 2013.



based on a forecast of U.S. natural gas production that was in the vicinity of AEO 2013, then the dated forecast criticisms would be addressed.

In fact, DOE’s LNG Export Study’s high shale EUR production case had production levels that are quite similar to those in AEO 2013. Figure Four below compares the forecasts of U.S. natural gas production in the AEO 2011 high shale EUR production case used in the DOE’s LNG Export Study, AEO 2013 forecasts, and Navigant’s Spring 2012 forecast. Projected U.S. natural gas production in the AEO 2011 high shale EUR case lies between U.S. production in two current forecasts and therefore provides a reasonable estimate of the current U.S. natural gas production outlook.

Figure 4. U.S. Shale Gas Production (Dry)



Source: Navigant, EIA

Therefore, the results produced by DOE’s LNG Export Study under the AEO 2011 high shale EUR U.S. natural gas production scenario are consistent with the results one would obtain on the basis of current U.S. natural gas production forecasts. Under the AEO 2011 high shale EUR natural gas production scenario, NERA found that LNG exports were

economic under all three international demand for LNG scenarios.<sup>11</sup> U.S. LNG exports made a net positive contribution to the U.S. economy (e.g., gross domestic product was higher) and natural gas prices remained relatively low even under the highest U.S. LNG export levels (i.e., when there was a supply/demand shock and no constraint on U.S. LNG exports).<sup>12</sup> Finally, the largest net positive economic impact under the high shale EUR natural gas production scenario was obtained when there was no constraint on U.S. LNG exports.<sup>13</sup>

Navigant is hopeful that these comments will be helpful for the DOE as it gets set to make decisions of high importance to the LNG export projects, to the natural gas industry, to other parties reliant upon abundant and clean natural gas as a fuel source, and to the country as a whole.

Respectfully submitted,



Gordon Pickering  
Director, Energy  
Navigant Consulting, Inc.



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<sup>11</sup> See NERA analysis, pages 40-41.

<sup>12</sup> See NERA analysis, page 196.

<sup>13</sup> See NERA analysis, pages 185-196.

## Attachment 1

### Discussion of NERA's Global Natural Gas Market Model, EIA's Energy Modeling System, and NERA's Macroeconomic Model

#### The NERA and EIA Natural Gas Market Models

NERA's Global Natural Gas Model ("NERA's GNGM") incorporates worldwide natural gas demand and supply, regional natural gas prices, and natural gas imports and exports between regions.<sup>14</sup> NERA's GNGM consists of 12 regions, and the United States is in a region by itself. Each of the 12 regions has individual natural gas supply and demand curves.<sup>15</sup> NERA's GNGM characterizes the world natural gas market as consisting of a dominant supplying country that limits exports with other supplying countries being perfectly competitive.<sup>16</sup> NERA's GNGM determines the world natural gas market conditions by maximizing total consumer and producer surplus minus transportation costs taking into account constraints on transportation and liquefaction and regasification capacities.<sup>17</sup> In scenarios where the volume of U.S. LNG exports are limited, NERA's GNGM incorporates this constraint.

NERA's GNGM analyzes world natural gas demand and supply, determines the resulting world natural gas prices, and determines the price that would be received by U.S. LNG exporters. Conversely, EIA's National Energy Modeling System ("EIA's NEMS") considers only the U.S. natural gas market and does not project world market natural gas prices. Therefore, EIA's NEMS is not able to estimate the effect of increased U.S. LNG exports on the world natural gas market, and thus EIA's NEMS cannot determine how the world natural gas price would change in reaction to differing levels of U.S. LNG exports.<sup>18</sup> In addition, as the EIA recognizes, EIA's NEMS system cannot capture the effects of U.S.

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<sup>14</sup> Section III of the NERA analysis describes the world natural gas market and NERA's model of it. *See* NERA analysis, pages 16-22.

<sup>15</sup> NERA analysis, pages 99- 20.

<sup>16</sup> NERA analysis, page 97.

<sup>17</sup> NERA analysis, pages 100-2.

<sup>18</sup> "NEMS is not a world energy model and does not address the interaction between the potential for additional U.S. natural gas exports and developments in world natural gas markets," *see* EIA analysis, page 3.

LNG exports on the U.S. economy.<sup>19</sup> These limitations of the EIA's NEMS necessitates the use of an international energy model linked to a U.S. macroeconomic model to address the effect of differing levels of U.S. LNG exports on the U.S. economy. The pairing of NERA's GNGM and NERA's macroeconomic model ("NERA's N<sub>ew</sub>ERA") provides this linkage. NERA's GNGM is used to estimate the expected level of U.S. natural gas exports under the EIA scenarios. In turn, NERA's N<sub>ew</sub>ERA model is used to estimate the effects on the U.S. economy of the LNG export levels generated by NERA's GNGM.

EIA's NEMS and NERA's GNGM have different modeling structures and/or parameters for the natural gas sector and thus would not produce the same results given the same set of assumptions. To produce results that are consistent with the results of the EIA's NEMS, the natural gas supply curve in the NERA's GNGM was calibrated to the EIA's High/Rapid scenario produced using EIA's NEMS.<sup>20</sup> The natural gas prices generated by the NERA GNGM after calibration closely match those Produced by EIA's NEMS in the Baseline High/Rapid scenario.<sup>21</sup>

NERA also calibrated the natural gas demand and production generated by its GNGM to those generated by EIA's NEMS. The results of NERA Baseline Reference Case were adjusted to match the results of the EIA U.S. and International Baseline Reference cases for world supply and demand, U.S. natural gas imports from Canada, and international trade in natural gas.<sup>22</sup> The GNGM's Baseline Reference case is based on the EIA's International Energy Outlook (IEO) 2011 reference case.<sup>23</sup> The Baseline Reference case assumes that planned international LNG projects are constructed in the future.

NERA's GNGM, because it includes a world natural gas model, is able to estimate the world market demand for U.S. LNG exports. The EIA analysis provides the maximum amount of LNG for each scenario.<sup>24</sup> NERA's GNGM models what level of U.S. LNG exports are feasible under each scenario.<sup>25</sup> In some scenarios, NERA's GNGM finds that "the world natural gas market would not accept the full amount of exports assumed in the EIA scenarios at export prices high enough to cover the U.S. wellhead domestic prices calculated

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<sup>19</sup> "Macroeconomic results have not been included in the analysis because energy exports are not explicitly represented in the NEMS macroeconomic module," EIA analysis, page 5.

<sup>20</sup> See NERA analysis, pages 21, 31, and Appendix D, page 200. Appendix D examines in detail the differences between the EIA and NERA Models.

<sup>21</sup> See NERA analysis, Appendix D, pages 200-201.

<sup>22</sup> See NERA analysis, page 95.

<sup>23</sup> See NERA analysis, pages 29-30.

<sup>24</sup> See NERA analysis, page 9.

<sup>25</sup> Id.

by the EIA.”<sup>26</sup> The U.S. is able to export natural gas into the world market only if world natural gas prices are driven down low enough to produce additional demand in the world for natural gas.<sup>27</sup> NERA’s GNGM does not assume that another supplier will reduce its natural gas supply when the U.S. begins exporting so the world natural gas supply does not change and prices do not fall. In addition to evaluating EIA’s LNG export scenarios with binding export limits of 6 or 12 bcf/d, NERA evaluated scenarios in which there are no limits to U.S. exports of LNG.<sup>28</sup> These scenarios allow the examination of a case in which the world natural gas market conditions determine the size of the U.S. LNG export market.

### **NERA’s Macroeconomic Model**

NERA’s N<sub>ew</sub>ERA model’s long-term equilibrium economic growth for the U.S. economy. In any year, actual U.S. economic growth, employment, and prices may be above or below the long term equilibrium projections generated by the model.<sup>29</sup> NERA’s N<sub>ew</sub>ERA produces forecasts of consumption, investment, disposable income, supply and demand of all goods and services, commodity prices, and import and export levels.<sup>30</sup> NERA’s N<sub>ew</sub>ERA includes households, businesses, financial markets, government, and the world economy.<sup>31</sup> These sectors interact through the provision of labor, goods and services, savings and investment, taxes and subsidies, and imports and exports.<sup>32</sup> The model has five energy sectors and seven non-energy sectors. The model assumes full employment in the labor market with full flexibility to move between sectors.<sup>33</sup> Capital is associated with a particular sector and cannot move easily among sectors.<sup>34</sup>

NERA’s N<sub>ew</sub>ERA focuses on U.S. energy sectors and includes on LNG export sector, resource supply curves for U.S. natural gas, and natural gas imports into the U.S.<sup>35</sup> The model also includes, supply and demand curves for U.S. imports and exports of natural gas showing how the global LNG market price is influenced by the level of U.S. natural gas imports and exports.<sup>36</sup> NERA’s N<sub>ew</sub>ERA model incorporates economic data from IMPLAN and energy data from the EIA.

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<sup>26</sup> See NERA analysis, page 3.

<sup>27</sup> See NERA analysis, page 34.

<sup>28</sup> See NERA analysis, page 25.

<sup>29</sup> See NERA analysis, page 5.

<sup>30</sup> See NERA analysis, pages 22 and 112.

<sup>31</sup> See NERA analysis, pages 103-112 for a description of the NewERA model.

<sup>32</sup> See NERA analysis, page 103.

<sup>33</sup> See NERA analysis, page 110.

<sup>34</sup> See NERA analysis, page 110.

<sup>35</sup> See NERA analysis, pages 20-22.

<sup>36</sup> See NERA analysis, pages 21.

The NewERA model was calibrated to produce broadly the same results in its natural gas sector as did the EIA's NEMS. In particular, for any LNG export scenario, U.S. natural gas prices in the NERA NewERA model were the same as in the EIA NEMS.<sup>37</sup> Forecasts of GDP growth, energy supply and demand, and energy prices are calibrated to the EIA's AEO 2011 forecast.<sup>38</sup> Forecasts of labor sector trends are obtained from the U.S. Census.<sup>39</sup>

The NewERA model differs from an economic impact model in that it incorporates interactions among sectors, particularly in price feedbacks. An economic impact model calculates the effects on jobs, U.S. production measured by value added, and personal income primarily via increased wage payments from a change in economic activity such as an increase in the construction of LNG plants. However, an economic impact model does not show the effects of changes in prices associated with the changed economic activity. In the case of the construction of LNG plants, these price effects may occur as increases in the prices of construction materials, such as cement and steel, used in the construction. The NewERA model incorporates such price feedbacks and models their influence on other sectors. In the LNG plant construction example, an increase in the price of cement may cause sectors, other than the LNG construction sector, to use less cement.

The level of U.S. LNG exports in each scenario determined by GNGM is used as an input to the NewERA macroeconomic model.<sup>40</sup> U.S. natural gas wellhead prices are determined within the NewERA Model and do not match exactly the well head prices in the GNGM, but NERA describes these differences "not material to any of the results in the study."<sup>41</sup> Within the NewERA model, an increase in U.S. LNG exports raises the U.S. natural gas price above the price in the Baseline Reference case.<sup>42</sup> In turn, U.S. natural gas production increases.<sup>43</sup> A portion of the increased production is used for LNG exports. Higher natural gas prices affects industries that use natural gas a fuel which causes switches to cheaper fuel, a reduction in output, and the development of technologies to use natural gas more efficiently.<sup>44</sup>

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<sup>37</sup> See NERA analysis, pages 5, 10, 15, and 21.

<sup>38</sup> See NERA analysis, page 102.

<sup>39</sup> See NERA analysis, page 102.

<sup>40</sup> See NERA analysis, page 47. Several of the GNGM scenarios have the same level and pattern of U.S. LNG exports, so the number of scenarios analyzed in the NewERA Model is less than the number of GNGM scenarios. Also, some GNGM scenarios show no exports of U.S. LNG, so these scenarios are identical to the Baseline Reference.

<sup>41</sup> See NERA analysis, page 21.

<sup>42</sup> See NERA analysis, pages 49-51.

<sup>43</sup> See NERA analysis, pages 51-53.

<sup>44</sup> See NERA analysis, page 53.