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Subject: 2012 LNG Export Study – Reply Comments by The Dow Chemical Company
Date: Monday, February 25, 2013 3:32:13 PM
Attachments: image001.png
Dow Reply Comments to DOE.pdf

Enclosed herewith are the comments of The Dow Chemical Company in reply to comments submitted to DOE as of January 24,
2013 on the NERA Economic Consulting ("NERA") Report *Macroeconomic Impacts of Increased LNG Exports from the United States*.

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Before the
UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

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2012 LNG Export Study	)	Request for Comments
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REPLY COMMENTS OF THE DOW CHEMICAL COMPANY

February 25, 2013

I. Introduction

In accordance with the Department of Energy ("DOE"), Office of Fossil Energy's ("OFE") request for comments, The Dow Chemical Company ("Dow") is pleased to present these comments in reply to comments submitted to DOE as of January 24, 2013 on the NERA Economic Consulting ("NERA") Report *Macroeconomic Impacts of Increased LNG Exports from the United States* (the "NERA Report" or the "Report").[1] These comments incorporate by reference Dow's initial comments on the NERA Report that were submitted on January 24, 2013.

Sixteen applications for export of liquefied natural gas ("LNG") to countries without free trade agreements with national treatment for natural gas ("Non-FTA Countries") are pending before DOE. These applications represent an aggregate potential export capacity of approximately 24.5 bcf/d, which amounts to roughly 40% of U.S. natural gas consumption. The record in these application proceedings is inadequate and incomplete. No doubt these deficiencies had much to do with DOE commissioning the NERA Report.

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[1] *2012 LNG Export Study*, 77 Fed. Reg. 73,627 (Dec. 11, 2012).

As detailed below, public comments reinforce that the NERA Report provides no basis for broad issuance of the requested export authorizations. The Report is limited in scope and flawed in execution. More importantly, though, neither the NERA Report nor any macroeconomic analysis could justify immediate action on the export applications.

Beginning with its passage of the Natural Gas Act ("NGA") over 70 years ago, Congress has recognized that natural gas is a critical natural resource, trade of which can substantially affect the wellbeing of all Americans.[2] Consequently, Congress established that natural gas exports must be in accordance with the public interest.

Under the NGA, DOE is entrusted with determining whether proposed natural gas exports to Non-FTA Countries are in the public interest. The NGA does not explain or define "public interest." And, as Senator Wyden recently emphasized, DOE lacks the policy framework needed to make reasonable, informed judgments about the public interest with regard to LNG export applications:

> [T]he guidance the Energy Department now uses for evaluating gas export applications was originally created almost a quarter century ago for import policy. It seems to me it is now time to have a serious discussion as to whether the guidelines that now are in place at the Energy Department for approving export applications are what they need to be.[3]

A rulemaking proceeding would enable DOE to elicit analysis and information from the expanse of industry, non-government organizations, academia and other constituencies to establish criteria and metrics to make public interest determinations for

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[2] 15 U.S.C. §§ 717 to 717Z.

[3] United States Senate Committee on Energy & Natural Resources, *Wyden Opening Statement, Opportunities and Challenges for Natural Gas* (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=5a088d1f-69e8-4673-84a0-d551f4df10e4.

LNG export applications. This will facilitate thereafter a more deliberate, sequential, step-by-step assessment of each pending LNG export application with outcomes that, as Dow's Chief Executive Officer recently explained, benefit U.S. energy producers, U.S.-based manufacturers, the American people and the U.S. economy. In this way, Mr. Liveris continued, we will make decision-making on LNG exports "in interest of American workers, American consumers, American industry, and American producers. Let's put America first, we should all share that goal."[4]

With an appropriate articulation of public interest criteria for LNG exports, the impact of the pending applications on all affected constituencies can be systematically weighed. This will enable DOE to reach a reasoned decision derived from a comprehensive and legally sufficient record that can withstand judicial review, something it does not now have. As an immediate matter, the comments DOE has received on the NERA Study should be entered into the record of pending application proceedings. The comments include substantial evidence about broad issuance of LNG export authorizations and adverse implications for the United States that could make issuance of pending export applications contrary to the public interest. With the stakes of exporting so high, DOE owes it to the nation to take the time and make the effort to ensure that LNG export levels are consistent with its legal obligations and in the public interest.

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[4] Senate Committee on Energy And Natural Resources Holds a Hearing on Opportunities and Challenges For Natural Gas (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=0e5d5793-4e30-4fcd-a7c3-791c985b302e.

II. Executive Summary

The voluminous response to DOE's request for initial comments on the NERA Report underscores the importance of a national examination of LNG exports and the public interest. Although DOE sought comments focused on the study itself, the scope and breadth of the comments show that interested parties have wide-ranging views on the "public interest" that go beyond the net macroeconomic effects of LNG exports.

The NERA Report is a flawed document that is based on faulty assumptions with limited predictive value. Our reply comments are intended to address the principal arguments put forth in the submissions to DOE that supported the accuracy of the NERA Report. These supporters argue that DOE should accept the NERA Report and approve all pending export applications without delay. We disagree and believe such an approach would not be in the public interest in light of flaws in the study and the divergence of opinion on the "public interest" and LNG exporting.

Because natural gas is a scarce natural resource that is vital to our economy, our jobs, our environment and our energy independence and security, DOE should critically examine the NERA Report. While several commenters argue that the NERA Report is sound and reliable, those commenters overlook defects in the Report and related considerations as summarized below.

The NERA Report overstated supply

- The NERA Report overestimates the future supply of natural gas. The Report fails to account for the true natural gas supply curve, which is not flat or elastic at prices near current levels.
- Export demand would displace domestic supply and would not be satisfied entirely by incremental supply. Competition between domestic demand and export demand will apply upward pressure on prices.

- Sharply higher natural gas prices are not needed to stimulate domestic production.

The NERA Report understated demand

- Approval of pending export applications could result in LNG exports of 10 bcf/d or more by 2025.

- Applicants for LNG exports argue that export demand will be limited while at the same time representing that their facilities will be built. This position is inconsistent. The cumulative impacts of approving many applications will cause demand shocks if approved over a relatively short time frame.

- The NERA Report significantly understates future demand growth among the manufacturing, power and transportation sectors.

The NERA Report understates price volatility

- Prices would increase substantially if all pending LNG export proposals are approved in short order because the consequent spike in demand would not be matched by an increase in supply.

- If LNG exports rise to significant levels, then domestic natural gas prices will rise to meet falling international natural gas prices, and the costs of liquefying, transporting and gasifying natural gas will not provide a substantial buffer between domestic and international prices.

Natural gas exports will have a substantial impact on the manufacturing sector

- Reasonable and stable natural gas prices are fueling a manufacturing renaissance that consists of more than 100 announced projects representing approximately $95 billion in planned new investments so far. Natural gas prices impact investment decisions in this sector because the industry is particularly sensitive to modest changes in prices.

- Natural gas used in the manufacturing sector provides both a much greater contribution to GDP and significantly higher employment than does natural gas that is exported, resulting in comparatively higher GDP.

- LNG exports would not significantly reduce the United States' merchandise trade balance and could actually worsen that trade balance. In addition, natural gas used in the manufacturing sector results in much higher total export revenues than does natural gas that is exported.

Many commenters suggest that the NERA Report provides a sound basis for DOE to move forward with public interest determinations. Those commenters are wrong. The NERA Report should be one data point, albeit a flawed one, in DOE's evaluation of the public interest. The NERA Report modeled the macroeconomic impact of LNG exports to Non-FTA Countries, but did not address a variety of other considerations, such as industry specific or regional or local impacts, environmental concerns, international relations and trade policy, energy security or independence concerns or other qualitative factors.

Contrary to some commenters' position, then, a more delicate and balanced approach is needed to make reasonable, informed public interest determinations about LNG export applications. Evaluating the public interest in this context involves analysis of a broad range of factors that simply have not been identified or well-defined. Indeed comments to DOE raised a host of issues not directly addressed in the NERA Report but that should be considered as part of the public interest standard. In Part IV, we address comments relating to world trade policy, transshipment of natural gas and the environment. Most critically, as we explain in Part V, a manufacturing renaissance is underway in the United States that is supported in part by the prospect of reasonable and stable natural gas prices. This renaissance promises to bring jobs and advanced manufacturing back to the United States after a substantial decline in U.S. manufacturing.

By commissioning the NERA Report, DOE acknowledged that it needed more information to properly evaluate the public interest. A process that currently relies on interveners in application proceedings—who may not represent the broader public interest because of differences of perspective or lack of financial resources—simply is not producing a sufficient basis to evaluate the public interest for LNG exports to Non-

FTA Countries. Certainly DOE could not broadly and summarily issue requested export authorizations given evidence submitted in this comment proceeding. If DOE approved export applications over a short time frame, the growth in LNG export volumes would likely outstrip domestic supply growth, which would result in higher prices for U.S. customers and industry.

Reasonable administration of the NGA requires an inclusive rulemaking process to determine what the public interest entails. Armed with criteria and metrics from such a rulemaking, DOE could meaningfully evaluate whether proposed LNG exports would be in the public interest by, for example, spurring economic growth in the United States and resulting in reasonable and stable natural gas prices for consumers and industry alike.

Because natural gas exports are a matter of critical national significance, Dow believes that it is incumbent on DOE to examine critically the NERA Report for flaws in methodology, assumptions and conclusions and to engage in a comprehensive rulemaking process that incorporates the views of all stakeholders, thereby establishing a set of public interest criteria and metrics by which any pending LNG export applications can be adjudicated.

III. Shortcomings in Economic Analysis of Initial Comments and the NERA Report

A. Economic Models Like the One Underlying the NERA Report Serve A Limited Purpose

Many commenters have praised the economic modeling performed by NERA.[5] While economic models like the one underlying the NERA Report can be useful for analyzing economic relationships, they have crucial limitations. Modeling is necessarily based on assumptions about the future that almost certainly will vary from actual results. Furthermore, models cannot examine the full range of qualitative issues that should be examined for policymaking.

As shown in Dow's initial comments on the NERA Report, and as described below, the model underlying the Report is flawed and should not serve as a basis for DOE decision-making. Several of the modeling flaws in the NERA Report were avoidable. Others, however, are endemic to all economic models, something disregarded by those who suggest that the Report provides the answer for assessment of export applications. For example, determining the total impact on U.S. gross domestic product ("GDP") of an economic activity like exporting LNG may be discernible from a model, but determining how to weigh the production, employment and investment losses among segments of the economy against the gains among other segments is not. Those commenters urging DOE to base its public interest determination on the NERA Report fail to account for these inherent drawbacks

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[5] See, e.g., Jordan Cove at Appendix; GE Oil & Gas at 2; CLNG at 6-8; Southern LNG Company, at 4, 7. Appendix A includes full citations and corresponding short citations to the initial submissions to DOE in response to DOE's request for comments on the NERA Study. Short citations listed on Appendix A to those submissions are employed in this submission for ease of reference.

associated with economic modeling. The public interest encompasses far more than an arithmetic summation of gains and losses, even if those gains and losses could be accurately predicted.

B. Domestic Supply of Natural Gas

Both NERA and commenters advocating unlimited LNG exports overestimate domestic natural gas supply over the next 10 to 20 years. Contrary to commenters' suggestions, the relevant portion of the domestic supply curve is not close to being flat at prices near current levels. While the United States has an abundant supply of natural gas reserves, the amount that is marketable in the short- to medium-term is limited. Significant growth in natural gas demand therefore will not necessarily be met with ready supply at prices near current levels. Moreover, growth in supply will not necessarily match or exceed increases in LNG export volumes. To the contrary, as even NERA forecasted,[6] if DOE approves all pending export applications over a short time frame the growth in LNG export volumes will likely exceed the growth in domestic supply, resulting in reduced availability and higher prices for U.S. customers.

1. NERA Report Overstates Excess Supply in the Domestic Natural Gas Market and the Natural Gas Supply Curve is Not Flat or Nearly So at Prevailing Price Levels

Commenters claim that the domestic natural gas supply curve has become nearly flat or very price elastic and that ready amounts of additional supply would be

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[6] NERA Report at 180, 190.

made available to match any additional demand from LNG exports without a significant price increase.[7]

Contrary to these claims, the domestic natural gas supply curve is not close to being flat or very price elastic at prices near current levels. It is not the case that a major increase in the quantity of natural gas demanded (such as from LNG exports) would be readily met with increased supply of natural gas with little or no impact on the domestic price for natural gas.

To the contrary, as Charles River Associates demonstrates in its study, *U.S. Manufacturing and LNG Exports: Economic Contributions to the U.S. Economy and Impacts on U.S. Natural Gas Prices*, attached to this submission (the "CRA Study"),[8] the domestic supply curve for natural gas is upward sloping and only moderately elastic at prices near current levels. More specifically, the marginal cost of supplying natural gas to the domestic market is increasing, not constant, at production levels required to meet expected increases in aggregate demand for natural gas. Natural gas supply increases lag natural gas demand increases and take a number of years reach the market. The cost structure of different shale gas plays, together with infrastructure and inter-temporal

[7] American Council for Capital Formation at 2; GE Oil & Gas at 3. See also American Petroleum Institute ("API") at 8-10; CLNG at 9; Southern LNG Company at 4-6 (claiming that the NERA Report underestimates the future excess supply of domestic natural gas because more recent data included in the U.S. Energy Information Administration ("EIA") Annual Energy Outlook ("AEO") for 2013 show a 15% increase in domestic supply of natural gas, compared to a 5.6% increase in demand for natural gas).

[8] Attachment A.

constraints (such as pipeline capacity), yield an upward-sloping supply curve that often is not reflective of the lowest cost gas resource.[9]

One reason for natural gas supply inelasticity is restraints on the availability of expanded pipelines and other natural gas supply infrastructure. Even if natural gas can be removed from underground, it can only be supplied to consumers once it is transported to them via pipelines, and pipeline capacity is constrained.

Due to limitations on supply elasticity, increases in demand would not immediately be satisfied by increased production of natural gas. In other words, well head supply of natural gas would not immediately grow to offset demand from exports. The result would be natural gas price increases.

2. LNG Exports Will Absorb Existing Domestic Supply, Not Be Satisfied through New Supply

Some commenters claim that the U.S. natural gas resource base is sufficient to supply all levels of forecasted demand for decades to come at moderate cost.[10] As a result, these commenters argue, incremental increases in domestic natural gas production would meet or exceed increased demand from LNG exports, and thus the domestic supply of natural gas available to serve domestic demand would not be adversely affected. These claims are incorrect.

Indeed, even the NERA Report itself does not support these claims. To the contrary, the NERA Report indicates that increased LNG exports would significantly

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[9] CRA Study at 51.

[10] Shell Oil Company at 3; ExxonMobil at 3-4.

exceed the related increases in domestic natural gas production, thereby reducing the domestic supply of natural gas available to serve U.S. customers at or near current prices.[11]

As shown in the CRA Study, the domestic supply curve for natural gas is upward sloping at prices near current levels, and additional supply will be associated with higher price levels.[12] While the overall supply of natural gas would increase if significant LNG exports occurred, it is likely that the increase in LNG export volumes would exceed the increase in overall supply, resulting in a decline in supply of natural gas to the domestic market and an increase in prices. Significant increases in LNG exports are unlikely to be matched by commensurate increases in natural gas production. As a result, U.S. customers would face reduced availability of natural gas and significantly higher natural gas prices.

3. Modest Price Increases Associated with Expected Demand Growth Will Stimulate Domestic Supply Without Any Need for LNG Exports

Some commenters argue that LNG exports are needed to increase domestic prices and thereby increase natural gas supply.[13] They assert that domestic supply is contracting and is likely to continue to do so absent increased demand at higher prices from increased LNG exports.

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[11] For example, in NERA's scenario pertaining to High Shale production with a demand shock and unconstrained exports (HEUR_D_NC), exports total 4.87 Tcf in 2025, but production in 2025 is only 2.32 Tcf higher than the baseline case. NERA Report at 180, 190. Similarly, in NERA's scenario pertaining to High Shale production with a supply-demand shock and unconstrained exports (HEUR_SD_NC), exports total 6.72 Tcf in 2025 but production in 2025 is only 3.09 Tcf higher than the baseline case. Id. at 180, 190.

[12] CRA Study at 7-8, 48-51.

[13] Galway Group LP at 2; Cameron at 6; AXPC at 1.

Demand for natural gas is expected to increase significantly over the next 10 to 15 years independent of any increase in LNG exports. That demand growth will bring higher prices that in turn will stimulate additional supply. While some exports are expected to occur, LNG exports are not needed to achieve production increases and would only serve to increase prices well beyond the level needed to stimulate supply. Claims made by proponents of unlimited LNG exports are based on the incorrect premise that increased LNG exports will cause domestic natural gas prices to increase modestly and gradually. However, if DOE approves all pending LNG export applications in short order, then prices likely will increase markedly and quickly.

Modestly higher natural gas prices (for example, on the order of $5/mcf) that would be associated with DOE's gradual approval of pending applications would incentivize producers to increase production at existing facilities that are currently underutilized. But if DOE were to approve all pending applications over a short time frame, then increased volatility, including upward price spikes, would occur to the extreme detriment of U.S. customers and the U.S. economy.

C. Demand for Natural Gas for Domestic Use and LNG Exports

Contrary to the claims made by supporters of the NERA Report, NERA significantly underestimated the aggregate demand for natural gas over the next 20 years, and in so doing underestimated the impact that increased LNG exports would have on the domestic natural gas market. If requested LNG export permits are granted, LNG exports are expected to reach at least 10 bcf/day or more by 2025. Such exports would be additional to major increases in natural gas demand within the U.S. economy. Demand for natural gas among the manufacturing, power and transportation sectors likely will increase far more than NERA forecasted over the next 10 to 15 years. If this additional demand materializes and LNG exports reach the levels forecasted here, then domestic natural gas prices would increase significantly.

1. Claims that LNG Exports Would be Modest Due to Market Forces and Infrastructure Constraints are Inaccurate

Some commenters claim that even if all pending LNG export applications were approved in short order, LNG exports likely would be modest and represent only a fraction of the volume for which DOE export approval is being sought. This claim is inaccurate.

a. Approval of All Pending Export Applications Could Result in LNG Exports of 10 bcf/d or More by 2025

Commenters claim that, even if all pending LNG export applications are quickly approved by DOE, the volume of LNG exports in 2025 will be on the order of 6 bcf/day.[14]

This projection of LNG export levels likely is far too low. DOE has already approved LNG exports accounting for almost 45% of annual production in 2012. If even a quarter of that already-approved volume is exported, then LNG exports to FTA Countries could exceed 8% of production by 2025. Approval of pending export applications pertaining to Non-FTA Countries certainly would increase the share of LNG exports and would permit those exports to flow to Non-FTA Countries that have markedly more demand for U.S. natural gas, making it far more likely that a higher

[14] Southern LNG Company, Appendix A at 5-6; GE Oil & Gas at 3; Cameron at 20.

percentage of production would be exported as LNG. In the final analysis, there is firm reason to believe that LNG exports could reach 10 bcf/day or more by 2025.[15]

First, the major gap between foreign and domestic natural gas prices is an acute motivator to enjoy arbitrage profits from exporting. Exporters will repeatedly enter into contracts for export so long as a sufficient price gap and international demand for exports persist.

Second, international demand for U.S. LNG is high, and all evidence points to increasing demand. As of February 2013, U.S. natural gas committed for export already totaled 5 bcf/d, and that volume is expected to grow due to anticipated announcements from major petroleum companies.[16] Indeed, commenting on the recently announced export agreement between Freeport LNG Expansion LP and BP plc, one energy analyst noted that "clearly there is sufficient demand" for the United States to exceed previous expectations of only about 6 bcf/day of exports.[17] In 2011 worldwide LNG exports totaled approximately 240 million tons per year,[18] or 32 bcf/day.[19] One large petroleum company expects worldwide LNG demand to reach over 53 bcf/day by 2020, and to

[15] CRA Study at 3-4, 32-37.

[16] The Wall Street Journal, *Freeport, BP Reach Gas Export Agreement* (Feb. 11, 2013), available at http://online.wsj.com/article/SB10001424127887323696404578298353734143548.html.

[17] Id.

[18] Id. at 3.

[19] This is based on a conversion factor of 48.7 bcf per million tons. See http://www.bp.com/conversionfactors.jsp.

potentially reach 67 bcf/day by 2025.[20] Given the size and the growth rate of international natural gas consumption, it is reasonable to conclude that U.S. LNG export volumes will be near or above 10 bcf/day by 2025, especially considering that industry observers project that the United States will likely have some of the lowest cost producers in the LNG market.[21]

Moreover, the prevalence of long-term "take or pay" contracts in the LNG market could result in LNG exports even when such exports are unprofitable on a short-term basis.[22] In 2011, 75% of worldwide LNG trade by volume was conducted pursuant to contracts with durations of over four years.[23] To the extent that they are used, take or pay contracts will stabilize demand for LNG exports on a medium-term basis, but in doing so will cause LNG to be exported on a consistent basis, perhaps even during periods when LNG exports are not profitable on a spot market basis. Additionally, to the extent that an international cartel of LNG exporters develops, the United States could be the swing exporter of LNG in the world market, and the demand for domestic LNG could be even greater than would otherwise be the case.

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[20] LNG World News, *Shell Expects LNG Demand to Double by 2020, The Netherlands* (Nov. 14, 2012), available at http://www.lngworldnews.com/shell-expects-lng-demand-to-double-by-2020-the-netherlands/.

[21] Credit Suisse, *Global LNG Sector -- Update* 3 (Jun. 7, 2012).

[22] For example, the contracts entered into by Cheniere Energy Partners, L.P. for the Sabine Pass facility reportedly are all "take or pay" contracts. See http://www.chenièreenergypartners.com/liquefaction_project/liquefaction_project.shtml.

[23] International Group of Liquefied Natural Gas Importers, *The LNG Industry 2011* at 4, 27-30, available at http://www.giignl.org/fileadmin/user_upload/pdf/A_PUBLIC_INFORMATION/LNG_Industry/GIIGNL_The_LNG_Industry_2011.pdf.

b. Reasonable to Base Analysis on Applicants' Representations About LNG Volumes

Commenters argue that increased LNG exports volumes would be modest because the aggregate capacity represented by pending LNG export applications overstates the export capacity that will be constructed, as investment return considerations, including anticipated competition from LNG exporters in foreign countries, will limit the constructed capacity.[24]

DOE should not base its public interest analysis on volume estimates that are less than the applicants' own representations about LNG utilization and volumes. The applicants cannot have it both ways—they cannot advance utilization and volume data in their applications and then expect DOE to use different aggregate data to decide that proposed exports are in the public interest.[25] And DOE has recognized that it must account for the cumulative impact of LNG export approvals.[26] The reported contractual commitments already established in connection with DOE's approval of the Sabine

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[24] API at 14, 16; Southern LNG Company at 10; Cameron at 20 ; GE Oil & Gas at 3; EPRINC at 3.

[25] On the one hand, Cameron LNG, LLC ("Cameron"), like several other commenters, asserts that "it is highly unlikely that all of the LNG export projects with non-FTA applications currently pending before DOE/FE will be built." Cameron at 20. On the other hand, Cameron confirms that its project not only will be built, but will produce $8.6 billion per year in export revenue. Id. at 9, 12.

[26] Sabine Pass Liquefaction, LLC, FE Docket No. 10-111-LNG, Order No. 2961, at 32-33 (May 20, 2011) ("Sabine Pass Non-FTA Order"):

> We intend to monitor [supply and demand] conditions in the future to ensure that the exports of LNG authorized herein and in any future authorizations of natural gas exports do not subsequently lead to a reduction in the supply of natural gas needed to meet essential domestic needs. The cumulative impact of these export authorizations could pose a threat to the public interest. . . . Furthermore, DOE/FE will evaluate the cumulative impact of the instant authorization and any future authorizations for export authority when considering any subsequent application for such authority.

Pass application illustrate precisely why it is necessary and factually appropriate for DOE to take LNG export applicants at their word in terms of export levels they will achieve. The Sabine purchasers have entered into definitive 20-year "take or pay"[27] contracts to purchase substantially all of the Sabine Pass facility's approved output.[28] Thus, DOE simply cannot assess the public interest at anything less than what the export applicants say they intend to do.

In addition, over 60% of the pending LNG export capacity is associated with reworks of existing LNG import terminals. Conversion of existing LNG import terminals into export terminals involves significantly less capital investment than does building a new, "greenfield" export facility because there is already significant infrastructure in place, such as pipelines, shipping terminals, and storage tanks. Accordingly, financing of terminal conversions should be easier than for greenfield projects.

Finally, DOE should in examining the merits of each LNG export application, consider each application's cumulative impact with any other pending or approved LNG export applications. The cumulative volumetric impact of LNG exports on the domestic natural gas market could be extremely significant. According to OFE, as of January 11, 2013 DOE authorized export of 27.58 bcf/d of LNG to countries with which the United States has free trade agreements with national treatment for natural gas ("FTA Countries") and 2.2 bcf/d of LNG to Non-FTA Countries, and is considering applications

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[27] As used in this submission, a "take or pay" commitment refers to a purchaser's enforceable obligation either to purchase a specific quantity of LNG at a specific price or to pay for such quantity at such price.

[28] Cheniere Energy Partners, L.P. press release, available at http://www.cheniereenergypartners.com/liquefaction_project/liquefaction_project.shtml.

to export an additional 3.83 bcf/day of LNG to FTA Countries and an additional 22.6 bcf/d of LNG to Non-FTA Countries.[29] As a result, if DOE were to approve all pending LNG export applications, approximately 45% of the nation's annual natural gas production could be exported as LNG.[30]

c. There is a Significant Gap Between U.S. and Japanese LNG Prices

Some commenters assert that NERA overstates the gap between U.S. and Japanese prices and the associated incentive to export.[31] Shipments to east Asia are especially important because that region is the largest consumer of LNG in the world, consuming 63% of LNG in 2011.[32] These commenters suggest that U.S. LNG would cost roughly $10/mcf landed in Tokyo Bay, and that this price is in the range of prices of LNG there over the past three years.[33]

The suggestion that the price of LNG in Japan over the last three years has been in the range of $10/mcf is not correct. According to the Federal Energy Regulatory

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[29] OFE, *Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of January 30, 2013),* available at http://www.fossil.energy.gov/programs/gasregulation/reports/summary_lng_applications.pdf. The summary table of OFE that shows LNG export applications contains a footnote "d" that explains that the FTA and non-FTA volumes shown in the table are "not additive at a facility." Curiously, this limitation is not underscored in DOE's authorization for the Sabine Pass facility to export LNG to non-FTA countries. Sabine Pass Non-FTA Order at 42-47. This limitation is inherent in and essential to DOE's order. Dow respectfully suggests that it be stated fully and explicitly in future DOE authorization orders.

[30]EIA, *Natural Gas Withdrawals and Production*, available at http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_NUS_a.htm.

[31] Shell Oil Company at 5.

[32] *The LNG Industry 2011* at 3.

[33] Shell Oil Company at 5.

Commission ("FERC"), the current landed price of LNG in Japan is $17.90/mcf[34] or approximately 180% more than NERA's estimate. Moreover, Japan's LNG import price has been well above $10/mcf and closer to $15/mcf for the last two years.[35] Indeed, EIA reports that prices for LNG exported to Japan from Alaska averaged almost $16/mcf in 2012.[36] Based on this evidence, a major gap exists between U.S. and Asian LNG prices. NERA understated (not overstated) this gap and, as a result, domestic LNG exporters have a major incentive to export LNG.

The NERA Report also minimizes the differences in U.S. and Asian LNG prices by grossly overstating the transportation and insurance costs associated with shipping LNG to Asia. NERA estimates that these costs would be on the order of $2.60/mcf for U.S. shipments to Asia.[37] Official trade statistics published by the U.S. Census Bureau, however, establish that these costs would be closer to $0.50/mcf.[38] NERA thus may understate the gap between U.S. natural gas prices and Asian LNG prices adjusted for transportation and liquefaction by over $2.00/mcf. In doing so, NERA misses the incentive that U.S. LNG exporters would have to export LNG and the related upward impetus on domestic natural gas prices.

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[34] FERC, Market Oversight, *World LNG Estimated February 2013 Landed Prices* (Jan. 15, 2013), available at www.ferc.gov/market-oversight/mkt.../ngas-ovr-lng-wld-pr-est.pdf.

[35] YCharts, *Japan Liquefied Natural Gas Import Price Chart*, available at http://ycharts.com/indicators/japan_liquefied_natural_gas_import_price.

[36] EIA, *U.S. Natural Gas Exports by Point of Exit Data*, available at http://www.eia.gov/dnav/ng/ng_move_poe2_a_EPG0_PNG_DpMcf_m.htm.

[37] NERA Report at 88, 90.

[38] Based on the average cost, insurance and freight expenses associated with U.S. imports of LNG in 2010 and 2011. USITC Dataweb (import data for HTSUS 2711.11).

2. NERA Underestimates Future Domestic Demand for Natural Gas Among Manufacturing, Power and Transportation Sectors

a. NERA Underestimates Future Demand By the Power Sector and Industry

As discussed in detail in the CRA Study, demand for natural gas within the domestic power sector and the industrial sectors, respectively, is likely to be far higher over the next 10 to 20 years than was forecasted by the NERA Report.[39] Demand for natural gas within the power sector could reach 27.3 bcf/day by 2020 and 32.8 bcf/day by 2030, up from roughly 20 bcf/day in 2010.[40] Demand for natural gas within the industrial sector could increase over 2010 levels by 4 bcf/day by 2022 and almost 5 bcf/day by 2030.[41] NERA forecasted far lower growth rates in both of these sectors.[42]

b. NERA Underestimated Future Demand Within the Transportation Sector

Some commenters argue that NERA's assumptions regarding the amount of natural gas used in transportation are generally accurate and that other claims that demand for natural gas to be used in transportation could be significantly higher are incorrect.[43]

To the contrary, NERA Report projections of future demand for natural gas in the domestic transportation sector appear to be far too low. Using data from AEO 2011, the NERA Report assumes a very modest increase in demand for natural gas to be used in

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[39] CRA Study at 38-47.

[40] Id. at 43.

[41] Id. at 40.

[42] Dow at 9-10.

[43] EPRINC at 3.

transportation, shifting from 0.1 to 0.2 bcf/d over the 2013–2020 timeframe. In fact, use of natural gas in transportation likely will grow far more rapidly in the coming years. Applying the 2009-2011 growth rate of 9.8% for natural gas use in vehicles out to 2035 yields an increase of 2 bcf/d.[44] The CRA Study shows that demand for natural gas within the transportation sector could reach 3.2 bcf/day by 2030.[45]

Even more conservative forecasts from Wood Mackenzie, CERA and others indicate a potential increase from 0.2 to 1.5 bcf/d. Accordingly, NERA may have grossly underestimated future natural gas demand for use in transportation, by a factor of 7.5 to 10.[46]

As detailed below, expected increased demand for natural gas in the transportation sector is due to anticipated implementation of transportation-related public policies favorable to the market for natural gas vehicles ("NGV"), market-driven increases in fleet vehicles converting from conventional fuels to LNG and compressed natural gas and related wide-scale build-out of a geographically broad fueling infrastructure. As DOE has confirmed,[47] increased domestic use of natural gas in this

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[44] Id.

[45] CRA Study at 46.

[46] Dow at 11.

[47] As DOE has observed:

> Since natural gas is not presently a widely available substitute fuel for petroleum as a transportation fuel, the impact of the proposed LNG exports on oil consumption is not likely to be significant at least for the immediate future. In this regard, [DOE] acknowledge[s] that the development of a domestic infrastructure capable of supporting broader use of natural gas in the transportation sector could alter the current situation. To the extent, therefore, that natural gas becomes a substitute for petroleum on a wide-scale basis in the transportation sector, e.g. through the build-out of a geographically broad infrastructure capable of distributing natural gas to vehicles capable of using it, the argument made by

(continued…)

manner implicates domestic energy security and is a factor that must be considered in determining whether to grant pending LNG export applications.

President Obama underscored the importance of the use of natural gas in both passenger and heavy-duty vehicles following his State of the Union address in 2012.[48] With more stringent emissions standards and favorable public policies adopted, the NGV market in the United States faces rapid expansion and, by 2025, may grow to 1.25 Tcf as compared to 45 bcf in 2010.[49] This projection is supported by world-wide data relating to the rapidly growing NGV market and by the NGV market's continued expansion, even during the recent global recession.[50]

NGVs used for waste collection, transferring vehicles and to service airports are the fastest growing domestic NGV market segments,[51] with new projects underway to further increase the use of natural gas in these segments. For example, Clean Energy Fuels Corp. announced recently that it has begun providing natural gas fuel to additional trucking fleets.[52] Waste Management Inc. plans call for making 80% of the trucks that it

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(…continued)

> the opponents to the authorization regarding reducing dependence on imported energy could be a factor for consideration in later proceedings.

Sabine Pass Non-FTA Order at 36.

[48] Brookings Energy Security Initiative, *Liquid Markets: Assessing the Case for U.S. Exports of* Liquefied *Natural Gas* at 18, available at http://www.brookings.edu/~/media/Research/Files/Reports/2012/5/02%20lng%20exports%20ebinger/0502_lng_exports_ebinger.pdf.

[49] The American Oil & Gas Reporter, *With NGVs Taking Off, U.S. Transportation Sector Accelerating Natural Gas Demand*, available at http://www.aogr.com/index.php/magazine/cover-story/with-ngvs-taking-off-u.s.-transportation-sector-accelerating-natural-gas-de.

[50] Id.

[51] Natural Gas Vehicles for America, available at http://www.ngvc.org/forfleets/index.html.

[52] Clean Energy Fuels, *Clean Energy Adds Major Trucking Fleets to Natural Gas Fueling* (June 29, 2012), available at http://www.cleanenergyfuels.com/news/2012/6-29-12.html.

purchases over the next five years NGVs. It expects to have a fleet that consumes more natural gas than diesel by 2017.[53]

Growth in fueling infrastructure will be a major contributing factor to growth in the use of NGVs. About 1,100 out of 150,000 vehicle fueling stations in the United States provide natural gas fueling currently. But natural gas fueling availability is presently growing by 15-20 stations a month, and that rate is increasing.[54] For example, Royal Dutch Shell recently announced that it will invest more than $300 million to build out a portfolio of LNG filling stations at the largest chain of truck stops in the United States.[55] Similarly, Clean Energy Fuels Corp. is planning to complete a network of 150 LNG truck fueling stations connecting major freight trucking corridors across the United States.

D. Impact of LNG Exports on Natural Gas Prices

1. Increased LNG Exports Will Tend to Bring High, Non-Market Oil Pricing to the U.S. Natural Gas Market

There currently is not a world market for natural gas (or LNG). Instead, various regional markets exist across the world, and prices among those markets differ markedly.[56] The U.S. natural gas market currently functions efficiently and effectively, with the interaction of demand for and supply of natural gas dictating the domestic price of natural gas.

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[53] The Wall Street Journal, Will Truckers Ditch Diesel? (May 23, 2012), available at http://online.wsj.com/article/SB10001424052702304707604577422192910235090.html.

[54] Id.

[55] Forbes, *Shell Investing $300 M to Fuel LNG_Powered Trucks*, available at http://www.forbes.com/sites/christopherhelman/2012/06/13/shell-investing-300m-to-fuel-lng-powered-trucks/.

[56] International Gas Union, *World LNG Report 2011* at 18, available at http://www.igu.org/igu-publications/LNG%20Report%202011.pdf.

In contrast, prices for natural gas in Asia are dictated largely by the price of oil, not simply the interaction of demand for and supply of natural gas within those regional markets.[57] The world price for oil also is not truly market-driven, as the members of the Organization of the Petroleum Exporting Countries generally attempt to manipulate the price, and other non-economic, strategic and geopolitical concerns also affect the price.[58] Nevertheless, there generally is a single world market for oil (with submarkets for various types of oil).[59]

As exports of LNG from the United States increase, interaction between the U.S. market for natural gas and overseas (particularly Asian) markets for natural gas will also increase. As a result, beyond some level, exports of LNG will cause oil-indexed pricing to be imported into the U.S. market. If that happened, both the price level and the volatility of prices within the domestic natural gas market would spike upwards. Senator Manchin recognized this potential problem during the February 12, 2013 Senate Energy and Natural Resources Committee hearing on Opportunities and Challenges for Natural Gas when he asked "who controls the American pricing? Because once you go into the overseas market, you lose your ability to set your own destiny." [60]

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[57] Id. at 18

[58] See, for example, MIT Study on the Future of Natural Gas at 151, 152, available at http://mitei.mit.edu/system/files/NaturalGas_Chapter7_Markets.pdf.

[59] Id.

[60] Senate Committee on Energy And Natural Resources Holds a Hearing on Opportunities and Challenges For Natural Gas (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=0e5d5793-4e30-4fcd-a7c3-791c985b302e.

Significant increases in gas demand from LNG exports will tighten the U.S. supply-demand balance to where spikes above the average range of volatility will occur.[61] As Dow's Chief Executive Officer recently explained, and as discussed further below, this could bring to bear in the United States the problems that Australia is experiencing—it is importing sharply higher natural gas prices and exporting employment.[62]

2. Approval of Pending LNG Export Applications Over Short Period Would Result in Increased Domestic Natural Gas Price Volatility

Proponents of increased LNG exports claim that increases in the domestic price of natural gas resulting from increased LNG exports would be modest and that increased LNG exports will lower the price volatility of the domestic natural gas market by increasing both domestic production and the overall supply responsiveness of the market.[63] These contentions are inaccurate.

Price spikes are frequently driven by expectations, rather than current reality, and since natural gas supply often takes years to come online, expectations of increased demand often outpace expectations of increased supply. On the demand side, expectations often run far ahead of reality. Gas traders routinely count increased demand as soon as the contracts are signed, even though the contracts may run for years and the actual level of demand will not increase significantly until several years

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[61] CRA Study at 54.

[62] Senate Committee on Energy And Natural Resources Holds a Hearing on Opportunities and Challenges For Natural Gas (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=0e5d5793-4e30-4fcd-a7c3-791c985b302e.

[63] Southern LNG Company at 4, 8-9, Appendix A (at 6-7); Cameron at 2, 10-11, 14-15.

down the line. In contrast, on the supply side, expectations and reality are more closely aligned, as traders and other market participants recognize that it will take years for new production and pipelines to come online and supply to increase. These dynamics exacerbate price spikes during inflection periods (i.e. periods of market change).[64]

This phenomenon is exacerbated within the natural gas derivatives market, which is actually larger and more liquid than the spot market.[65] Within the derivatives market, expectations of future demand among traders and other participants typically drive prices beyond the levels dictated by existing demand volumes. Many natural gas contracts for physical delivery in the United States are indexed to the derivatives market, so approvals of all pending LNG export applications over a short time period would drive up both future natural gas prices and current natural gas prices.

Price volatility is caused not only by supply movements, but also by aggregate demand movements, including manufacturing, power generation, consumer and transportation sector demand. Indeed, it is the interaction between excess supply and excess demand in the domestic natural gas market that leads to price volatility within that market. If demand and supply are balanced then prices are stable. Otherwise, prices spike or plummet, and price volatility occurs. Arguments focusing exclusively on the supply side of the market ignore this reality. Approval of several LNG export applications over a short time period would cause a demand shock, which is unlikely to

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[64] CRA Study at 52-53.

[65] The Henry Hub Natural Gas Futures contract traded on the NYMEX (a trading platform of CME Group) is the third largest physical commodity futures contract in the world by volume, with a daily average notional volume representing 3.5 billion mmBtu. CME Group, *Henry Hub Natural Gas (NG) Futures (2012)*, available at http://www.cmegroup.com/education/files/PM310_Natural_Gas_Futures.pdf.

be met with a commensurate increase in supply, at least in the short term. It is possible that the demand shock would eventually be matched by supply increases, but only after triggering price volatility and instability. Price volatility creates inherent uncertainty and thereby inhibits or curtails investment by industrial users of natural gas. Indeed, as recent history has proven, few things are more damaging to business investment than uncertainty.

3. Increase in Domestic Price of Natural Gas Resulting From Significant Volumes of LNG Exports Likely Would Be Comparable to Decrease In Foreign Natural Gas Prices Resulting from those Exports

Proponents of higher LNG exports claim that the increase in domestic natural gas prices from increased LNG exports would be far less than the resulting decrease in foreign natural gas prices.[66] These claims are incorrect.

First, analysis shows that domestic natural gas prices would increase significantly in connection with increased LNG exports. Recent modeling by Professor Wallace Tyner at Purdue University's Global Policy Research Institute shows that if LNG exports reached 12 bcf/day or more, then domestic natural gas prices would increase by over 40%.[67] The Market Allocation ("MARKAL") macroeconomic model employed by Dr. Tyner is a well-established bottom-up energy model.[68] It is at least as credible as the model employed by NERA. Professor Tyner's study is attached as Attachment B to this submission. Furthermore, as shown by CRA, the domestic natural

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[66] GE Oil & Gas at 2, 3; Cameron at 5, 6, 15.

[67] Wallace E. Tyner, *Economic and Environmental Impacts of Increased U.S. Natural Gas Exports.*

[68] Wallace E. Tyner and Kemal Sarica at 3.

gas market would experience sustained price increases if market participants expect the licensing of significant volumes of LNG exports, and exports in excess of 18 bcf/day by 2030 could lead to a tripling of domestic natural gas prices.[69]

Second, the claim that liquefaction, transportation and regasification costs will provide a buffer between domestic and foreign natural gas prices is misleading. The gap between domestic and foreign natural gas prices is far greater than the sum of liquefaction, transportation and regasification costs, particularly in Asia. This is especially true given that NERA grossly overstated the costs associated with transporting LNG to Asia as discussed in section III.C.1.c. Accordingly, domestic prices could rise significantly before hitting the purported buffer.

Third, announced arrangements between domestic exporters and foreign purchasers indicate that pricing of LNG for export may be linked to Henry Hub prices in some instances.[70] As a result, LNG export prices would directly affect domestic prices if significant volumes of LNG exports are permitted. Henry Hub prices would, in turn, increase significantly, to the extent that exports become a significant share of U.S. production and domestic and international prices are determined in concert. In this way, excess demand for U.S. LNG exports and the arbitrage opportunities provided by the significant gap between domestic and foreign (especially Asian) prices will drive domestic natural gas prices upwards.

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[69] CRA Study at 8-9, 52.

[70] Tokyo Electric Power Company press release, available at http://www.tepco.co.jp/en/press/corp-com/release/2013/1224596_5130.html.

Finally, Australia's experience shows that significant exports of LNG can lead to marked increases in domestic natural gas prices within countries with ample supplies of natural gas. As Dow's Chief Executive Officer noted in the February 12, 2013 Senate Energy and Natural Resources Committee hearing on Opportunities and Challenges for Natural Gas, "Australia has desperately got it wrong."[71] Australia provides a cautionary example of the potential impact on domestic natural gas prices from LNG exports. According to the International Energy Agency, Australia, which is a major natural gas producer, currently exports more than 50% of the natural gas it produces.[72] As a result, domestic natural gas prices in Queensland and Western Australia have tripled to roughly $13/mcf.[73] In March 2011, at a time when domestic natural gas prices had risen significantly but by far less than they have now risen, the Parliament of Western Australia determined that:

> Despite the inherent differences in the respective markets, LNG prices do impact domestic gas prices in Western Australia. It is now highly likely that the recent rise in local gas prices has created an environment where –for certain contracts–domestic prices will trade at or above LNG netback equivalent levels.[74]

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[71] Senate Committee on Energy And Natural Resources Holds a Hearing on Opportunities and Challenges For Natural Gas (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=0e5d5793-4e30-4fcd-a7c3-791c985b302e.

[72] International Energy Agency, *Monthly Gas Survey: Oct. 2012*, Table 1.1.

[73] The Australian, *Danger Lies Ahead With Gas Bills Set To Explode* (Feb. 7, 2013), available at http://www.theaustralian.com.au/business/opinion/danger-ahead-with-bills-set-to-explode/story-e6frg9if-1226572145055.

[74] Parliament of Western Australia, Economics and Industry Standing Committee, *Inquiry Into Natural Gas Prices*, Report No. 6 in the 38th Parliament 73 (2011).

Similarly, the Australian Competition and Consumer Commission determined in September 2010 that "the price of LNG impacts on the domestic price" of natural gas.[75] As Dow's Chief Executive Officer stressed to the Senate Energy and Natural Resources Committee, Australia's natural gas exports resulted in Australia importing higher natural gas prices and exporting jobs from decreased manufacturing competitiveness.[76]

E. General Domestic Economic Impact of LNG Export, including Impacts on Manufacturers and Others

Contrary to the claims of NERA and those commenters advocating higher LNG exports, the net economic benefits of retaining natural gas domestically and employing that natural gas to boost the health of domestic industry would far outweigh the net economic benefits of exporting the natural gas. Moreover, the impact on the U.S. trade balance of LNG exports likely would be far less beneficial than various commenters suggest, and the impact of such exports on the international competitiveness of U.S. energy intensive, trade exposed ("EITE") industries would be far worse than various commenters suggest. Finally, no comments provide reason to doubt NERA's central finding that higher LNG exports would harm every sector of the economy other than oil and gas. DOE should consider these impacts in evaluating export applications to ensure that export levels support reasonable and stable natural gas prices for consumers and industry alike.

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[75] Id. at 70.

[76] Senate Committee on Energy And Natural Resources Holds a Hearing on Opportunities and Challenges For Natural Gas (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?ID=0e5d5793-4e30-4fcd-a7c3-791c985b302e.

Some would have DOE believe, in essence, that LNG export licensing must be administered in a way that enhances oil and gas but undermines the rest of the country. As Dow's Chief Executive Officer explained, export licensing requirements can be administered in a way that benefits not just the manufacturing sector but also the entire country—that is, in a way that truly serves the public interest.[77]

1. GDP May Actually Decline As Result of LNG Exports

Professor Tyner's modeling indicates that increased LNG exports would result in modest declines in United States' GDP.[78] The MARKAL macroeconomic model employed by Dr. Tyner is a well-established bottom-up energy model ideally suited for determining the GDP impact of alternative energy policies.[79] That model is certainly no less credible than the model employed by NERA, so the NERA Report's conclusion that LNG exports would boost GDP is subject to debate and cannot be accepted at face value.

2. GDP Would Increase More if Natural Gas is Used in Manufacturing Activities than If the Same Quantity of Natural Gas Is Exported

Exporting a non-renewable natural resource such as LNG is not akin to exporting a manufactured product. Fostering a manufacturing sector enhances U.S. competitiveness. Exporting natural resources does not do so. Unlike some raw materials that are employed only by a relatively small number of manufacturing

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[77] Id.

[78] See Attachment B to this submission.

[79] Wallace E. Tyner and Kemal Sarica at 3.

industries, natural gas is employed to a greater or lesser extent by much of manufacturing.

Utilizing natural gas domestically would enhance United States' aggregate value added (or GDP) by far more than would exporting natural gas.[80] First, as demonstrated in the CRA Study, deploying 5 bcf/day of natural gas in the domestic manufacturing sector would increase GDP by $4.9 billion, while exporting that same 5 bcf/day of natural gas overseas as LNG would increase GDP by only $2.3 billion.[81] Second, even within the construction sector, the payoff from using natural gas domestically far exceeds the benefits of exporting LNG, as the plant-building construction activity associated with increasing the supply of natural gas to EITE industries is more than four and one-half times greater than the construction activity associated with LNG exports.[82] Third, the transfer of wealth to holders of capital in natural gas enterprises associated with increased LNG exports will result in less domestic spending than would using the natural gas within the manufacturing sector. Shareholders of oil and gas companies likely are far wealthier than wage earners in the manufacturing sector who will see their numbers contract as a result of increased LNG exports,[83] and wealthier persons

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[80] The U.S. Bureau of Economic Analysis defines value added as the difference between an industry's gross output (consisting of sales or receipts and other operating income, commodity taxes, and inventory change) and the cost of its intermediate inputs (including energy, raw materials, semi-finished goods, and services that are purchased from all sources). *See* "What is Value Added?" on www.bea.gov.

[81] CRA Study at 2, 12-15.

[82] Id.

[83] In 2007, only approximately 50% of U.S. households directly or indirectly owned stock. Approximately 14% of families with the lowest incomes held any stock at all, as compared to 91% of families with the highest incomes. U.S. Census Bureau, *Statistical Abstract of the United States: 2012*, available at http://www.census.gov/compendia/statab/2012/tables/12s1211.pdf.

generally have a lower propensity to spend and a higher propensity to save and invest than do less wealthy persons.[84] This trade-off will result in comparatively lower GDP. Additionally, wealth transfers to holders that are foreign persons will further comparatively affect GDP negatively, since GDP does not include spending abroad.

Accordingly, more value is added to the U.S. economy by utilizing natural gas domestically within the manufacturing sector than by exporting LNG.

3. NERA Report Overestimates Positive Employment Effects of LNG Exports

Some commenters claim that the NERA Report overestimates the negative employment effects of increased LNG exports. These commenters claim that NERA's assumption of full employment renders the employment benefits of the study unduly conservative, and that the NERA Report understated the positive impact of employment added in connection with increased LNG exports.[85] Finally, these commenters claim that the average hourly wage of production workers in the oil and gas extraction sector is higher than the other wages, resulting in a higher GDP multiplier from consumer spending.[86]

Contrary to these claims, any beneficial employment impact of increased LNG exports would be far smaller than the beneficial employment impact of utilizing reasonably-priced natural gas in the domestic manufacturing sector. As the CRA Study demonstrates, ongoing permanent employment would be significantly higher if natural

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[84] Dyan, Skinner & Zeldes, *Do the Rich Save More?*, Journal of Political Economy (2004).

[85] ExxonMobil at 2; Cameron at 11-14; CLNG at 9-10.

[86] GE Oil & Gas at 4; ExxonMobil at 4-5.

gas is retained for use in domestic manufacturing, rather than being exported as LNG. Specifically, the direct effect of utilizing 5 bcf/day of natural gas in the domestic manufacturing sector would be associated with a manufacturing employment increase of approximately 180,000 jobs, while exporting the same volume of natural gas as LNG would bring about an employment increase of only 22,000 jobs.[87]

Moreover, even within the construction sector, the benefit from utilizing natural gas domestically far exceeds the benefit from exporting it as LNG. Construction activity associated with increasing the supply of natural gas to EITE industries is more than four and one-half times greater than the construction activity associated with LNG exports.[88] There is significantly more construction employment in building domestic manufacturing facilities that use natural gas than in building LNG export terminals. This relationship is driven by two factors. First, the level of capital investment in manufacturing facilities using natural gas is approximately four times the investment required for LNG export facilities necessary to export a comparable quantity of LNG. Second, the labor intensity of construction of manufacturing facilities is higher than the labor intensity of construction of LNG export facilities. In addition, the geographic distribution of employment benefits associated with utilizing natural gas within the manufacturing sector are far wider than are the employment benefits associated with exporting LNG.[89]

While NERA's assumption of full employment understated the ease with which currently unemployed construction workers would be absorbed into new construction

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[87] CRA Study at 2, 13, 15-16.

[88] Id.

[89] CRA Study at 16-17.

jobs, NERA's assumption of full employment also overstated the ease with which manufacturing workers displaced by the negative effects of LNG exports would find new employment. The unfortunate reality of the U.S. economy today is that workers laid off from manufacturing jobs do not quickly or easily find new employment.

Finally, while wages in the oil and gas extraction sector may be higher than average wages in manufacturing as a whole, the workers who build and operate LNG export facilities will not be part of the oil and gas extraction sector. Instead, they will be part of the manufacturing sector, and the level of their prospective wages vis-à-vis production workers in EITE industries is not known. Moreover, as noted above, the employment multiplier effect of using natural gas within the domestic manufacturing sector is roughly four and one-half times greater than the employment multiplier effect of exporting LNG.

4. Domestic EITE Industries Would Not Maintain International Competitive Advantage If LNG Exports Increase Domestic Natural Gas Prices

Some commenters argue that downstream domestic industry will maintain its international competitive advantage even if LNG exports rise because energy-intensive manufacturing companies around the world will continue to have a feedstock price disadvantage when compared to domestic EITE companies due to the addition of liquefaction, transportation and re-gasification costs.[90]

As noted above, NERA overstates the transportation costs associated with moving LNG to Asia. Moreover, to the extent that "take or pay" contracts are employed

[90] Cameron at 15.

in export deals, the gap between domestic natural gas prices and foreign LNG prices may be smaller than the sum of liquefaction, transportation and re-gasification costs.

Additionally, feedstock costs are not the only costs faced by domestic EITE industries and their competitors abroad. These companies face many other costs of doing business, including costs of labor, capital and regulatory costs, including environmental compliance costs. As a result, it could be the case that domestic EITE industries currently have only a marginal cost advantage that is much less than the differential represented by the costs of liquefaction, transportation, re-gasification and downstream transportation costs of exporting natural gas. To the extent that such is the case, if domestic natural gas prices increase, then domestic EITE industries could lose their cost advantage against international competitors.

5. Trade Balance Would Be Better Served by Exports of Manufactured Goods than by Exports of LNG

Some commenters claim that LNG exports would improve the U.S. balance of trade.[91] Those claims are incorrect. LNG exports would, at best, only marginally improve the U.S. trade balance and could instead worsen the U.S. trade balance. Moreover, the country's merchandise trade deficit certainly would be lowered more if natural gas were used domestically than if it were exported to Non-FTA Countries as LNG.

a. Exports of LNG Would Not Significantly Lower the United States' Trade Deficit

[91] America's Natural Gas Alliance at 1; Dominion Cove Point LNG at 5; 21st Century Energy (U.S. Chamber of Commerce affiliate) at 3; Cameron at 9-11; GE Oil & Gas at 4; AXPC at 1-2.

As an initial matter, and without consideration of the adverse effect LNG exports will actually have on trade, the total value of exports associated with LNG exports would be modest as compared to the aggregate U.S. trade deficit. The aggregate value of LNG exports is unlikely to be more than $30 billion per year, assuming total LNG exports of 10 bcf/day and a "free alongside" export price of roughly $8/mcf.[92] For comparison, the U.S. merchandise trade deficit in 2012 was more than $735 billion.[93] Accordingly, even if viewed in complete isolation, LNG exports are unlikely to lower the trade deficit by more than 5%.

In reality, however, increased LNG exports would have an even smaller positive impact on the trade balance, and could in fact have a negative impact on the trade balance. Insofar as increased domestic natural gas prices will adversely impact the international competitiveness of not only EITE industries but also the rest of the domestic industrial and agricultural sectors, the overall level of exports outside of the natural gas sector is likely to decrease. Even a modest percentage drop in those exports would overwhelm any increase in LNG exports. Indeed, given that aggregate U.S. exports outside of the oil and gas sector are in excess of $1 trillion per year, it is possible that the decrease in exports by the domestic agricultural and industrial sectors resulting from increased LNG exports would be well in excess of $30 billion by 2020. Accordingly, recent improvements in the U.S. trade balance and desired future

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[92] Of course, if proponents of unlimited LNG exports are to be believed, then export volumes will never exceed 6bcf/day and f.a.s. export prices will never exceed $5.50/mcf – in which case total export revenues would be only $12 billion a year.

[93] U.S. Census Bureau, *U.S. International Trade in Goods and Services Highlights, Goods and Services Deficit Decreases in 2012* (Feb. 8, 2013), available at http://www.census.gov/indicator/www/ustrade.html.

improvements in that balance would be significantly undercut by a pronounced increase in LNG exports.

The U.S. trade surplus in basic chemicals has grown from approximately $15 billion to approximately $35 billion in recent years as natural gas prices have decreased. A significant increase in LNG exports could reverse that trend, not only because the international competitiveness of domestic EITE industries would be hurt, but also because foreign producers of chemical products and other energy-intensive products would benefit from lower natural gas prices and would increase their exports to the United States, competing with U.S.-based manufacturers.

Finally, in 2012 the United States had a trade surplus of roughly $14 billion in coal.[94] Insofar as LNG would substitute for coal in many overseas markets, particularly in Europe, increased U.S. exports of LNG likely would reduce the nation's trade surplus in coal, thereby offsetting some or all of the trade balance benefits associated with LNG exports.

b. Employing Natural Gas in Manufacturing Rather Than Exporting It Would Lower the United States Trade Deficit Far More

Utilizing a given volume of natural gas domestically would lower the United States' merchandise trade deficit far more than would exporting the volume of natural gas. As demonstrated in the CRA Study, utilizing 5 bcf/day of natural gas in the domestic manufacturing sector would lead to an improvement in the United States'

[94] Id.

merchandise trade balance of $52 billion, while exporting that same 5bcf/day of natural gas as LNG would improve the United States' trade balance by less than $20 billion.[95]

This five-fold difference clearly evidences that the United States' trade balance would be far better served by utilizing natural gas domestically than it would by exporting natural gas as LNG. Moreover, if, instead of being exported, natural gas were used domestically to produce transportation fuels, then the positive impact on the trade balance could be far greater than if the LNG were exported.

6. Tax Revenues Would Increase More Without LNG Exports than With Them

Some commenters argue that increased LNG exports are justified because the tax revenue effect will be positive. For example, these commenters claim an LNG export facility will produce substantial local, state and federal tax revenue over its 30-year life.[96]

Even assuming that the welfare effects indicated by the NERA Report are accurate, which they are not, tax revenues would be higher at lower levels of LNG exports than at higher levels. The NERA Report finds net economic benefits from increased LNG exports due to (i) the aggregate increased wealth that accrues to holders of capital interests in, and wage earners working at, natural gas enterprises being in excess of (ii) the negative welfare effects accruing to all other sectors of the

[95] CRA Study at 18-19.

[96] Dominion Cove Point LNG at 5.

U.S. economy, including the manufacturing sector and all wage earners working for companies other than natural gas enterprises.[97]

Tax revenue is a positive function of the tax base in the United States. The U.S. tax base, in turn, is a positive function of GDP, so as GDP increases, so does the U.S. tax base upon which taxes are collected. Accordingly, as discussed in part III.E.1., increased LNG exports will result in lower GDP (and lower tax revenues) than would be the case if LNG exports were not increased.

7. Even the Results of the NERA Report Indicate Disproportionate and Regressive Welfare Effects

Almost all commenters supporting unchecked LNG exports reference the NERA Report's finding of net economic benefits to the United States as a primary source of support. Even if taken at face value, those results indicate the LNG exports would provide net economic benefits solely to the oil and gas sector and their stakeholders and economic losses to all other sectors of the economy (including agriculture and consumers).[98]

A massive transfer of wealth from every sector of the economy, save one, to that one specific sector of the economy cannot be in the public interest. The President recognized in his 2013 State of the Union address that nearly all U.S. citizens to date have benefited from increased natural gas production,[99] which reinforces the need to

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[97] NERA Report at 8.

[98] Id.

[99] The President stated that "[w]e produce more natural gas than ever before – and nearly everyone's energy bill is lower because of it." See http://www.whitehouse.gov/state-of-the-union-2013.

define broad-based public interest criteria. As Synapse Energy Economics has observed:

> Policy decisions cannot be made solely on the basis of aggregated net impacts: costs to one group are never erased by the existence of larger gains to another group. The net benefit to society as a whole shows only that, if the winners choose to share their gains, they have the resources to make everyone better off than before—but not that they will share their gains. In the typical situation, when the winners choose to keep their winnings to themselves, there is no reason to think that everyone, including the losers, is better off.[100]

Even the lead author of the NERA Report, W. David Montgomery, has admitted as much:

> There are enough hidden differences among recipients of allowances within any identified group that it takes far more to compensate just the losers in a group than to compensate the average. Looking at averages assumes that gainers compensate losers within a group, but that will not occur in practice.[101]

Benefits that are highly disproportionate and regressive are not in the public interest. At a minimum, such benefits must be viewed in a much broader context.

8. LNG Exports Will Result in Capital Investments That May Become Stranded Costs

Some commenters claim that opportunities for the United States to export LNG are time limited due to anticipated additional LNG supply from foreign nations.[102] As a result, these commenters argue, DOE should approve all pending LNG export

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[100] Sierra Club at Exhibit 5 at 7.

[101] *Prepared Testimony of W. David Montgomery, before the Committee on Energy and* Commerce *Subcommittee on Energy and Environment, U.S. House of Representatives, Hearing on Allowance Allocation Policies in Climate Legislation* (June 9, 2009) at 3, available at http://democrats.energycommerce.house.gov/Press_111/20090609/testimony_montgomery.pdf.

[102] Galway Group LP at 1; Jordan Cove at Appendix at 3-4.

applications as expeditiously as possible so that the United States can participate over this limited time period.

These claims overlook or ignore the risk that the massive capital investments necessary to build LNG export facilities would become stranded if profitable LNG export opportunities are not available over the useful life of these facilities. Even if multiple LNG export facilities are constructed, future demand could be lower than anticipated due to the time-limited opportunities claimed by LNG export proponents. In that case, these facilities would be shuttered or underused, just as has happened in the past with import facilities.[103] If realized, these stranded costs would be a major deadweight economic loss for the United States and would negatively impact GDP and job creation.

Of course, the worst outcome for the United States would be not only shuttered export facilities that do not export LNG, but also lost industrial capacity because new capital investments were deterred by high and volatile prices from immediate-term establishment of excessive LNG export operations.

IV. Other Comments

A. WTO/International Trade Rules

As a company that sells products in 160 countries around the globe, Dow is a substantial exporter and a supporter of rules-based free trade. Dow understands that well-functioning rules-based markets are essential to economic growth.

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[103] See, e.g., Alcoa Energy at 4; The New York Times, *Exports of American Natural Gas May Fall Short of High Hopes* (Jan. 4, 2013), available at http://www.nytimes.com/2013/01/05/business/energy-environment/exports-of-us-gas-may-fall-short-of-high-hopes.html?pagewanted=all&_r=0.

Some argue that the World Trade Organization's ("WTO") General Agreement on Tariffs and Trade ("GATT") mandates immediate, automatic issuance of any requested LNG export authorizations. In essence, these commenters contend that any meaningful implementation of the NGA's public interest standard is impermissible under WTO requirements. This is inaccurate.

The United States administers scores of import and export licensing arrangements on a diverse array of products and materials. Indeed, the United States has maintained LNG import and export licensing requirements since the NGA was enacted in 1938—nine years before the GATT was signed and decades before the WTO was created. The proposition that the NGA's import and export licensing requirements necessarily violate the GATT would mean that the United States signed a trade agreement that was, on its face, inconsistent with a domestic law that had been enacted not even ten years earlier.

United States LNG import and export licensing arrangements are parts of overall U.S. policy regarding the conservation of non-renewable natural resources that are critical to American industry and consumers alike. The GATT does not categorically prohibit export licensing arrangements, and under WTO rules and other treaties, countries retain rights to regulate deployment of natural resources. NGA import and export licensing requirements can surely be administered in a way that, as required, serves the public interest while abiding by U.S. international obligations.

B. Transshipment and Re-export

The LNG applications currently pending before DOE involve proposed exports to Non-FTA Countries. Some submissions to DOE argue that LNG exports to Non-FTA

Countries would occur regardless of DOE's approval of any pending applications because exporters could ship LNG to FTA Countries that would then be resold to Non-FTA Countries.

While possible transshipments and re-exports to Non-FTA Countries merit attention, they do not represent a rationale for unchecked LNG exports to Non-FTA Countries because legal requirements restrict such transshipments and re-exports. DOE has addressed this matter in most of its export license orders.[104] In 17 of its 19 export authorizations to FTA Countries, DOE has included an order requiring contractual prohibitions on re-sale to Non-FTA Countries. As further protection against transshipment, the free trade agreements with FTA Countries[105] also contain provisions that would limit re-export of LNG to a Non-FTA Country if the United States limited or restricted exports of LNG to that country.[106]

As a condition to granting any export licenses to FTA Countries, DOE should continue its current practice of requiring applicants to include provisions in LNG purchase or transfer agreements that prohibit any resale or transfer of that LNG to Non-

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[104] See e.g. Lake Charles Exports, LLC, FE Docket No. 11-59-LNG, Order No. 2987 at 10; Golden Pass Products LLC, FE Docket No. 12-88-LNG, Order No. 3147 at 8-9; Sabine Pass Non-FTA Order at 43-44.

[105] The United States has free trade agreements that require national treatment for natural gas with the following countries: Australia, Bahrain, Canada, Chile, Colombia, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Mexico, Morocco, Nicaragua, Oman, Panama, Peru, Republic of Korea and Singapore.

[106] These provisions generally specify that "[i]n the event that a Party adopts or maintains a prohibition or restriction on the importation from or exportation to a non-Party of a good, nothing in this Agreement shall be construed as preventing the Party from: (a) limiting or prohibiting the importation from the territory of the other Party of such good of that non-Party; or (b) requiring as a condition of export of such good of the Party to the territory of the other Party, that the good not be re-exported to the non-Party, directly or indirectly, without being consumed in the territory of the other Party."

FTA Countries, as applicable. Continuing use of this condition would reduce the risk that transshipment of LNG to Non-FTA Countries would frustrate policies underlying the NGA.

Possible transshipments and re-exports of LNG are not a rationale to disregard the NGA public interest mandate. Rather, they require vigilant U.S. government monitoring of trade flows, enforcement of export authorization bans on transshipments and re-exports, and exercise of U.S. rights in the same area under free trade agreements with national treatment for natural gas.

C. Greenhouse Gas Emissions

Some supporters of unlimited LNG exporting have argued that increasing LNG exports would reduce greenhouse gas emissions. They claim that lower natural gas prices would result in substitution of natural gas for coal in countries that import U.S. LNG.

As we discussed more fully in our initial submission, this generalized claimed benefit lacks support under the public interest standard in three respects. First, while global emissions levels may be important as a general matter, it is inappropriate to give any such attenuated benefits much weight, if any, under the NGA public interest standard. Moreover, some of the countries that are most interested in the natural gas exported from the United States, such as Japan, are suspending nuclear plants in favor of natural gas fired facilities, which would increase, not decrease, those countries' greenhouse gas emissions. Second, life-cycle emissions of LNG exports are higher than domestically consumed gas as we discussed in our initial submission. Finally, any benefits that accrue in other countries may be outweighed because higher domestic prices are likely to cause domestic electric generation to favor additional coal-fired generation at the margins in the United States.[107] Under the public interest standard, the impacts on domestic greenhouse gas reductions should be given more weight than emissions in other countries.

V. Manufacturing Renaissance Fueled by the Prospect of Reasonable and Stable Natural Gas Prices

We disagree with the commenters that have argued that the conclusions, methodology and assumptions contained in the NERA Report are accurate. But we agree with those commenters supporting the NERA Report's finding that any benefits of LNG exports will accrue solely to oil and gas companies and their stakeholders, and the costs will be borne by all others, including the manufacturing sector.

The United States is on the cusp of reversing a decade of job losses in the manufacturing sector through a manufacturing renaissance. We agree with President Obama's declaration that "our first priority is making America a magnet for new jobs and manufacturing."[108] The manufacturing renaissance that the President and other Americans are seeking will be driven in part by stable and reasonable natural gas prices. Natural gas is an essential component to thousands of everyday consumer products such as cars, appliances, paper, steel, plastic products, pharmaceuticals and fertilizer for our farms, in addition to providing heat, hot water, cooking and electric power to tens of millions of residential consumers.

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[107] EIA, *Effect of Increased Natural Gas Exports on Domestic Energy Markets* 6 (Jan. 2012), available at http://www.eia.gov/analysis/requests/fe/pdf/fe_lng.pdf.

[108] Remarks by the President in the State of the Union Address (Feb. 12, 2013), available at http://www.whitehouse.gov/the-press-office/2013/02/12/remarks-president-state-union-address.

As a substantial exporter, Dow supports rules-based trade and an "all-of-the-above" approach to energy security and energy independence. But we are in year four or five of a 100-year opportunity to harness new-found natural gas supplies to support economic growth and development in the United States. We believe that a prudent approach to exports, consistent with the NGA's public interest standard and the nation's international trade commitments, will help make this manufacturing renaissance a reality.

Some commenters would lead one to believe that the health and well-being of domestic manufacturers should be of little importance to DOE in reaching a public interest determination. We strongly disagree. Investments in manufacturing spurred by reasonable and stable natural gas prices will have a profound effect on the American economy, jobs and global competitiveness. The manufacturing sector in the United States has a direct and vital impact on jobs and investment opportunities that ripples throughout the economy.

- Each job created in the manufacturing sector leads to five more jobs in the larger economy.
- Each job in petrochemical manufacturing creates eight more jobs in the larger economy.
- Industrial manufacturing creates $8 of value in the larger economy for every $1 of natural gas consumed. The manufacturing sector contributes a higher value added multiplier to the economy than any other sector or any other use of natural gas.
- Manufacturing firms drive innovation by conducting two-thirds of U.S. research and development.

As we detailed in Exhibit 1 to our initial comments to DOE, over 100 new manufacturing projects have been announced so far, representing approximately $95 billion in new investments. According to the Boston Consulting Group, reasonable natural gas prices could lead to the addition of approximately five million manufacturing jobs. This manufacturing renaissance was unimaginable but a few short years ago. Dow itself has pledged to invest $4 billion in new facilities that will create thousands of new American manufacturing jobs.

Dow is an advanced manufacturing company that continually focuses on improving and innovating our processes, products and energy and environmental performance. Likewise, the manufacturing renaissance promises to contribute to technological developments and investments in new and proven technologies and to expand the industrial base. These advancements, if allowed to come to fruition, would underpin a revitalization of America's competitive advantage in manufacturing for years to come. The volatile and spiking natural gas prices likely to result from precipitous approval of LNG export applications will undermine competitiveness in the U.S. manufacturing sector. This will derail a manufacturing renaissance that is in its infancy.

For three decades up to 2000, the United States experienced relatively affordable and stable natural gas prices. But from 2000 to 2007, U.S. natural gas prices were very volatile, exposing domestic manufacturers to the vicissitudes of the natural gas markets. As shown by CRA, during this period increasing natural gas prices were a substantial contributor to decisions to idle and shut down manufacturing plants.[109] As prices rose from lows of $3.5/MMbtu to highs of almost $14.50/MMbtu, job losses in the manufacturing sector totaled approximately 5.4 million according the Bureau of Labor

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[109] CRA Report at 39.

Statistics. Experiences in the fertilizer sector, a significant industrial consumer of natural gas in the United States, demonstrate the impact of unstable natural gas. According to published reports, in the period of 2000-2006, domestic ammonia fertilizer production declined 44%, and more than a third of all U.S. fertilizer production capacity shuttered, with imports and the cost of fertilizer skyrocketing by 115% and 130% during the same period.[110]

The United States should take advantage of this once-in-a lifetime opportunity. Manufacturers are positioning themselves to do so. Many manufacturing companies report that their production capacity is currently at historic highs with increased competitiveness due to affordable natural gas. But hydrocarbon rich shale is available in other regions of the world, and it will not be long before other countries begin using technology advances to recover natural gas from their own shale deposits. The United States should capitalize on this opportunity to support the revitalization of its manufacturing base and the economic multiplier that it provides while the opportunity is at hand.

As discussed above, EITE manufacturers like Dow are particularly vulnerable to increases in natural gas and electricity costs, a fact acknowledged by the NERA Report findings but dismissed by supporters of unchecked LNG exports.[111] EITE manufacturers are highly dependent on natural gas inputs for feedstock and electricity consumption. Because their demand for natural gas is highly elastic, these industries,

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[110] U.S. Department of Agriculture, *Impact of Rising Natural Gas Prices on U.S. Ammonia Supply*, available at http://www.ers.usda.gov/publications/wrs0702/wrs0702.pdf.

[111] NERA Report at 67.

such as fertilizer, plastics, chemical and steel, must rapidly reduce consumption of natural gas in periods of rising prices to remain competitive. In effect, this response acts as a shock absorber by reducing aggregate demand and muting price volatility for other consumers of natural gas.

Given the importance of the manufacturing sector to the country's overall economic well-being, employment levels and competitiveness, the public interest standard should account for the economic impacts on sectors of the economy rather than solely net economic effects on the economy in general. Economic gains for oil and gas companies should not come at the expense of EITE industries and the rest of society that are sensitive to increases in natural gas prices. Exercising a public interest approach towards LNG exports will not only support domestic manufacturing but will also benefit EITE-related industries and farms, the technology and defense sectors, petrochemical companies, and consumers and workers at large.

Using domestic natural gas within the country can revitalize manufacturing and generate a more valuable export mechanism and a greater economic value than exporting LNG as a natural resource. The NERA Report underestimates the benefits of low gas prices on creating or maintaining jobs in the manufacturing sector and the production of value-added products using natural gas as a resource—such as steel—that may be exported at more competitive prices to benefit the U.S. job market, balance of trade and GDP. As discussed in more detail above, jobs created as part of this manufacturing renaissance are not the type of temporary jobs that last as long as it takes to build an LNG export facility, pipelines and other infrastructure.[112] They are quality, long-term, well-paying jobs that are needed now.

VI. Rulemaking Proposal for Criteria to Determine the Public Interest

In the NGA, Congress charged the executive branch with regulating the import and export of natural gas in accordance with the public interest. DOE has extensive experience evaluating import applications, but it has had limited experience with export applications and none with proposed exports of the magnitude at hand. Perhaps not surprisingly, there are no clearly established criteria for DOE to apply in determining the public interest with regard to natural gas exporting. As Senator Wyden recently observed, there is a policy vacuum in this area.[113] DOE does not have the criteria and metrics needed to make informed public interest determinations regarding LNG export applications.

Most importantly, too much is a stake for all Americans to leave these public interest determinations to decision-making without clear standards. A process is needed for the breadth of U.S. stakeholders to provide information and analysis as a basis for DOE to develop appropriate public interest criteria and metrics. A tried and true approach to such a process would be a rulemaking proceeding, which could serve as an efficient, fair, consistent and reasoned process to fill the policy vacuum.

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[112] Brookings Energy Security Initiative, *Liquid Markets: Assessing the Case for U.S. Exports of Liquefied Natural Gas*.

[113] United States Senate Committee on Energy & Natural Resources, *Wyden Opening Statement, Opportunities and Challenges for Natural Gas* (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=5a088d1f-69e8-4673-84a0-d551f4df10e4.

A. Public Interest Standard

Supporters of LNG exports appear to argue that the Natural Gas Act creates a rebuttable presumption that absolves DOE from ensuring that it considers all relevant information and viewpoints on the public interest as it pertains to LNG exports. This view is contrary to the Natural Gas Act and the history of its implementation.

The NGA expressly requires an evaluation of any proposed export to determine whether that export is inconsistent with the public interest. The NGA specifies that "no person shall export any natural gas from the United States to a foreign country" without authority ensuring that such an export comports with the public interest.[114] Section 3 of the NGA grants DOE the power to prevent gaps in regulation and the flexibility to exercise that power.[115] This authority is critical in the current circumstances, where DOE is faced with evaluating an unprecedented influx in export applications resulting from a newly increased supply of natural gas as well as potential changes in the regulatory scheme governing natural gas production.

The statutory framework of the NGA does not provide explicit guidance to DOE to evaluate the public interest according to the current environment as it relates to LNG exports. However, DOE is still responsible for giving reasoned consideration to all the material facts and issues presented by each application, and for supporting its decision with substantial evidence, as required by Section 19 of the NGA.[116] Establishing criteria

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[114] 15 U.S.C. § 717b(a).

[115] West Virginia Pub. Servs. Comm'n v. DOE, 681 F.2d 847, 857 (D.C. Cir. 1982).

[116] Id. at 859.

for evaluating export applications would enable DOE to assure that it meets these obligations.

DOE has been interpreting the public interest standard as it pertains to applications seeking to import natural gas for decades. But DOE has less experience with LNG export applications and certainly has never faced the challenge entailed by the current phalanx of applications to export enormous quantities of LNG to Non-FTA Countries. As Senator Wyden recently observed, DOE has no policy framework for evaluating the public interest in these circumstances and the framework used for import applications is entirely unsuited for this challenge.[117] Senator Wyden is correct that the meaning of the public interest in the current context of export applications deserves systematic consideration by DOE.

The NERA Report, in evaluating whether increased LNG exports serve the public interest, concluded that benefits of LNG exports would accrue to the oil and gas industry. While increased revenue and jobs within the oil and gas industry serve an important economic value, this measure of value does not accurately reflect the meaning of the "public interest" in the context of the NGA. The meaning of the public interest standard should be informed by the purpose of the NGA and associated congressional intent.[118] The purpose of the NGA was to "encourage the orderly development of plentiful supplies of electricity and natural gas at reasonable prices" and

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[117] United States Senate Committee on Energy & Natural Resources, *Wyden Opening Statement, Opportunities and Challenges for Natural Gas* (Feb. 12, 2013), available at http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=5a088d1f-69e8-4673-84a0-d551f4df10e4.

[118] NAACP v. FPC, 425 U.S. 662, 669-670 (1976); West Virginia Pub. Servs. Comm'n v. DOE, 681 F.2d at 855.

to "protect the consuming public from exploitive practices of the natural gas companies."[119] A public interest determination, for the purposes of the NGA, must weigh these considerations in the context of the current environment.

As it relates to exports in particular, the public interest has a different meaning than it does with regard to imports. The purpose of the NGA, in regulating LNG exports, is conservation of domestic natural gas, a nonrenewable, finite natural resource essential to the economy. Early drafts of Section 3 of the NGA placed no restrictions on imports, but sought to regulate exports exclusively. The NGA, in that form, articulated a more specific standard for evaluating exports: whether the proposed export "would impair the sufficiency of the supply of natural gas within the United States."[120] Legislative history surrounding the passage of the NGA demonstrates similar concerns with regard to export regulation, noting that Section 3 was drafted for the purpose of conserving America's natural gas supply and guarding against ill-advised sales of natural gas to foreign countries.[121] A proper evaluation of the national supply of natural gas, including a consideration of energy and manufacturing needs, the effect of future policy decisions such as environmental regulations and changing tax incentives, and the ability of natural gas providers to keep pace with demand in a safe and responsible matter, is critical to preserving an adequate and reliable domestic supply.

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[119] Id.

[120] See West Virginia Pub. Servs. Comm'n v. DOE, 681 F.2d at 855 (quoting H.R. 11662, 74th Cong., 2d Sess. §3 (1936); S. 4480, 74th Cong., 2d Sess. § 3 (1936)).

[121] See 81 Cong. Rec. 9312-13 (1937).

The topics that DOE has previously identified for evaluating the public interest are too narrow and vague to capture all of the critical national, regional and local issues at stake with LNG exports or to offer complete and comprehensive guidance. The public interest standard is not an easy benchmark for an agency to follow. DOE is not the only agency to have been tasked with evaluating applications based on such a standard. Nor is it the first agency to struggle to articulate suitable guidelines to define the public interest for purposes of its regulation. Most notably, the Federal Communications Commission ("FCC"), under the Communications Act of 1934, is tasked with the authority to grant broadcast licenses upon the determination that a license would meet the public interest of the community.[122] The developing nature of broadcasts during the late 1950s raised concerns over the FCC's application of the public interest standard and, after hearings to determine whether the FCC should exercise its rulemaking power to set out more detailed and precise standards for determining the public interest, the FCC issued a policy statement in 1960 articulating fourteen criteria to guide the evaluation of whether the public interest was met in the context of the Communications Act.[123]

DOE would be well served to similarly articulate criteria to guide the determination of whether an export would be inconsistent with the public interest. This would allow for a more reliable and consistent evaluation of each proposed export, which would facilitate the export of an appropriate amount of natural gas to benefit free trade and the domestic economy, while still protecting against a frenzied depletion of

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[122] 47 U.S.C. § 336(d).

[123] See *En Banc Programming Inquiry*, 44 F.C.C. 2303, 2304, 2314 (1960).

our resources that would benefit solely oil and gas companies and foreign nations at the expense of natural gas consumers, manufacturers, national security, and/or the environment.

DOE properly recognized the need to develop such criteria when it previously confronted the challenge of evaluating LNG imports, rather than exports. Indeed, when concerns were raised about imports proposed by Trunkline LNG Company ("Trunkline"), OFE's predecessor, the Economic Regulatory Administration ("ERA"), deferred its final review of Trunkline's authorization while DOE held public conferences at which all persons could comment on what the criteria should be and how they should be applied in the consideration of applications to import natural gas.[124] This public process ultimately culminated in the development of DOE's 1984 policy guidelines for natural gas imports.[125] ERA then reopened its review of Trunkline's authorization in light of the new guidelines.[126]

As Senator Wyden noted, DOE has been forced to rely on 1984 guidance that applies to decision-making about natural gas import permitting. Given the momentous possible implications of the outstanding requests to export enormous volumes of LNG, continued reliance on that out-of-date import guidance seems unthinkable.

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[124] *Trunkline LNG Company*, ERA Docket No. 82-12-LNG, Order No. 50 (Feb. 25, 1983) (deferring review because, among other things, "the Department of Energy is reviewing the policies that bear on gas import authorizations"); Review of Government Policy in Authorizing Imports of Natural Gas, 48 Fed. Reg. 34501 (July 29, 1983) (inviting public comment).

[125] *See* New Policy Guidelines and Delegation Orders From Secretary of Energy to Economic Regulatory Administration and Federal Energy Regulatory Commission Relating to the Regulation of Imported Natural Gas, 49 Fed. Reg. 6684 (Feb. 22, 1984).

[126] *Trunkline LNG Company*, ERA Docket No. 82-12-LNG and 83-04-LNG, (Sept. 23, 1983).

B. Proposed Rulemaking Criteria

We disagree with those commenters that suggest that, in light of the NERA Report, DOE should proceed with approving LNG export applications to Non-FTA Countries because it now has adequate information to make an informed decision on the public interest as it pertains to LNG exports.

Dow supports expanded exports and trade. However, we also believe that it is crucial for DOE to have the information and analysis necessary to properly apply the NGA requirement that exports be consistent with the public interest based on informed, reasoned consideration. We applaud DOE's recent acknowledgement that the NERA Report is but one data point in the broad array of considerations that are relevant for a public interest determination.

In short, Dow supports an approach to such determinations by DOE that is based on objective criteria and metrics, established through a public process and applied on an incremental, case-by-case basis in a consistent and balanced manner. Moreover, we agree with DOE that it should monitor supply and demand conditions in the United States to make sure 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."[127]

Commissioning the NERA Report should be the first step in developing policies that will enable DOE to administer appropriate public interest determinations for LNG export applications. As we discussed above, no economic study can account for the full

[127] Sabine Pass Non-FTA Order at 32.

profile of U.S. values that should inform the public interest with regard to natural gas exports.

Again, the outstanding authorization requests present what is essentially a new challenge. DOE needs to continue its effort to improve the process for evaluating LNG export applications by providing an opportunity for all affected constituencies and the public at large to comment on how best to assess the public interest as it pertains to exports of natural gas.

Currently, DOE regulations provide for the adjudication of LNG export applications on a case-by-case basis in proceedings that depend on the parties to raise issues relevant to a public interest determination and to support their positions with persuasive evidence. DOE interprets the NGA's public interest standard as creating a rebuttable presumption that a proposed export of natural gas is in the public interest. This means that DOE is to approve an application unless those who oppose the application can overcome this presumption.

In response to the NERA Report, DOE has received more than 400 submissions from a broad array of stakeholders covering an equally broad array of topics. The sheer number of submitted comments reflects the depth of interest regarding this issue. Unfortunately, the current process of adjudicating export applications provides no assurance that DOE will consider all aspects of the public interest in any given proceeding. This is inevitable for an administrative process that depends on arguments and evidence submitted by the parties to a specific export application process. These parties are representing their specific interests and may not adequately represent the totality of the public interest.

A timely DOE rulemaking process to formulate criteria for determining the public interest as it relates to LNG exports would ameliorate some of the shortcomings of the current process. All of the major constituencies affected by LNG exports should have an opportunity to be heard, which could enable DOE to obtain much broader public input and do so efficiently in a single forum. This would increase the likelihood that all relevant considerations will be identified and that cumulative and national effects will be addressed as well as regional and local effects, further enabling DOE to make determinations thereafter with reasoned consideration and on the basis of substantial evidence. The result of such a rulemaking process—establishment of uniform and actionable criteria with measurable metrics—would facilitate balanced, comprehensive consideration of the public interest by DOE, give parties in individual proceedings advance notice of many of the most relevant considerations, create a more efficient procedure for evaluating export applications and reduce the risk of inconsistent adjudications across applications. The rulemaking process will create an efficient procedure for expeditious evaluation of all future LNG export applications.

Once the rulemaking is complete, DOE would apply these criteria and metrics incrementally over time in individual application proceedings, which would assure fairness and uniformity, while allowing DOE to consider changes in circumstances from one application to the next. As DOE acknowledged in its order in the Sabine Pass approval, the supply/demand balance for natural gas will change over time, and DOE should continue to engage in a searching evaluation of LNG export applications to Non-FTA Countries to ensure that the exports contemplated by the pending applications continue to be in the public interest.

While criteria for determining the public interest should be developed as part of the rulemaking described above, we believe the list below provides a good starting point for identifying specific, concrete and forward-looking criteria that DOE should evaluate in connection with LNG export applications:

- Domestic manufacturing: How will exports impact natural gas prices and the supply/demand balance? Will natural gas supply be reduced? Will there be less feedstock for announced investment projects? Will the jobs created by increased exports exceed jobs lost by the manufacturing industry? Will additional exports displace U.S. consumption?

- U.S. consumers: Will exports reduce the supply of natural gas available for utilities or affect consumer prices or energy costs? Will utilities decrease fuel switching to natural gas?

- Energy security: Will exports reduce the volume of natural gas available for domestic use or increase the need to rely on imported petroleum?

- Employment: How many new jobs will be created or existing jobs impacted? Are employment gains in the oil and gas sector offset by job losses in other areas of the economy affected by relatively higher natural gas prices?

- International trade: Will exports improve the U.S. balance of trade payments sufficiently to offset falling exports in other value-adding sectors of the economy? As to proposed exports to FTA Countries, are the exports destined for consumption in the FTA country or will there be transshipment of natural gas to Non-FTA Countries? How can export applications be disposed of in a manner consistent with U.S. trade obligations?

- Environmental: What would the proposed exports' environmental impact be?

- Strategic interests: Will the exports support a strategic American ally in a meaningful way and consistent with stated policy priorities? Do proposed importing countries accord the United States reciprocal favorable international trade treatment? What are the implications for any current or proposed FTA negotiations?

- Price and volatility: How is the LNG contract being priced, and is it linked to oil in some manner? What is the expected short- and long-term impact on natural gas and electricity price volatility?

- Other regulatory impacts: What is the potential impact of other regulatory decisions on natural gas demand or supply and what is the interplay between those impacts and exports of natural gas?

DOE should apply criteria that result from this rulemaking to pending applications on a case-by-case basis and in an incremental fashion. This would entail opening the record of each pending export application to all interested parties and evaluating whether approving each individual application, in light of the cumulative impact of prior approvals, is in the public interest.

VII. Conclusion

Under the NGA public interest standard, it is incumbent upon DOE to critically examine the NERA Study's methodology, conclusions and assumptions. Upon careful examination, the shortcomings of the study undermine the conclusions on the macroeconomic impact of LNG exports. Moreover, no macroeconomic study should form the sole basis of any public interest determination because of the inherent limitations of economic modeling and the myriad other qualitative factors that should form the basis of a public interest evaluation.

But because this issue is critical to our economy and our energy security and independence, we urge DOE to engage in a comprehensive rulemaking process aimed at developing criteria and metrics to determine the public interest in this context. All stakeholders, including individual consumers, producers, industry, power generation, academics and non-government organizations, should have the opportunity to inform DOE's evaluation of public interest. The current process of case by case adjudication of applications for export of LNG to Non-FTA Countries simply does not provide an appropriate or adequate forum for airing these issues.

Dow appreciates the opportunity to submit these comments and welcomes any questions that DOE or OFE may have.

Respectfully Submitted,

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Dated: February 25, 2013

Appendix

Index to Short Citations of Submissions to DOE

No.	Citation	Abbreviation
1.	Comments of America's Natural Gas Alliance (filed January 24, 2013)	America's Natural Gas Alliance
2.	Comments of the American Council for Capital Formation, Increased U.S. Exports of Liquefied Natural Gas Will Boost Economic Growth and Improve the U.S. Trade Balance, Pınar Çebi Wilber, Ph.D., Senior Economist, American Council for Capital Formation and Margo Thorning, Ph.D., Senior Vice President and Chief Economist, American Council for Capital Formation (filed January 24, 2013)	American Council for Capital Formation
3.	Comments on the DOE Natural Gas Export Study of the American Exploration & Production Council (filed January 23, 2013)	AXPC
4.	Comments of the American Petroleum Institute (filed January 24, 2013)	API
5.	Comments of Cameron LNG, LLC on LNG Export Studies (filed January 24, 2013)	Cameron
6.	Comments by the Center for Liquefied Natural Gas (filed January 23, 2013)	CLNG
7.	Comments of Dominion Cove Point LNG, LP on the 2012 LNG Export Study (filed January 24, 2013)	Dominion Cove Point LNG
8.	Comments of The Dow Chemical Corporation (filed January 24, 2013)	Dow
9.	Comments of the Energy Policy Research Foundation, Inc. (filed January 24, 2013)	EPRINC
10.	Comments of Exxon Mobil Corporation Regarding 2012 LNG Export Study (filed January 24, 2013)	ExxonMobil

No.	Citation	Abbreviation
11.	Comments of the Galway Group LP on the 2012 LNG Export Study (filed January 23, 2013)	Galway Group LP
12.	Comment Letter of Daniel C. Heintzelman, President & CEO of GE Oil & Gas on behalf of the General Electric Company (filed January 24, 2013)	GE Oil & Gas
13.	Comments of the Institute of the 21st Century Energy, an affiliate of the U.S. Chamber of Commerce (filed January 24, 2013)	21st Century Energy
14.	Comments of Jordan Cove Energy Project, L.P. (filed January 24, 2013)	Jordan Cove
15.	Comments of Shell Oil Company (filed January 24, 2013)	Shell Oil Company
16.	Comments on behalf of the Sierra Club and on behalf of Catskill Citizens for Safe Energy, the Center for Biological Diversity, Center for Coalfield Justice, Clean Air Council, Clean Ocean Action, Columbia Riverkeeper, Damascus Citizens for Sustainability, Delaware Riverkeeper Network, Earthworks' Oil and Gas Accountability Project, Food and Water Watch, Lower Susquehanna Riverkeeper, Shenandoah Riverkeeper, and Upper Green River Alliance, and on behalf their members and supporters (filed January 24, 2013)	Sierra Club
17.	Initial Comments of Southern LNG Company, L.L.C. on the Department of Energy LNG Export Study (filed January 24, 2013)	Southern LNG Company
18.	Comments of Wallace E. Tyner and Kemal Sarica, Comparison of Analysis of Natural Gas Export Impacts from Studies Done by NERA Economic Consultants and Purdue University	Tyner and Sarica

Attachment A

Charles River Associates Study

Charles River Associates

Prepared For:

The Dow Chemical Company

US Manufacturing and LNG Exports:

Economic Contributions to the US Economy and Impacts on US Natural Gas Prices

Prepared By:

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1201 F St, NW – Suite 700

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Date: February 25, 2013

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We would like to give special thanks to Lucy Fan, Pang Laohapairoj, and Jonathan Painley for their efforts in helping to prepare this report.

Disclaimer

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Executive Summary

A manufacturing renaissance is under way in the United States, and it is being driven by a favorable natural gas price environment not seen for over a decade. Since 2010, there have been announcements of more than 95 major capital investments in the gas-intensive manufacturing sector representing more than $90 billion in new spending and hundreds of thousands of new jobs all related to our domestic natural gas price advantage. The low gas prices are also sparking interest in large-scale LNG exports to higher-priced markets, such as Europe and Asia. While high volumes of LNG exports would increase profits to some participants in the oil and gas sector, the resulting increase in domestic gas prices may disrupt the growth in domestic manufacturing, natural gas vehicles, and electricity generators. Consequently, the United States is faced with a critical policy decision: how to balance demand for LNG exports versus realization of domestic value added opportunities.

To better understand the impacts of LNG exports, The Dow Chemical Company asked Charles River Associates (CRA) to examine the importance of natural gas-intensive manufacturing to the US economy and how LNG exports could impact growth of other major demand sectors. This request was made in light of the recently released NERA Report that finds LNG exports to be favorable to the economy along with recent comments submitted to the Department of Energy (DOE) supporting unconstrained exports of our domestic natural gas resource.

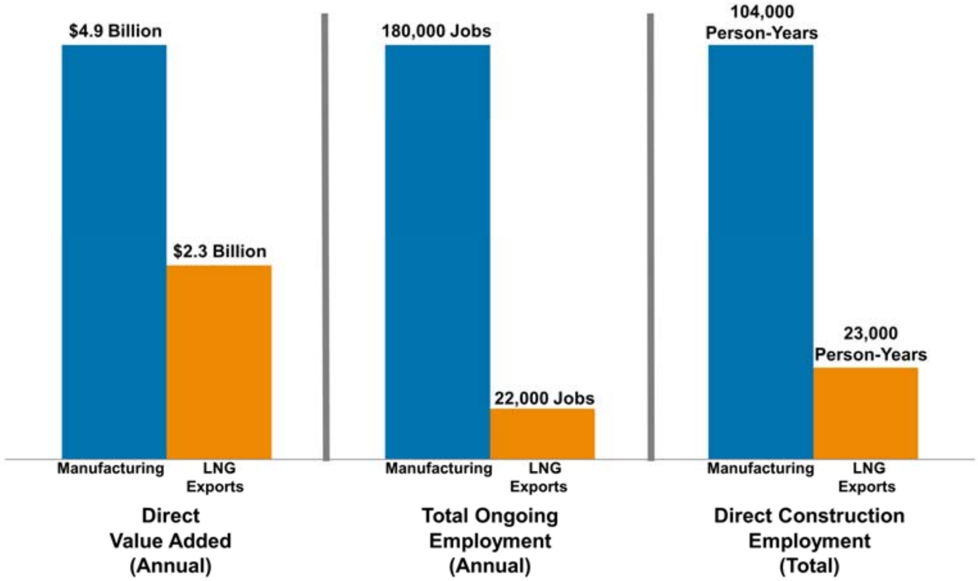
This report examines the major premises supporting unconstrained exports of LNG and shows that many of them are built upon false assumptions. We find that the manufacturing sector contributes more to the economy and is sensitive to the natural gas prices that will rise in an unconstrained LNG export scenario due to high global LNG demand and a non-flat domestic natural gas supply curve.

The US Economy Is Better Off with Natural Gas Used in Manufacturing than Natural Gas Exported as LNG

With a finite natural gas resource, a non-flat supply curve, and significant options for increased demand, it is clear that the United States will have to consider demand opportunity trade-offs in its assessment of the public interest of LNG exports. While there is not a one-to-one trade-off between exports and other new demand sources in the near term (i.e., one to five years), the various options cannot all be brought on in parallel without any demand opportunities losing out.

We compared the economic contributions of 5 Bcf/d of natural gas use in the manufacturing sector to the economic contributions of 5 Bcf/d of LNG exports. This level represents a subset of the announced investments in new manufacturing capacity in the United States compared to the export capacity of two large LNG terminals. We compared the contributions across three main metrics: value added, employment, and impact on trade balance. Our results, based on generous assumptions inflating LNG economic contributions, are shown in the figure below. It shows that even a trade-off of losing only 1 Bcf/d of manufacturing to gain more than 5 Bcf/d of LNG exports would have negative impacts on US employment.

Economic Contributions Are Greater for 5 Bcf/d of Natural Gas Used in Manufacturing than 5 Bcf/d of Exports



Source: IMPLAN, CRA analysis of public announcements in the gas-intensive portion of the manufacturing sector

Value added. High-margin and labor-intensive industries generally provide the most value added to GDP for a given level of investment. Value added is much higher for a given level of natural gas consumption by the manufacturing sector than for LNG exports. We calculated $4.9 billion of direct value added and about $35 billion of indirect value added for the manufacturing sector. For LNG exports we used extremely generous assumptions, such as all profits along the LNG value chain staying in the United States, to calculate direct value added of $2.3 billion. These results were expected given the amount of economic activity required for many manufacturing processes, as well as the deeper domestic supply chains.

Employment. In the current economic environment, employment stands out as a key metric to evaluate. We focused our analysis on employment related to two phases of new plants and terminals: construction employment and ongoing employment. Direct construction employment is significantly higher for the manufacturing sector (104,000 person-years) than LNG exports (23,000 person-years). The total direct and indirect employment for the manufacturing sector (180,000 annual jobs) is more than eight times the total direct and indirect employment from LNG exports (22,000 annual jobs).

Another employment factor often overlooked is the regional diversity of jobs. The planned manufacturing facilities are spread out across the Gulf Coast, the South, the Midwest, and the West Coast, and their supply chains are even more expansive. The LNG export facilities, on the other hand, are concentrated in a few coastal states. Even these states would generally fare better with natural gas going to manufacturing as they are likely recipients of large investments in that sector.

Trade balance. Significant attention is directed at reducing the United States' trade deficit, and natural gas used in the manufacturing sector does a better job of reducing this deficit than LNG exports. We compared the trade impacts of the announced manufacturing investments. We determined a $52 billion annual trade benefit from manufacturing, which would come in the form of both increased exports and decreased imports. This would lead to a $37 billion trade surplus for those subsectors. The LNG export trade impact, viewed in isolation from its price impacts on domestic manufacturing, is estimated to be $18 billion at a natural gas price of two times the current price. This would lead to a trade surplus of $10 billion in natural gas, but not improve the $15 billion gas-intensive trade deficit.

Manufacturing Is Highly Sensitive to Natural Gas Prices

A significant portion of the US manufacturing sector is exposed to impacts from increased natural gas prices. The subsectors with the most exposure are those that use natural gas as a feedstock, as a heat source, for co-firing for steam, and/or as source of electricity, generated either on- or off-site, and (1) have international exposure through either reliance on exports or competition from imports, or (2) are not able to economically substitute other factors of production for natural gas. Most LNG-related economic studies are not inclusive enough when identifying exposed subsectors because they focus on old data (often from 2007) and ignore sectors that may be exposed to natural gas price changes without being trade exposed. The energy-intensive subset of the manufacturing sector represents at least 10% of total manufacturing production.

Even the NERA Report acknowledges negative impacts on the overall manufacturing sector from LNG exports, but their model systematically underestimates these impacts. For their analysis, they used a computable general equilibrium (CGE) model that requires simplified representations of the main sectors of the economy. In NERA's model, all manufacturing is represented by only two sectors, which mutes the many differences in subsectors that should be key factors in an analysis. **Any model that ignores these differences introduces significant error into results and thus is not credible**.

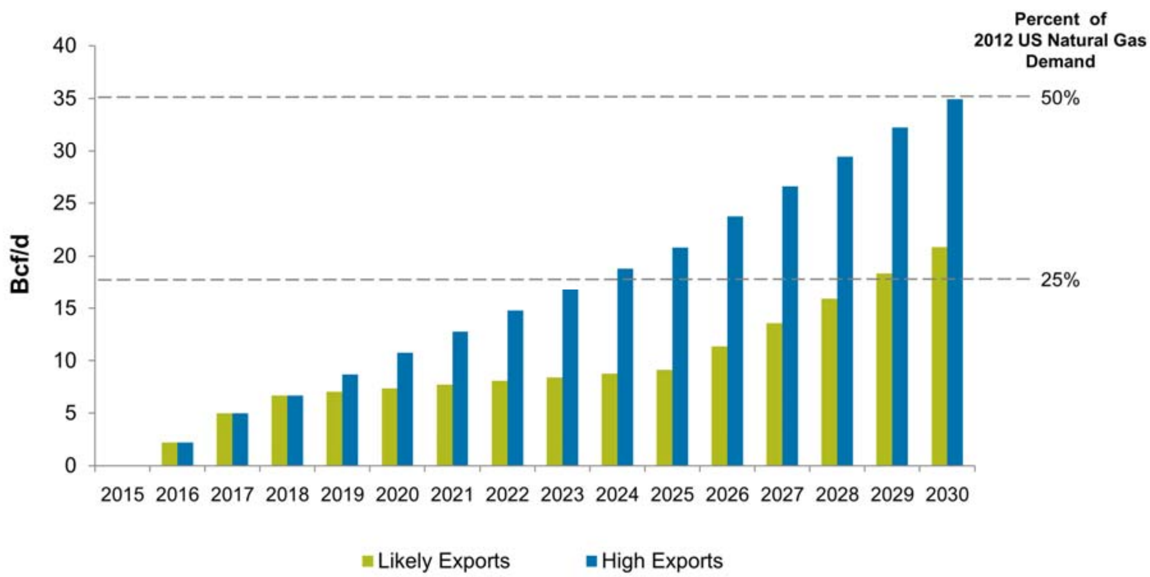
To illustrate how a subsector within the manufacturing sector can be sensitive to increased natural gas prices, we analyzed the ammonia manufacturing industry. Its reliance on natural gas as a feedstock and indirectly for operations, its trade exposure, and its history of shedding domestic production in periods of high natural gas prices suggest the ammonia industry is highly sensitive to natural gas prices, much more so than the CGE model would reflect. We verified this by examining producers' margins, which creep toward negative numbers with ammonia prices from a few years ago and the reference natural gas price forecast by the US DOE Energy Information Administration (EIA).

US LNG Exports Could Supply 9–20 Bcf/d by 2025

In the first decade of the 21st century, the United States was expected to be a net importer of LNG. With the advent of improved technology to access non-conventional (shale) gas, our position could reverse if export terminals are approved and licensed. CRA projects a global LNG supply shortage of 9–20 Bcf/d by 2025, which US exports would likely play a major role in filling. There currently are 29.4 Bcf/d of LNG export projects that have applied to the Department of Energy. Of these, 18.4 Bcf/d are at existing import facilities that are economically advantaged to become exporters because of existing infrastructure, and 5–6.7 of that 18.4 Bcf/d, or almost 10% of total domestic demand, have announced contracts with buyers and are projected to be in operation between 2015 and 2018. One facility, Sabine Pass (2.2 Bcf/d), is already under construction.

In addition to the global LNG capacity shortage, a number of long-term contracts are expiring, which opens up opportunities for US LNG to compete with existing capacity. These factors, along with high Asian LNG import prices, create an extremely compelling case for investors in US LNG exports. We contend that these factors will support the investment in US LNG export terminals going forward. The figure below shows that potential exports could reach more than 25–50% of 2012 domestic demand by 2030.

US LNG Exports Could Represent a Large Share of Domestic Natural Gas Demand



Source: CRA Analysis

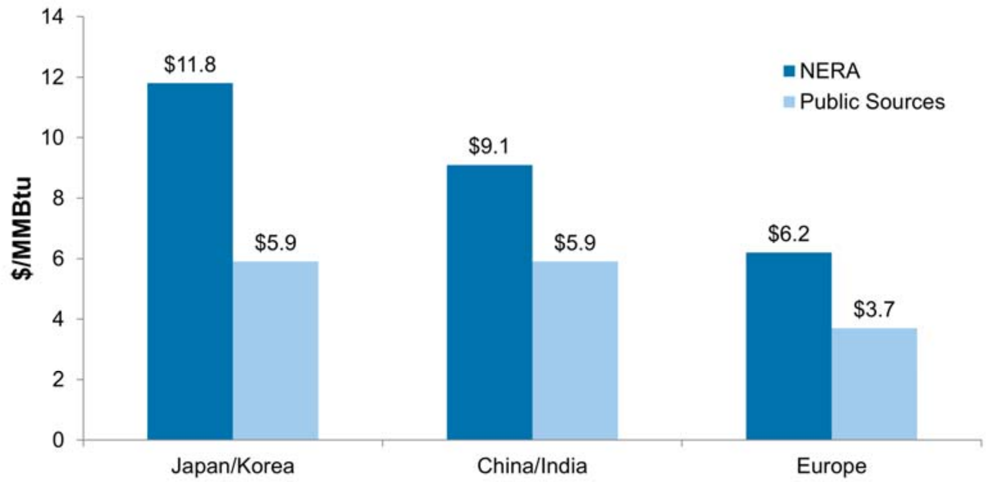
NERA's Incorrect Assumptions Led to a Massive Understatement of US LNG Export Potential

The NERA Report concluded that US LNG export potential is limited except for a few cases in which there is an international demand shock (e.g., Fukushima Daiichi) and/or a supply shock (e.g., no additional non-US LNG export capacity is built):

> *. . . in many cases the world natural gas market would not accept the full amount of exports specified by [The Office of Fossil Energy] in the EIA scenarios at prices high enough to cover the US wellhead price projected by EIA.* (NERA Report, p.4)

NERA came to this conclusion because it grossly overstated the netback costs to the United States from major LNG markets. Higher netback costs lower payments to providers of natural gas, and thus decrease the incentive to export. Netback costs include the cost of liquefaction at the export terminal, shipping, and regasification at the import terminal. The figure below shows that NERA used a netback cost that is twice as high as costs quoted by publicly available sources used in our analysis.

NERA Applied Netback Costs Twice as High as What Public Sources Quote for Japan and Korea



Source: NERA Report, pp 84–92; CRA analysis of publicly available data

NERA also arrived at its conclusion on LNG export potential by assuming Japan and Korea can respond to rising prices by reducing demand in the near term (through 2020). Historical observation of LNG import prices and demand over the last decade shows quite the opposite. We contend that Japan and Korea have little ability to respond to higher prices, as approximately 20% of their energy mix is natural gas and they have no easy, near-term fuel substitutes for power generation, heating, industrial usage, and vehicles.

Manufacturing, Electricity Generation, and Natural Gas Vehicles Will Also Be Significant Drivers of Future Natural Gas Demand

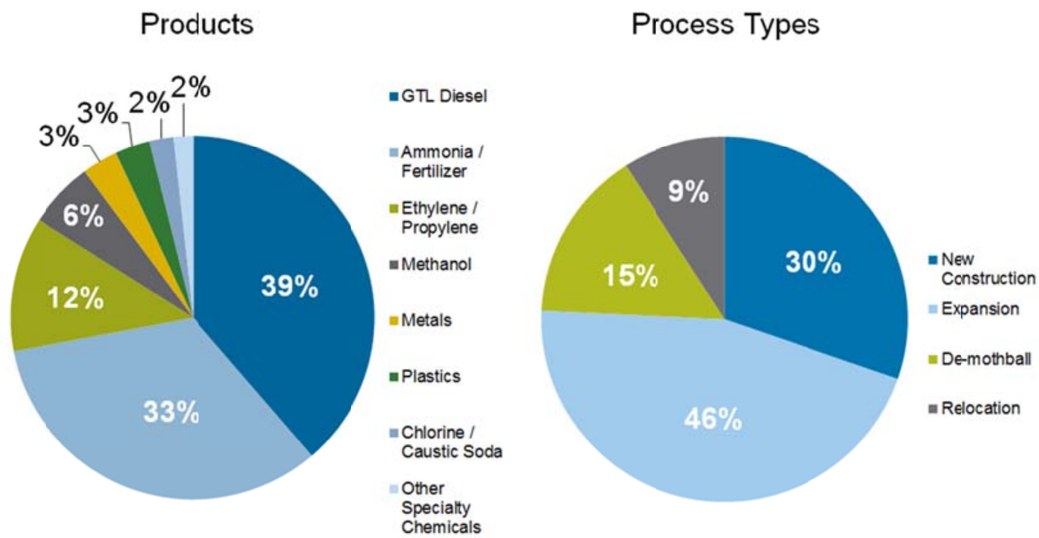
In addition to any approved LNG exports, there will be three other major drivers of natural gas demand over the next 10–20 years:

- ***Manufacturing renaissance*** due to currently favorable US natural gas prices relative to international prices faced by global competitors
- ***Coal-to-gas switching in the electric sector*** due to currently competitive natural gas prices and regulation induced coal retirements
- ***Natural gas vehicle (NGV) penetration***, particularly in the vehicle fleet market, such as heavy-duty trucks (freight trucks) and medium-duty trucks (delivery trucks)

Manufacturing Renaissance

The large, publicly announced natural gas-intensive manufacturing investments we identified are expected to add about 4.8 Bcf/d of industrial natural gas demand in the next decade. This subset of the natural gas–based manufacturing renaissance is broad-based in terms of products (e.g., diesel, fertilizers, methanol, and specialty chemicals) and also project types (e.g., new construction and expansion) as shown in the figure below.

The Manufacturing Renaissance Footprint Is Diverse in Product and Project Types



Source: CRA analysis of public announcements in the gas-intensive portion of the manufacturing sector

Our estimate of manufacturing natural gas demand is not all-encompassing. In reality, there are likely hundreds more projects that are planned but unannounced. We therefore anticipate that manufacturing natural gas demand could be much higher than 4.8 Bcf/d.

Coal–to–Natural Gas Switching in the Electric Sector

The implementation of multiple environmental regulations over the next 10 years will have a significant impact on natural gas demand in the electric sector. Recent proposed and finalized rules from the US Environmental Protection Agency (EPA) target the regulation of air quality, water quality, solid waste disposal, and greenhouse gases (GHG). We forecast more than 56 GW of the US coal fleet retiring by 2020, representing 18% of current generation capacity. In addition, electricity demand will increase, leading to the electric sector increasing natural gas consumption by 13 Bcf/d in 2030.

NGV Penetration

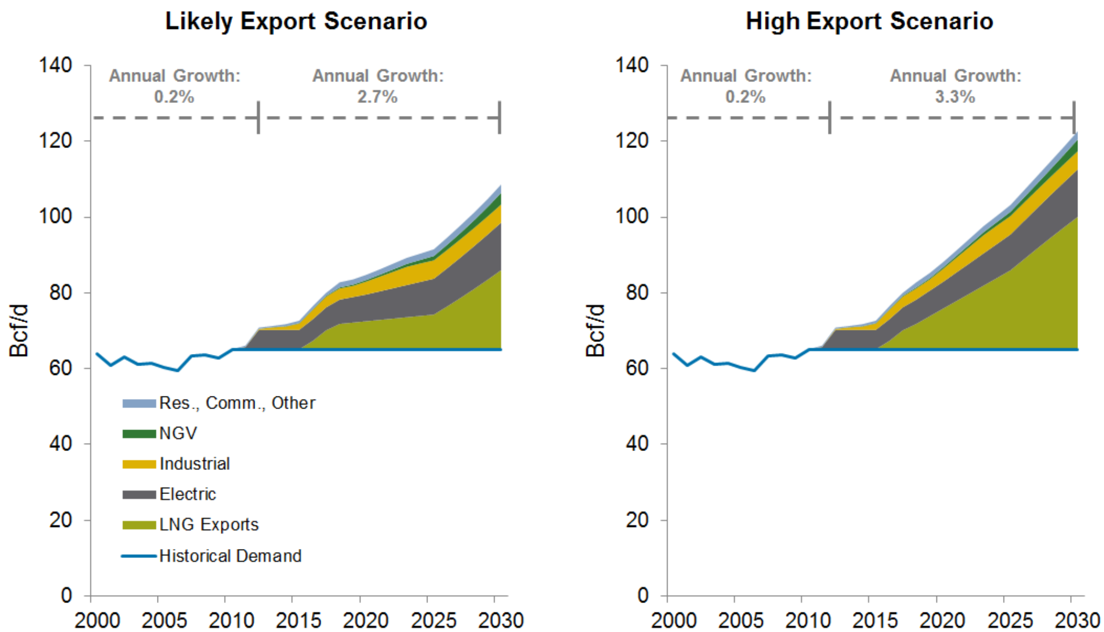
Natural gas can be used for all vehicle types including light-duty vehicles (LDVs), such as cars; medium-duty vehicles (MDV), such as buses and small trucks; and heavy-duty vehicles (HDVs), such as freight trucks. While historical natural gas vehicle penetration has been low compared to conventional vehicles, the spread between diesel and natural gas prices has made switching to natural gas compelling, especially for companies and governments with fleet vehicles. These entities have an economies of scale factor that can help overcome infrastructure and financing constraints.

Our forecast for NGVs reflects an expectation for the compelling cost savings for NGVs and infrastructure build-out to continue, leading to 3.2 Bcf/d by 2030. This rate of penetration implies a market share of 6% of the EIA's projected fuel consumption for transit buses, school buses, LDVs, and HDVs in 2030.

Cumulative Impacts of Demand

The combination of natural gas demand by the four major drivers—manufacturing, electric generation, NGVs, and LNG exports—is shown in the figure below for both the two demand scenarios analyzed. In the Likely Export and High Export scenarios, demand increases to 110 Bcf/d and 124 Bcf/d in 2030, respectively, from 65 Bcf/d in 2010. This amounts to a 69–91% increase in natural gas demand over 20 years, or 2.7–3.3% annually. To put this growth into context, US demand grew 1.1% annually from 1990 to 2010, or almost one-third of what is projected in these scenarios. During this same historical period, US natural gas production grew by 0.9% annually.

Cumulative Natural Gas Demand in the Likely Export and High Export Scenarios



Source: EIA historical data; CRA projections

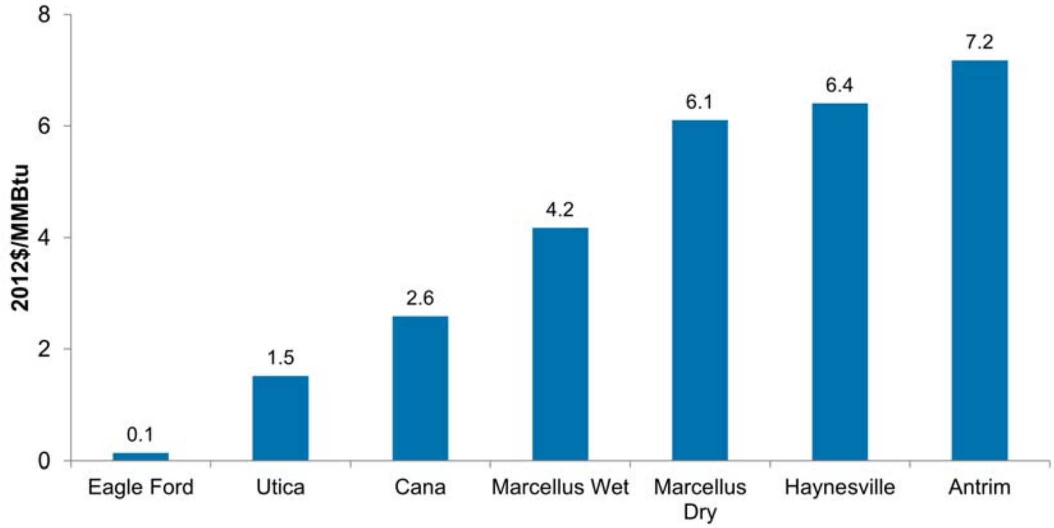
Production will need to rise at the same level as demand for the United States to maintain balance in this scenario. The last time the United States was able to maintain an average annual growth rate of 2.3% or higher for the preceding 20 years was 1980, at which point producers were growing from a much smaller base.

The US Natural Gas Supply Curve Is Upward Sloping (Not Flat)

Several commenters have mentioned that the shape of the natural gas supply curve is effectively flat for the foreseeable future. Our analysis shows otherwise. The figure below shows the levelized cost of producing an average or typical well for seven different shale plays.[1] These costs do not represent the better or worse performing locations within a play that result from natural variations in cost and performance.

[1] The levelized cost of production represents the cost a producer would need to achieve in order to receive the necessary returns to cover capital costs along with fixed and variable costs.

Average All-In Costs to Produce Example Shale Plays Indicate the Supply Curve Is Upward Sloping



Source: CRA US Gas Model

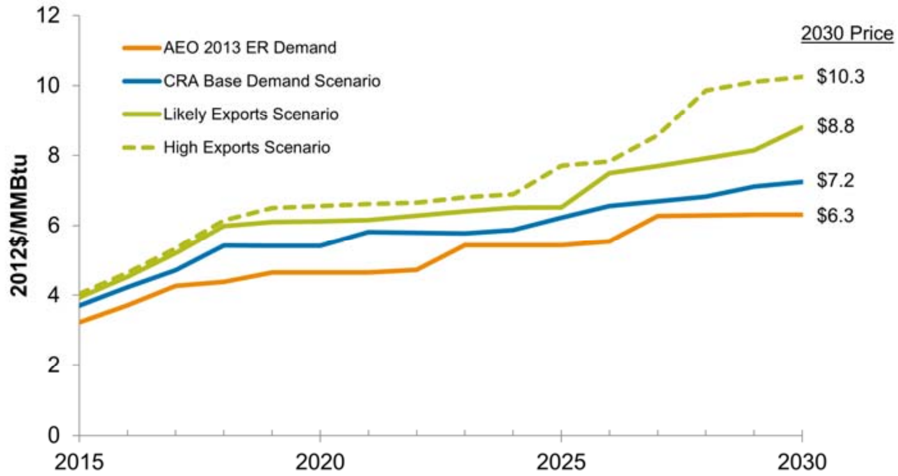
New conventional onshore and offshore natural gas plays along with many tight gas and coalbed methane plays generally are not competitive with shale. As a result, shale dominates the cost structure of the US resource base and drives the shape of the natural gas supply curve. The figure above indicates that the US natural gas supply curve is upward sloping and not flat.

Domestic Natural Gas Prices Could Triple under a High Export Scenario

CRA modeled the impacts on natural gas prices in both the Likely Export and High Export scenarios. The scenarios were developed by first developing the CRA Demand scenario, which reflects a higher forecast than EIA's Annual Energy Outlook 2013 Early Release (AEO 2013 ER) for manufacturing, electric generation, and NGVs. We then layered on the likely LNG exports and high LNG exports to create the Likely Export and High Export scenarios.

The results of our analysis are shown in the figure below. It shows that higher rates of natural gas demand are not sustainable without significantly higher natural gas prices.

Without Trade-offs, Natural Gas Prices Will Almost Triple by 2030 with Higher Demand and LNG Exports



Source: CRA US Gas Model

The sectors that will lose the most from natural gas prices rising to $10/MMBtu are the manufacturing and electric sectors. A significant, natural gas–intensive portion of the manufacturing sector will not be able to simply pass through additional feedstock and energy costs, and will therefore lose production relative to a scenario with reasonable natural gas prices. The electric sector will migrate to other generation technologies, such as clean coal and renewables, but only at higher relative costs to generators (and therefore consumers) than a scenario with reasonable natural gas prices. The expected penetration of natural gas vehicles, mostly fleet vehicles, may not be as affected as they primarily compete with oil-fueled vehicles. LNG exports are the most immune, given the strong global economics supporting their high development even at relatively high domestic prices.

The fact that the manufacturing sector is sensitive to natural gas prices and will be a major loser in a high LNG export scenario has severe consequences for the US economy. Any crowding out of investments in domestic manufacturing will result in a variety of negative economic impacts, including:

- **Lower GDP.** We showed that the manufacturing sector has at least double the direct value added, or GDP contribution, for a given level of natural gas use than LNG exports.
- **Less employment added.** Our analysis also showed that the investment in manufacturing for a given level of natural gas demand is significantly higher than the investment required to export the same level of natural gas. This leads to over four times the construction employment. The labor intensity of production and deep domestic supply chain for manufacturers lead to eight times the total (direct and indirect) employment of LNG exports during operations.
- **Higher trade deficit.** The announced natural gas-intensive projects have the potential to reduce the trade deficit by over $50 billion annually, compared to $18 billion for exporting the same level of natural gas as LNG. This discrepancy is important for a country focused on improving its negative trade balance.

1. Introduction

Charles River Associates (CRA) was retained by The Dow Chemical Company (Dow) to assess the economic impacts of LNG exports on the US economy, with a particular focus on competing demand from the manufacturing sector. We were asked to conduct this analysis in response to the December 2012 NERA report "Macroeconomic Impacts of LNG Exports from the United States" (NERA Report) along with the first round of comments submitted to the Department of Energy's Office of Fossil Energy in response to the NERA Report.

In particular, Dow asked us to provide analysis and comments around the following five questions that have emerged from review of the NERA Report and its supporting comments:

1. **What are the economic benefits (GDP, employment, and trade balance) of natural gas demand in the manufacturing sector relative to LNG exports?** *(Section 2)*

   Given price responses to increased demand, there will inevitably be trade-offs between domestic uses of natural gas and any approved LNG exports. It is important to understand the comparative impacts of each competing natural gas use on the US economy. We focus our analysis on the economic contributions of 5 Bcf/d of natural gas use in the manufacturing sector compared to the contributions of 5 Bcf/d of LNG exports. We find significantly more value added, employment, and trade benefits from manufacturing.

2. **What is the sensitivity of the US manufacturing sector to natural gas prices?** *(Section 3)*

   In a scenario of rising natural gas prices, the existing manufacturers must respond to increased production costs and the investors in new plants must reevaluate their plans. The NERA Report finds that LNG exports have adverse impacts on the manufacturing sector, but underestimates them given its reliance on a simplified representation of the sector in its model. We examine the sector in more detail and explain why conclusions cannot be drawn on this subject from the NERA Report.

3. **What is a potential high LNG export scenario?** *(Section 4)*

   There are currently applications for 29.4 Bcf/d of LNG exports awaiting review by DOE. NERA's analysis estimates a maximum of 12 Bcf/d of exports under an extreme high-demand, limited-supply scenario. We examine and uncover why NERA came to the conclusion that most scenarios would not include US LNG exports. We also explore what a more reasonable LNG export scenario would be under likely and high LNG demand scenarios.

4. **What are the major drivers of future US natural gas demand, and how would they stack up against LNG exports?** *(Section 5)*

   Relatively low domestic natural gas prices have attracted a variety of new demand opportunities. If supply at low prices was not an issue, there would be many new sources of demand coming online in parallel over the next 5–15 years. It is important to understand how massive this potential demand could be because it has direct implications on domestic prices and the US economy. We estimate demand in the manufacturing sector, the electric sector, and for natural gas vehicles (NGVs), and then show the cumulative impact when that demand is combined with LNG exports.

5. **What is the shape of the US natural gas supply curve, and how would natural gas prices be impacted under a high LNG export scenario?** *(Section 6)*

   The expected sizeable growth in demand would increase prices and result in economic harm to the US economy because the supply side cannot produce unlimited natural gas at current prices. NERA overestimates the ability of US producers to provide significantly higher quantities of natural gas, assuming that the supply curve is nearly flat. It is not flat, and we provide an analysis to address this issue.

To answer the questions, we employed both publicly available and proprietary economic tools, most notably:

- CRA's US Gas Model: A proprietary, bottom-up natural gas supply model that replicates the cost and performance characteristics of all US shale plays. This model was used to examine the natural gas price impacts of LNG exports on top of the growing demand from other sectors.
- CRA's NEEM Model: A proprietary, bottom-up model of the North American electric sector that closely resembles the electric sector component of the N_{ew}ERA model used by NERA in its analysis. This model was used to evaluate natural gas demand in the electric sector, a major component of domestic natural gas consumption.
- IMPLAN: A widely used, peer-reviewed input-output model that represents the interactions between the different sectors of the economy and shows how direct spending in specific sectors filters through the economy, creating additional value. This model provides data informing NERA's N_{ew}ERA model and was used with more specificity in our analysis to estimate indirect employment and value added impacts for the manufacturing sector.

These economic tools were not selected to replicate NERA's analysis, but rather to provide a more granular look at the value of manufacturing to the US economy and the effects of LNG exports on competing demand drivers. It is our contention that the modeling approach of NERA blatantly obscured critical components of the economics in an attempt to form a simple answer. This is not to say that their model, a complex computable general equilibrium (CGE) model, is simple, but rather that in order to use such a model simplifying assumptions were made that biased the results. For example, the CGE model rolls all manufacturing industries into two sectors for analysis, despite their many differences in sensitivities to natural gas prices.

For the purposes of this report, we have conducted our analyses through 2030, which represents a reasonable end to most firms' investment horizon when it comes to large capital-intensive investments.

2. Comparative Economic Contributions of LNG Exports and the Manufacturing Sector

While the shale resource drives the economics of the natural gas supply picture for many years, CRA has found in our analysis that the shale resource is finite and has an upward sloping supply curve that will drive prices significantly higher under futures where LNG exports are sizable.[2] As such, the United States will have to consider trade-offs in its assessment of the public interest. While there is not a one-to-one trade-off between exports and other new demand sources in the near term (i.e., one to five years), the various options cannot all be brought on in parallel without some demand opportunities losing out. It is therefore important to understand the uses of natural gas that contribute the most to the US economy.

The results of our comparison, that manufacturing adds more to gross domestic product (GDP) and contributes more employment than LNG exports for a given level of natural gas input, are not unexpected. Many countries endowed with vast natural resources have spent significant public and private capital and developed policies that are designed to enhance domestic value added activity. For example, Qatar currently has a moratorium on new production in its largest natural gas field while it simultaneously spends more than $25 billion to double its petrochemical production following several years of major investments in gas–to–liquids and fertilizer plants.[3]

2.1. Value Added (GDP) and Employment Contributions

A comparison of the economic contributions of investments spurred by a given amount of natural gas in different sectors of the economy can shed light on the relative abilities of each opportunity to turn the natural gas resource into economic value and employment in the United States. For our analysis the manufacturing sector was selected for comparison to LNG exports. The focus is on new investments in the manufacturing sector, not on existing manufacturing. The exposure of existing manufacturing to natural gas price changes is discussed in Section 3 of this report. The conclusion of our analysis is that more economic benefits can be achieved by utilizing a given volume of natural gas in the manufacturing sector than by exporting that same volume of natural gas.

The comparison is based on 5 Bcf/d of natural gas used either in the manufacturing sector or for LNG exports. This level of natural gas use was based on a selected subset of announced manufacturing investments, which can be considered scalable. While not intended to show a one-to-one trade-off between natural gas uses, our analysis provides an idea of the difference in scale of contributions of each natural gas use. It shows that losing even 1 Bcf/d of manufacturing to gain more than 5 Bcf/d of LNG exports would have negative impacts on US employment and possibly GDP.

Selecting the economic metrics for comparison is an important step of the analysis. Focusing only on profits of entities involved in the investment activities would be deceiving. Profits are only one part of the story, and a very convoluted one when considering foreign repatriation of

[2] See Section 6.

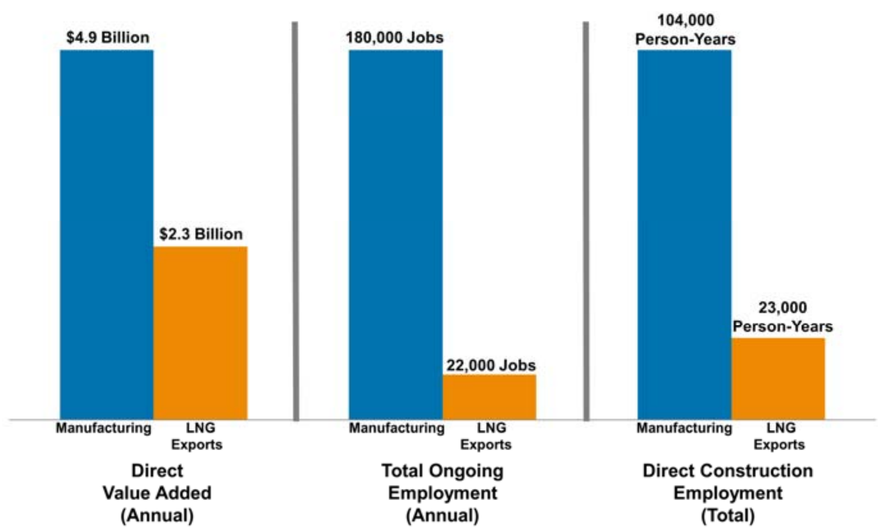
[3] Abdelghani Henni, "Life's a Gas for Qatar's Big Downstream Players," *Arabian Oil & Gas*, 4 April 2012.

investor earnings and their tendency to disproportionately benefit those who earn investment income. For a strong economic metric, we selected value added, which is the contribution of an economic activity to overall GDP. We also consider employment contributions of the projects, during both construction and operations.

The economic contributions are considered along the entire value chain for each natural gas use type. It starts with direct impacts on-site at the plants and terminals. Supply chain activities related to the new manufacturing plants and LNG terminals are evaluated as indirect impacts. Increased natural gas exploration and production activity is also considered, but given the assumption that both demand types require 5 Bcf/d of natural gas, contributions in this part of the supply chain basically cancel each other out in the comparison.[4] We do not include what are commonly referred to as induced effects, which are the contributions of employees spending their wages in the economy and taxes being reintroduced to the economy through government spending. It can generally be assumed that the natural gas use type with the largest direct and indirect impacts will have the largest induced impacts.

Figure 1 shows the results of our comparison of the effects of the manufacturing sector using 5 Bcf/d of natural gas versus LNG terminals exporting 5 Bcf/d of natural gas. It clearly shows higher value added and employment related to the manufacturing investments. This is primarily driven by the higher level of investment required to manufacture products using the natural gas than to export it. Natural gas use of 5 Bcf/d in the manufacturing sector requires more than $90 billion in investments and significant annual spending, while LNG export terminals with 5 Bcf/d of capacity would involve only $20 billion in new investment.

Figure 1: Economic Contributions of Manufacturing Compared to LNG Exports, 5 Bcf/d Equivalent



Source: IMPLAN; CRA analysis of public announcements in the gas-intensive portion of the manufacturing sector

[4] The main difference in the exploration and production parts of the value chains for manufacturing versus LNG exports is the location of the activity. This will be partially driven by the siting of the plants and terminals, but more so by the location of the gas resources. The overall impact should be similar between demand types.

The economic metrics of value added and employment are discussed in more detail in the following subsections.

2.1.1. Value Added

The first metric evaluated was the value added by each type of gas consumption. Value added is an important metric because national GDP is defined as the value added of all the sectors in the economy added up. The following is a definition of value added from the US Bureau of Economic Analysis:[5]

> *Value added equals the difference between an industry's gross output (consisting of sales or receipts and other operating income, commodity taxes, and inventory change) and the cost of its intermediate inputs (including energy, raw materials, semi-finished goods, and services that are purchased from all sources).*

Value added is often confused with either revenues or "output." Value added is a subset of output at each stage along the value chain. It is the employment compensation, earnings by shareholders/owners, and a few other categories that are not considered intermediate goods. Each step on the supply chain will contribute some value added, with more labor-intensive and high-margin industries tending to contribute the most per level of output.

The value added analysis focused on the post-construction phases of the manufacturing and LNG export facilities. For the manufacturing sector, a natural gas–intensive subset of proposed new manufacturing facilities was selected to represent 5 Bcf/d of new natural gas use in the manufacturing sector. The types of plants in this subset include the following:

- Ethylene, polyethylene
- Propylene
- Methanol
- Ammonia/fertilizer
- Chlorine, caustic soda
- Plastics
- Aluminum, steel
- Gas-to-liquids (GTLs)
- Other chemicals

For each plant, the expected production levels and employment were gathered from publicly available information on the plants. This data was used to inform input-output modeling using IMPLAN, which is described in Appendix A.3. IMPLAN determined the value added directly at the new facilities through economic multipliers obtained for each manufacturing subsector. We estimated that the direct value added would be $4.9 billion per year for 5 Bcf/d of new natural gas use in the manufacturing sector. With typical value added multipliers of around 8, the total value added would be almost $40 billion per year.

Calculating value added for LNG export terminals is not as straightforward because there are no publicly available multipliers for this subsector. This is evidenced by the fact that all of the applications for LNG terminals include economic impact studies that either used roundabout methods to determine the value added of the exports or did not address the issue at all. We used some very generous assumptions and selected data from NERA's study to estimate value added for LNG exports.

[5] "What Is Value Added?" on www.bea.gov.

The assumptions were that all profits (or “rents”) along the LNG value chain were earned by the exporters and that the exporters’ profits remained in the US economy and therefore contributed entirely to value added. A cursory look at the list of applicants for terminals shows how this is not the case: many investors are foreign owned or publicly held, which suggests at least partial foreign ownership. Also, if tolling contracts, such as those used by Freeport LNG,[6] are used at a high rate, the rents could be collected elsewhere along the value chain, depending on contract terms. If these rents are collected further down the value chain than the export terminals, the United States may not benefit from them as value added.

The profits that determine value added were obtained from the NERA study, which estimated quota rents under scenarios in which exports are constrained. The quota rent is the difference between the netback price (discussed in Section 4.5) and the wellhead price. The HEUR_SD_LR scenario estimates about 5 Bcf/d of exports, and the associated quota rent was $1.80 per Mcf. This leads to total quota rents of $2.1 billion. We then added all operation and maintenance (O&M) costs as estimated by NERA, generously assuming they were all value added, for a total value added of $2.3 billion per year.

2.1.2. Employment

Another economic metric of high importance in the current economy is employment contributions. Our employment analysis focuses on two phases of the projects: construction and ongoing operations.

Direct construction employment. The major driver of the difference in direct construction employment between the manufacturing sector and the LNG exports is the scale of the projects required to consume the set volume of natural gas. The manufacturing sector requires almost five times the capital investment to build plants compared to the amount required by LNG exporters to build terminals. Given that both types of construction involve about the same level of labor intensity (jobs per million dollars of investment), the difference in employment levels is almost entirely driven by the different investment levels.

These numbers were not assumed, but rather calculated based on construction employment estimates from manufacturers and studies attached to LNG export applications. After scaling employment estimates to 5 Bcf/d for each natural gas use type, we arrived at 104,000 person-years for manufacturing and 23,000 person-years for LNG export facilities. This 4.5 multiplier is identical to the 4.5 investment multiplier. Indirect employment could differ if one natural gas use type involved more equipment manufactured domestically, but that was not part of our analysis.[7]

Ongoing employment. Once the facilities are built, there is a difference between the two natural gas uses in the on-site labor requirements (direct employment) and supply chain employment (indirect employment). Ongoing employment involves jobs that will last as long as the facilities are in operation, and thus they are considered permanent jobs. The direct

[6] “Freeport LNG Signs 20-Year Liquefaction Tolling Agreement with BP Energy Company,” *PRNewswire*, 11 February 2013.

[7] For example, 60% of the capital cost for the Excelerate Lavaca Bay MG project is directed to a floating vessel built in Korea. Referenced in “Economic Impacts of the Lavaca Bay LNG Project,” Black & Veatch, 5 October 2012.

employment for the manufacturing facilities, 10,600 full-time equivalents (FTEs),[8] was based on estimates provided by various plant announcements and scaled for each subsector to a total of 5 Bcf/d across the entire manufacturing sector. The direct employment for the LNG export terminals, 750 FTEs, was calculated using a review of the various economic impact studies associated with the DOE applications to date. The reports are very inconsistent in their estimates of jobs per Bcf/d at the terminals, so we used a natural gas consumption weighted average with adjustments for extreme high and low outliers.

Indirect employment for the manufacturing sector was estimated using employment multipliers from the input-output model IMPLAN. Multipliers were used for seven different subsectors, leading to an overall multiplier of about 17 and a total employment number of 180,000 FTEs. Indirect employment was not credibly presented and isolated in any of the LNG export application filings (they often included additional impacts). This is mostly due to the fact that there is no existing government source for these multipliers specific to LNG exports. Several filings incorrectly used the “oil and gas exploration and production” output multipliers to calculate jobs, but LNG exports are a different business activity and thus the multipliers do not apply. Instead we used a generous assumption of a 30 multiplier—roughly double the multiplier used for the manufacturing sector—to calculate a total of 22,000 FTEs.

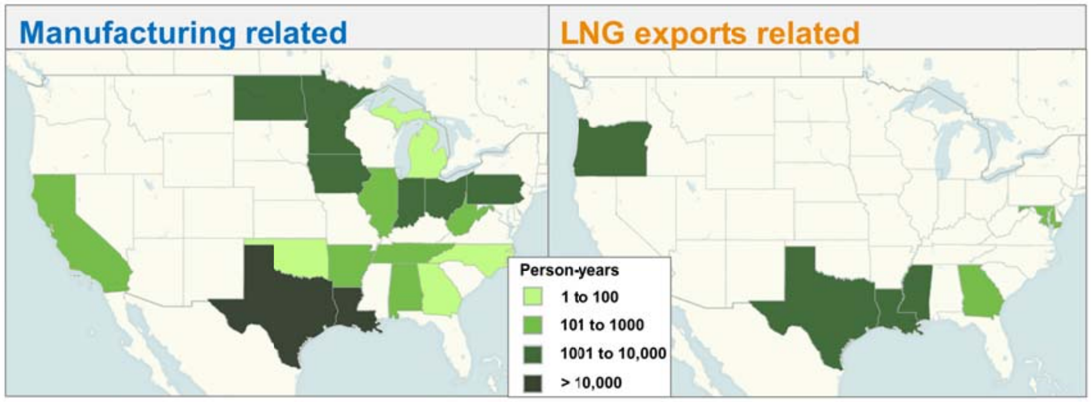
2.2. Comparison of the Regional Diversity of Economic Contributions

One important factor not covered in most studies supporting LNG exports is the geographic distribution of economic benefits. The majority of direct impacts are located close to the facilities, and therefore more geographic diversity of new facilities leads to a greater spreading of benefits across states. The tables in Appendix A.2 show the geographic distribution of the projects included in our analysis. For manufacturing projects, we included a subset of natural gas–intensive projects announced in the past few years. For LNG exports, we used all the projects proposed to DOE, weighted to reach a 5 Bcf/d equivalent total. The actual geographic distribution for LNG exports will be lower because not all projects would be built in a 5 Bcf/d scenario. This level of exports would support two or three projects, based on the size of projects that have applied to DOE.

Figure 2 shows the distribution of construction-related direct employment across the United States. The manufacturing sector spreads the higher number of jobs across more states than LNG exports.

[8] Annual employment estimates are provided throughout this report as full-time equivalents (FTEs). An FTE can be considered one person-year of employment, though it could represent two half-time jobs or a fraction of a job that includes overtime. This is a standard unit for reporting jobs in economic impact studies.

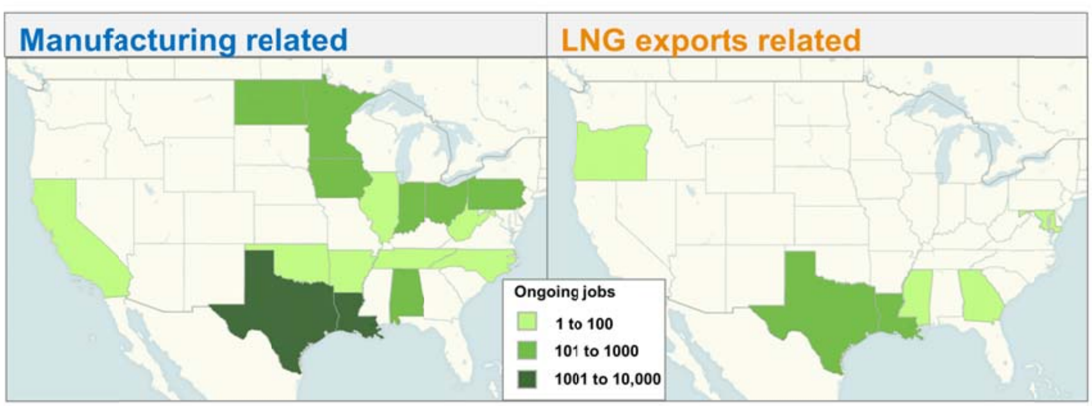
Figure 2: Geographic Distribution of Direct Construction Employment, 5 Bcf/d Equivalent



Source: CRA analysis of public announcements in the gas-intensive portion of the manufacturing sector

Figure 3 shows the distribution of direct ongoing employment across the United States. The manufacturing sector spreads a higher number of jobs across more states. A significant share of the jobs associated with manufacturing are located in the Midwest; this is not the case for LNG exports, which benefit only a few coastal states. Even in those states with LNG exports, the manufacturing sector could potentially provide more employment at 5 Bcf/d of national natural gas consumption, as many of the manufacturing sector investments are planned in those states.

Figure 3: Geographic Distribution of Ongoing Employment, 5 Bcf/d Equivalent



Source: CRA analysis of public announcements in the gas-intensive portion of the manufacturing sector

2.3. Trade Impacts of Natural Gas Use in Manufacturing Compared to Exporting LNG

The United States has carried a negative trade balance since 1975, meaning that in each of the past 37 years imports have exceeded exports. In 2012, the deficit was$728 billion,[9] or 4.6% of GDP. The country is expending considerable effort on reducing this deficit, which over time has an impact on the country's financial accounts and other macroeconomic factors. There are currently some important market factors swinging in the United States' favor, including currency movements and, in particular, the change in energy economics that have resulted from the shale gas revolution. How the country handles this valuable resource will determine the ultimate impact it will have on balance of trade.

Proponents of LNG exports have touted the positive impact such exports will have on the US trade balance. To support this argument, these commenters must determine that the increase in exports of LNG will offset negative trade impacts in other sectors of the economy, specifically the increased imports and decreased exports in the manufacturing and industrial sectors. These sectors will be less competitive in the international market due to relatively increased natural gas prices and will be exposed to greater levels of imports and lower exports. The NERA Report discussed this trade-off,[10] but due to some modeling constraints and several assumptions, it did not convincingly establish a positive overall effect. For example, the model does not precisely differentiate the many manufacturing subsectors, but rather aggregates them into a few large industries that do not accurately portray the impact prices have on trade. This is discussed more in Section 3.2.

Focusing on the trade balance, we compared the benefits of 5 Bcf/d used in an expanded manufacturing sector relative to 5 Bcf/d of LNG exports, mirroring our analysis of value added and employment.[11] For both types of natural gas use, we focused only on the incremental impacts of the new economic activities and not the price impacts.

The natural gas industry ran an $8 billion trade deficit in 2012. The value of LNG exports will vary depending on assumptions about natural gas prices and contract terms. At the price of natural gas in February 2013, the export value of 5 Bcf/d would be $9 billion.[12] If the natural gas price doubled, the export value would be $18 billion. This would result in a trade surplus in natural gas of up to $10 billion.

For the manufacturing sector, we focused on the natural gas–intensive subsectors that have announced new projects. These subsectors had a combined trade deficit of $15 billion in 2012. Calculating the overall trade impact of increased manufacturing is more complicated because the proposed projects may be parts of the same value chain and include imported inputs. Analyzing the value chains of 26 different products to be produced in the natural gas–intensive manufacturing renaissance, we calculated a production end value of $52 billion after a correction for imported inputs.

[9] Source: United States Census Bureau.

[10] NERA Report, p. 13.

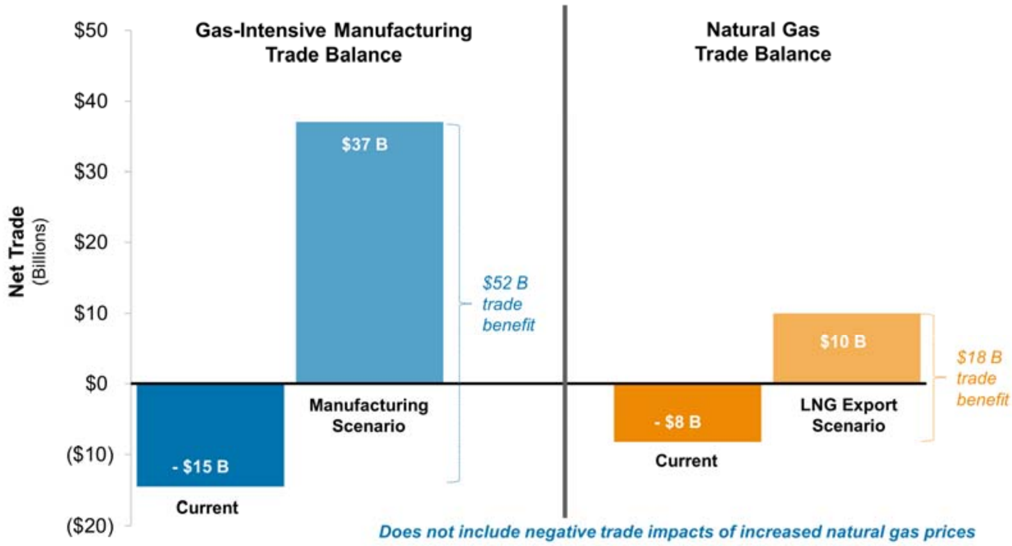
[11] Note that we are assuming 5 Bcf/d for illustrative purposes only and that the results here would be significantly higher if, as expected, LNG exports were significantly higher.

[12] This is based on the 15% Henry Hub markup and $2.25 tolling fee in the Cheniere-BG Group contract, referenced in "Cheniere Closes in on Its Two-Train FID for Sabine Pass," *ICIS*, 19 April 2012.

Given the global nature of the markets for most manufacturing subsectors, this additional production will mostly either substitute for imports or lead to more exports. This substitution is determined by trade exposure of each subsector, as discussed in the next section.

Figure 4 shows the results of our analysis of how 5 Bcf/d of activity in the manufacturing sector would affect the US balance of trade compared to 5 Bcf/d of LNG exports. The chart shows that the manufacturing sector has a much greater benefit to the balance of trade.

Figure 4: Trade Impacts of 5 Bcf/d of Economic Activity in Manufacturing and LNG Exports



Source: CRA Analysis of publicly available data

3. US Manufacturing Sensitivity to Natural Gas Prices

This section explores how natural gas price increases impact the manufacturing sector, a vital yet sensitive contributor to the economy. Given the high level of value added per input, which we presented in the previous section, losses in this sector are particularly damaging to the economy. We begin by taking inventory of the industries within the manufacturing sector that are exposed to natural gas price variations and then examining which of these industries are also exposed to international competition. We then discuss ways to quantify natural gas price impacts on manufacturing output. Finally, we present a case study on ammonia manufacturing for a closer look at how an industry has historically responded to natural gas price changes and how its prospects are changing given the potential for low prices.

3.1. Manufacturing Sector Exposure to Natural Gas Prices

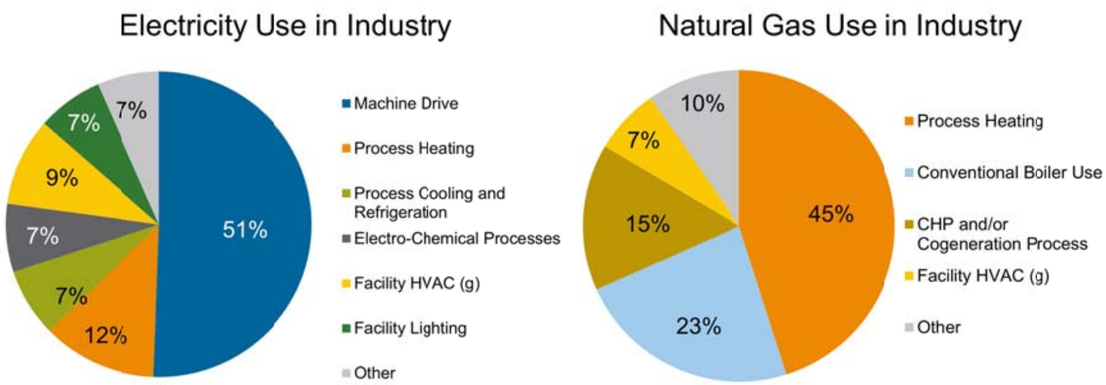
Natural gas costs find their way onto the operating ledgers of manufacturers in a variety of ways. While some industries have little exposure to natural gas prices, many rely on natural gas at multiple points in their manufacturing processes. Manufacturers with the following characteristics are most likely to be natural gas–intensive:

- Natural gas is a feedstock. Products such as fertilizers, plastics, and some pharmaceuticals can include components of natural gas as feedstock. For many there is a fixed natural gas component of the end product and they cannot adjust the share based on natural gas prices.
- Natural gas is a heat source. With relatively low natural gas prices, heat can be generated from natural gas more economically than by electrical heaters. This is common in the metals and chemicals industries, where heat is an essential part of the manufacturing process.
- Natural gas is used for co-firing. Co-firing, in which natural gas supplements the combustion of other fuels (such as wood, coal, and biomass), increases industrial efficiency and is common in industrial boilers that provide steam and/or on-site generated electricity.
- The industry is electricity-intensive. The industrial sector consumes about a quarter of the electricity generated in the United States. Most manufacturers are dependent on this input, and for many it is a large share of their costs. Electricity-intensive manufacturers are most exposed to natural gas prices in regulated regions with a high level of natural gas generation and in market regions where natural gas frequently generation sets the electricity price (where natural gas is “on the margin”).

Figure 5 shows the use of electricity and natural gas in the manufacturing sector as of 2006, the most recent date of published government data.[13]

[13] DOE EIA Manufacturing Energy Consumption Survey (MECS), 2006.

Figure 5: Direct and Indirect Natural Gas Consumption by US Manufacturing



Source: EIA Manufacturing Energy Consumption Survey, 2006

The first step in understanding the exposure that the manufacturing sector has to natural gas price changes is an assessment of which industries within the sector are most exposed. Many studies jump straight to analyzing energy-intensive, trade-exposed (EITE) industries using definitions from climate legislation proposed in 2009, but this approach neglects three important points:

1) Trade exposure is not static and can therefore change over time. Domestic industries that were not trade exposed in 2007 (the data year used by the study referenced by the NERA Report) could have become so. For example, the industries we examined in the previous section that are on the verge of adding more domestic manufacturing had exports grow 87% and imports grow 17% from 2007 through 2012. A few industries saw their trade exposure grow even more. For example, ethyl alcohol exports increased more than 500% during that time period.

2) Just because a manufacturer sells its products primarily to the domestic market without significant foreign competition does not mean it can simply pass through additional operating costs, such as natural gas price increases. While producers of commodities traded on a global market are more clearly price takers, many industries face domestic competition from substitutes or face elastic demand for other reasons. Therefore focusing on trade exposure leaves out an important part of the story.

3) Setting an arbitrary hurdle of 5% as the energy intensity at which industries face business impacts may be helpful for evaluating policy mechanisms, but this should be done only with an understanding that many important industries may barely miss the cut. For example, industries with 4–5% energy intensity in 2011 have half the employment and value added as all the industries with greater than 5% energy intensity.

The manufacturing industries with more than 4% energy intensity in 2007 represented 10% of the output of the entire manufacturing sector in 2011.[14] Even when the industries that are not

[14] United States Census Bureau, Annual Survey of Manufacturers. CRA analysis.

trade exposed are removed, the EITE industries have a higher value added share of output than the sector average, which runs counter to what was stated in the NERA Report.[15]

3.2. Quantifying the Impact of Natural Gas Price Changes on Manufacturing

Even if all the challenges mentioned above are overcome and one can determine which industries within the manufacturing sector are *likely* to be exposed to changes in natural gas prices, understanding how and to what extent these industries will be impacted by natural gas price movements must be addressed. Many factors influence the price impacts on an industry beyond energy intensity, such as the homogeneity of the product, level of competition, geographic distribution of markets and competition, ability to increase efficiency, substitutes for natural gas and electricity, and more. The factors are different for each industry and may vary significantly within an industry for different firms, manufacturing processes, and products.

Companies like Charles River Associates and NERA have advanced electric sector models that are built from the bottom up, meaning they model the many different plants and technologies in the sector rather than generalizing and oversimplifying a complex industry. Unfortunately, such models do not exist for all of manufacturing. The advanced electric sector models are greatly aided by the fact that all entities produce one undifferentiated, commodity product. While this is basically true for many manufacturers, it is not true for all. There is also significantly less public data on the manufacturing sector than the electric sector.

Facing the challenges of accurately modeling the industries in the manufacturing sector, NERA simply used a Computable General Equilibrium (CGE) model that rolls all manufacturing industries into one of two subsectors: Energy Intensive and Other Manufacturing.[16] Each of these subsectors has a production function, which identifies the shares of factors such as energy inputs (among five sectors), non-energy inputs (among seven sectors), employee compensation, and investment that support each industry's production. This simplified production function would therefore be the same for Pulp and Paper as it is for Cement.

The production functions start as fixed shares based on non-current data and are allowed to change based on substitution elasticities built into the model. If the subsector-wide elasticities are set to allow low-cost substitution of labor, capital, or other energy for natural gas, the industry's production may not be impacted much by natural gas price changes when modeled. Within manufacturing there are subsectors that can switch easily and many that cannot.

It is important to note that NERA used its electric sector model combined with its macroeconomic CGE model when evaluating economic impacts of the LNG exports. They clearly understand the value of bottom-up representations of industries. NERA used its electric sector model when evaluating EPA environmental regulations.[17] Such a model was needed to estimate levels of coal plant retirements because a model that generalizes coal

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[15] NERA Report, p. 69.

[16] Cite modeling write-up in NERA Report.

[17] "Economic Implications of Recent and Anticipated EPA Regulations Affecting the Electricity Sector," NERA, October 2012.

plants would miss the fact that existing plants vary in several ways, such as heat rates and coal types, that impact their viability. The model had to take into account that the marginal units are the most exposed. Such is the case in the manufacturing sector, which is even more heterogeneous. Any analysis that does not include this reality introduces significant error into its results.

3.3. Case Study: Ammonia/Fertilizer Manufacturing

One example of an industry within the manufacturing sector that requires additional attention than what is afforded in an aggregated CGE model is ammonia manufacturing. This sector uses natural gas as both energy to fuel manufacturing and as a feedstock. NERA's model has ammonia production rolled into a single subsector with dozens of other manufacturing industries that are less natural gas–intensive. In the remainder of this section, we present our analysis of the impact of natural gas price changes on the ammonia manufacturing industry, mostly focusing on the potential for new plants in the United States. Our analysis shows how ammonia producers in the United States have fared historically with increasing natural gas prices and how their resurgence is vulnerable to increasing prices in the future.

3.3.1. Industry Overview

Ammonia plants process natural gas feedstock into hydrogen and combine it with atmospheric nitrogen under high pressure and high temperature to produce ammonia. Approximately 87% of ammonia is used as nitrogenous fertilizer,[18] one of the three primary fertilizers supporting the country's important agricultural sector. It is also used in plastics, cleaners, fermenting agents, explosives, and many other products that are manufactured and consumed domestically, as well as exported. This includes other fertilizer materials that are manufactured with ammonia and often exported in large quantities. Ammonia is a fungible commodity that is transported domestically in pipelines, in pressure tanks via rail or truck, and on barges. It can also be shipped internationally in liquid form, and is thus traded on the global market.

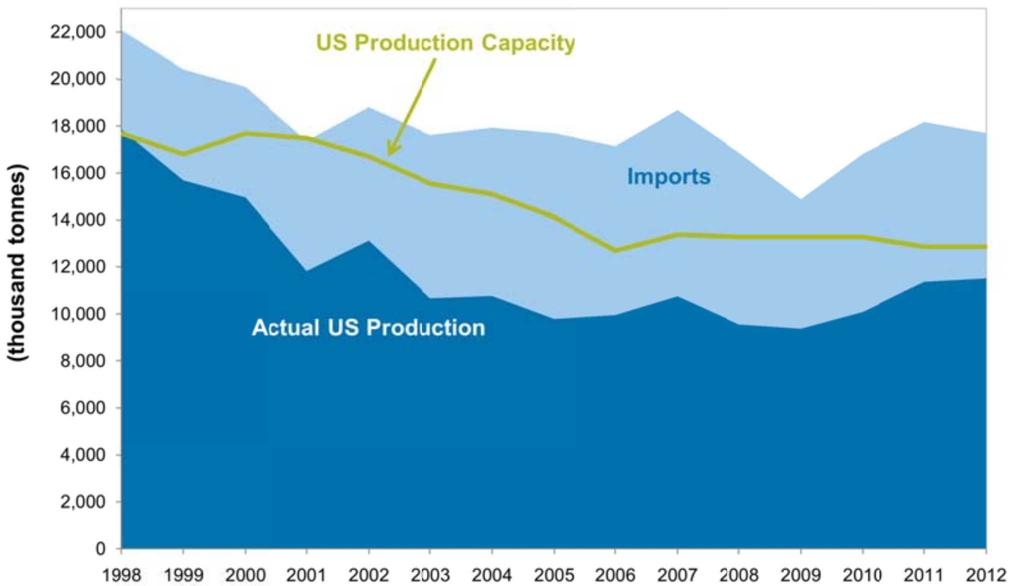
3.3.2. Historical Relationship of Domestic Production and Natural Gas Prices

The global nature of the market and increasing domestic natural gas prices in the early 2000s drove the United States to heavy reliance on imports, which grew from supplying 19% of domestic supply (production + imports) in 1998 to 45% by 2005. Domestic production dropped by almost half during that same period. Since 2007, however, both of those trends have been reversing. By 2012 imports supplied 35% of domestic supply as domestic production has rebounded. Figure 6 shows historical ammonia production, capacity, and imports. Note that excess capacity has been shrinking as utilization has risen, with domestic producers operating at about 85% capacity in 2012.[19]

[18] US Geological Survey (USGS) Mineral Commodity Summary, Nitrogen (Fixed)- Ammonia, 2013.

[19] Ibid.

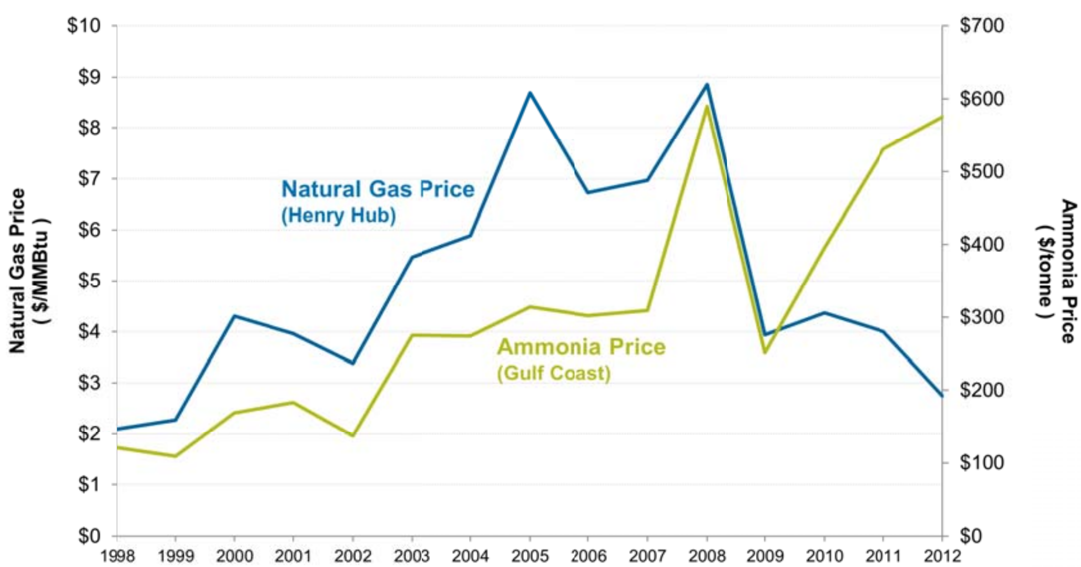
Figure 6: US Ammonia Production Capacity, Actual Production, and Imports



Source:

Production levels are heavily influenced by US natural gas and ammonia prices. Historical prices from 1998 to 2012 are shown in Figure 7. As they are on different scales, this chart is only to show relative movements, not direct comparisons.

Figure 7: Historical Ammonia and Natural Gas Prices, 1998–2012



Source: EIA; The Fertilizer Institute

A focus on the period from 1998 through late 2007 in the two graphs above illustrates how natural gas price increases have historically led to lower domestic production, increased imports, and increased ammonia prices. The changes in domestic ammonia price have, at times, been tempered by the switch to imports, but clearly the costs for the marginal producer (whether domestic or foreign) were impacting prices as they grew over 250%. However, when global ammonia markets are tight (as in 2008), imports have significantly less of a tempering effect on prices.

Note that overall consumption did not decrease at the same rate as ammonia prices increased, suggesting inelasticity of demand. Domestic agricultural demand for fertilizer is inelastic in both the short and long terms[20] as there is no viable substitute and the end product's demand is also inelastic. Over the long term domestic producers can switch to other fuel sources to create the hydrogen feedstock, but these switches historically remained uneconomic compared to imports even in very high natural gas price environments.

3.3.3. Expected Impacts of Increased Natural Gas Prices: Harm to Existing Producers

This historical period of increasing natural gas prices impacting the ammonia manufacturing industry provides an important lesson for natural gas policy making. During this time, profit margins for domestic producers were heavily squeezed. Given the availability of imports, the producers could not pass through increased natural gas costs to consumers. Based on the locations and configurations of the plants, as well as sales and supply agreements, some producers were able to continue ammonia production with the reduced margin while others were forced to shut down or cut back on production. By 2007, 27 plants out of the 58 that existed in 1999 had been de-ratedor mothballed.[21]

This reduction in domestic production reduced value added activity and employment while increasing the overall trade deficit. Based on a study of the economic impacts of the fertilizer manufacturing industry,[22] 7,565 direct jobs and 80,000 total jobs were associated with nitrogen fertilizer manufacturing in 2006. Assuming a fixed number of jobs per level of production would have meant a loss of more than 60,000 total jobs in the preceding eight years. While this suggests potential employment impacts among existing producers, the most sensitive future economic benefits are associated with new capacity planned in the industry.

3.3.4. Expected Impacts of Increased Natural Gas Prices: Lower New Capacity Development

Recently, both ammonia and natural gas prices have relaxed as the economy recovers from its downturn and natural gas prices have benefited from shale gas production. This has created significant economic incentive to increase domestic production. Existing plants have already ramped up production to high utilization of capacity. However, the largest economic

[20] Mark Denbaly and Harry Vroomen, "Dynamic Fertilizer Nutrient Demands for Corn: A Cointegrated and Error-Correcting System," *American Journal of Agricultural Economics*, vol. 75, February 1993, pp. 203–209.

[21] CRA Analysis of *USGS Minerals Yearbooks, Nitrogen*, 1999–2011.

[22] Jeff Plewes and Anne Smith. "Economic Contributions of the US Fertilizer Manufacturing Industry," Charles River Associates for The Fertilizer Institute, 2009.

impact will come from the investments in expanding existing facilities and developing new greenfield plants.

There are currently 25 active and three inactive ammonia plants in the United States.[23] A recent study identified more than 40 projects that are planned, under development, or recently completed.[24] These projects include expansions, de-mothballing, and the construction of new ammonia-related plants. Our analysis of less than half of these projects found planned investments total almost $16 billion and could create more than 1,000 direct jobs and more than 25,000 person-years of construction employment.

The investments will be realized only if the economics are favorable, and that means reasonable natural gas prices. To understand the impact of natural gas prices on the investment decisions, we evaluated the economics of a new ammonia plant under different natural gas and ammonia price assumptions. This involved a simple model of producers' gross margins. While there is no set margin that suggests an "adequate" return for the producers, it should be noted that during the contractionary period for industry (1999–2007), public ammonia producing firms were reporting margins between 5% and 15%. This suggests that sustainable gross margins should be higher.

On the cost side, the model considers three costs typical to ammonia producers: capital expenditure (capex), operation and maintenance (O&M), and cost of natural gas feedstock. The cost components are levelized to demonstrate the production costs on a per-tonne basis. On the revenue side, the sales realized by the producers depend on the world price of ammonia on a per-tonne basis.[25]

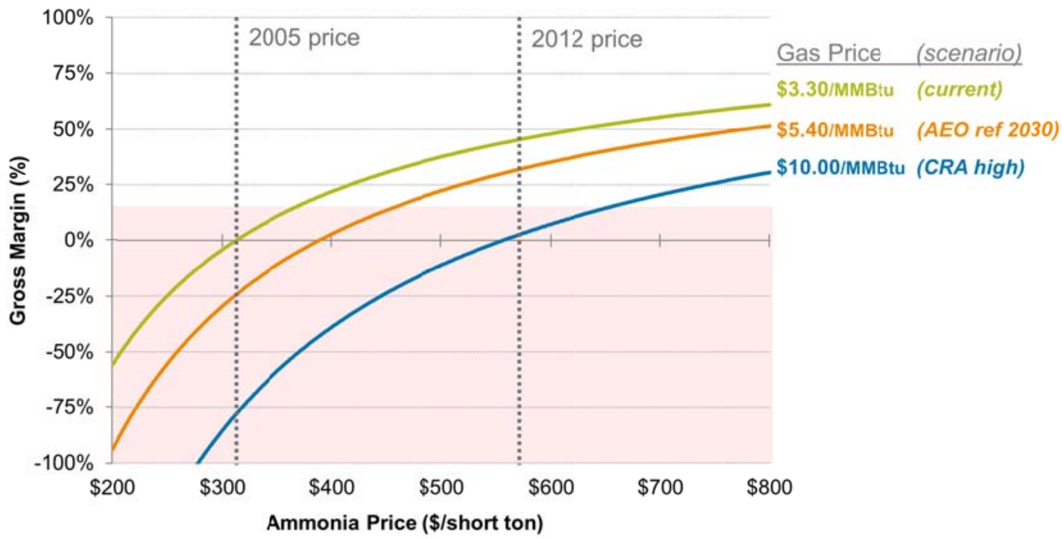
We compared the gross margins for producers at three natural gas prices: (1) the current Henry Hub natural gas price as of mid-February 2013, (2) the EIA's AEO 2013 Early Release reference price in 2030, and (3) a higher price calculated in Section 6.2. Our higher price is included to show the possible impacts of LNG exports on producer margins in the ammonia manufacturing industry. Figure 8 shows the results of this analysis.

[23] USGS Mineral Commodity Summary, Nitrogen (Fixed)- Ammonia, 2013.

[24] "Dozens of companies eye North American N expansions," *Green Markets*, 31 December 2012.

[25] Key model assumptions: Average capex and plant size based on several recently announced ammonia plants, O&M and Heat Input from The Fertilizer Institute's Ammonia Production Cost Survey (2005), scaled to 2012 dollars.

Figure 8: Ammonia Producer Margins under Varying Ammonia Prices



Source: CRA Analysis; The Fertilizer Institute

At the current natural gas and ammonia prices, new plants would clearly be "in the money" in the short term. However, investment decisions are made on expected returns over the lives of the plants, not current market conditions. Therefore it is important to consider the higher natural gas price scenarios and examine a possible range of ammonia prices. Our analysis in later sections highlights the likelihood of higher natural gas prices in a high LNG export scenario. At current ammonia prices and a natural gas price of $10/MMBtu, producers would effectively earn no margin. We do not forecast ammonia prices, but they very well may decrease in the future with a very large amount of new capacity being developed around the world and efficiency in fertilizer use impacting demand. With just a slight dip in ammonia prices, US producers will be very sensitive to higher natural gas prices. This is likely a reason why many firms have delayed final investment decisions until later in the year.[26]

[26] "US Mosaic May Build $700m Ammonia Plant in Louisiana," *ICIS News*, 21 December 2012.

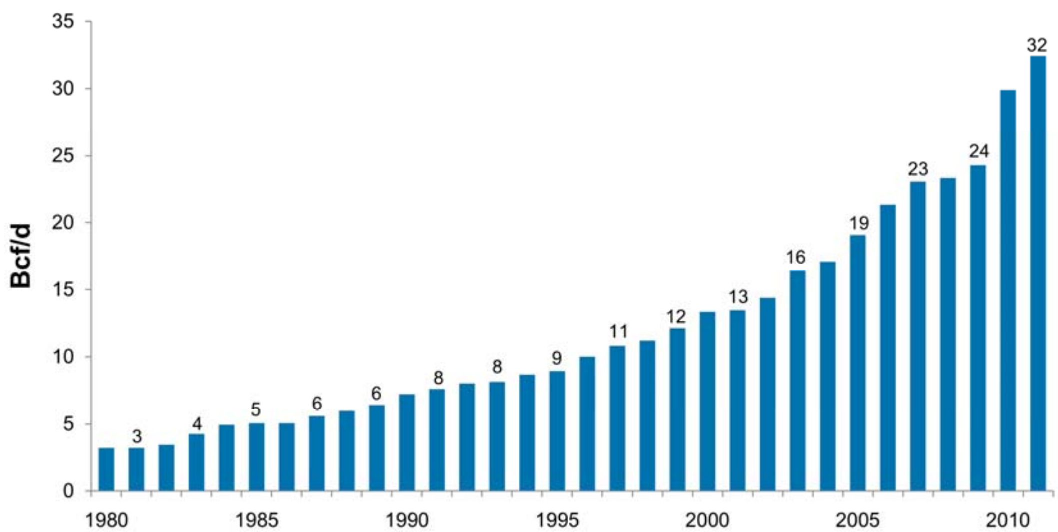
4. Potential High US LNG Export Scenario

In this section, we examine the size of the global LNG market and discuss how LNG prices are determined in major markets for LNG. We then discuss two scenarios for future LNG demand and the capacity required to meet that demand. This provides us with an assessment of a likely and a high US LNG export scenario through 2030.

4.1. LNG Market Overview

In 2011, the global LNG trade reached its highest level of 32.2 Bcf/d, an increase of 8% over the previous year with more growth expected. This increase was primarily due to a sharp increase in Japanese demand after the country suspended most of its nuclear operations. Other countries with increased demand include the UK, India, and China. Their demand more than offset the declines in demand from Spain, due to an economic recession, and the United States, where shale gas production rose considerably.

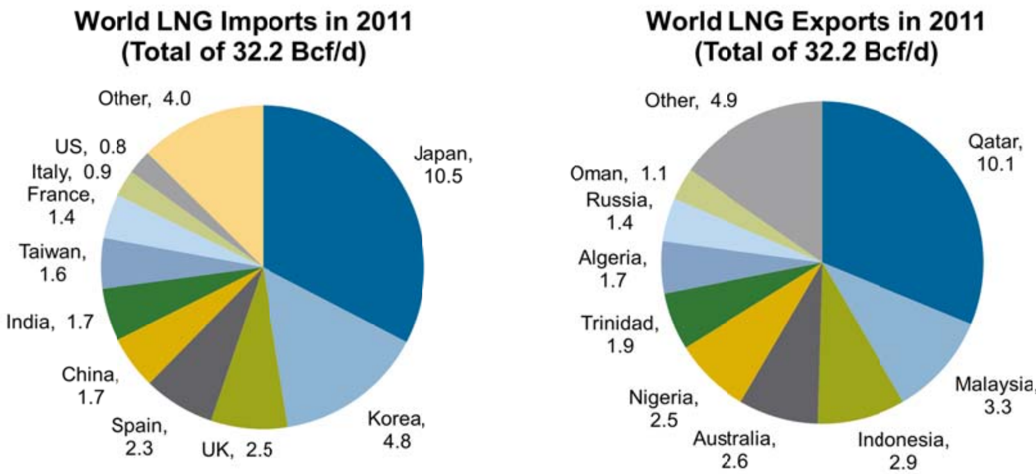
Figure 9: LNG Trades Volumes, 1980–2011



Source: *World LNG Report 2011,* International Gas Union, June 2012, p. 9.

Slightly more than half of the world's LNG supply is sourced from three countries, with Qatar as the world's largest LNG exporter with about 30% market share. On the demand side, Japan and Korea consume nearly 50% of the world LNG supply (Figure 10).

Figure 10: World LNG Imports and Exports by Country in 2011



Source: *World LNG Report 2011,* International Gas Union, June 2012, pp. 8, 11.

Post-2009, the global trade volume of LNG has grown at a much higher rate compared to the early 2000s. This is mainly due to the increased share of natural gas used in power generation, where global demand has shifted away from coal and nuclear.

4.2. LNG Pricing Structure and Major Markets

The LNG market is a relatively small market compared to the crude oil market, and pricing is less transparent due to a host of factors, including trade volumes and the relatively small number of LNG liquefaction and regasification facilities. The LNG market began under the framework of long-term supply contracts to bring natural gas into Japan, where security of supply was a chief concern. Due to the lack of competitive natural gas markets and competition from other fuels, LNG pricing in Japan and similar markets was and is largely tied to crude oil. In the LNG-dependent markets of Northeast Asia (e.g., Japan and Korea), the alternative is petroleum fuels, and there is no downstream natural gas market competition. As a result, almost 90% of long-term LNG contracts are oil-linked.[27] Most of these contracts are indexed to the average Japan Customs-cleared Crude (JCC) price of oil imports, although the terms of the contracts may vary depending on the regional markets and the times of negotiation.

As LNG consumption and diversity and supply and demand have grown in other markets, especially in Southeast and South Asia, there has been growth in LNG cargo trading under spot purchase agreements. The terms and pricing of the contracts are typically subject to bilateral negotiations between parties. In many of these countries there is some natural gas supply and hence some degree of LNG versus local natural gas competition.

[27] *2015–2035 LNG Market Assessment Outlook for the Kitimat LNG Terminal,* Poten & Partners, June 2010.

LNG cargos also flow into regions such as Western Europe and the United States, where there are large and widely traded natural gas markets.[28] In these markets, LNG imports can flow when prices are sufficiently high after accounting for differences in transport and other costs in comparison to LNG production costs and opportunities in other markets, especially in Asia.

4.3. Expectations of Foreign LNG Demand and the Supply Gap

In forecasting future demand for LNG we have developed two scenarios for future growth: Likely Export and High Export. Our export scenarios are driven by the size of the LNG market and the ability of the United States to fill the gap between projected demand and capacity, both existing and under construction. We rely primarily on PFC Energy's June 2012 LNG Markets Study[29] and data from the EIA's International Energy Statistics as guides for our forecast and relate our forecast to historical rates of growth.

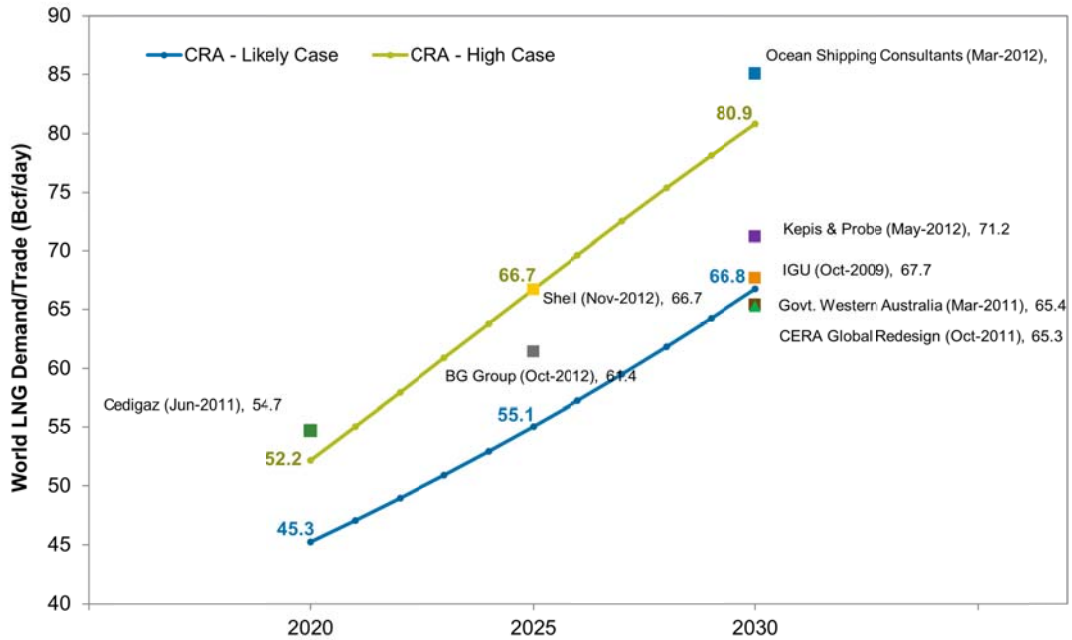
In 2010, the two key LNG import markets were Japan and Korea, as they composed just slightly more than 50% of the world demand. By 2030, we forecast that key markets will expand to include India, Southeast Asian countries (SEAC) and China. These markets will represent approximately two-thirds of the global LNG demand. India, SEAC, and China have experienced rapid demand growth of approximately 10% per annum, a trend likely to continue. The major driver of high LNG demand growth rates is increasing energy consumption per capita as the middle class expands and natural gas generation capacity is brought online to meet the demand. China has proven that it has the money to invest in infrastructure, but it can move only so quickly.

Figure 11 shows our projection of global LNG growth under both scenarios. Our Likely Export scenario takes a lower path that ends near the 2030 estimates of 66.8 Bcf/d that were projected by both the Government of Western Australia and CERA in 2011. Alternatively, our High Export case intersects the November 2012 Shell estimate of 66.7 Bcf/d in 2025 and then takes a similar rate of growth ending in 2030 at 80.9 Bcf/d. The key difference in these scenarios is the growth rate in LNG demand from China along with India and Southeast Asian countries. In the Likely Export scenario, the growth rate for these countries is 4% annually, while it is 6% annually through 2025 in the High Export scenario with some slow down post-2025. These scenarios are both conservative relative to the global 8% annual growth rate from 2000–2010 (pre Fukushima Daiichi disaster). See Table 1 for 2030 market shares by scenario.

[28] While the United States has import capability, it historically has had limited LNG imports due to domestic prices generally staying below the imported LNG price.

[29] *LNG Markets Study*, PFC Energy, June 2012.

Figure 11: World LNG Imports Forecast by Major Importers from 2013 to 2030



Source: *LNG Markets Study*, PFC Energy, June 2012; CRA analysis and industry research

Table 1: World LNG Imports in 2030

LNG Importers	Likely Export Scenario		High Export Scenario	
	LNG Imports in 2030 (Bcf/d)	Market Share	LNG Imports in 2030 (Bcf/d)	Market Share
India and SEA Countries	14.0	21.0%	21.1	26.1%
China	13.9	20.9%	21.0	25.9%
Japan	13.7	20.5%	13.7	16.9%
Europe	11.6	17.4%	11.6	14.4%
Korea	7.4	11.0%	7.4	9.1%
Taiwan	3.1	4.7%	3.1	3.9%
Other	3.0	4.5%	3.0	3.7%
US	-	0.0%	-	0.0%
World LNG Imports	**66.8**	**100.0%**	**80.9**	**100.0%**

To meet the 2030 demand, significant capacity will need to be built. By the end of 2011, the existing global liquefaction capacity totaled 278.7 MTA, or 37.2 Bcf/d. There were 84.2 MTPA or 11.2 Bcf/d of facilities under various phases of construction. Assuming a 95% capacity factor for LNG facilities, the capacity shortage in 2025 in the Likely and High Export scenarios is 9 and 20 Bcf/d. In 2030, the projected capacity shortage is 20 and 35 Bcf/d for the Likely and High Export scenarios, respectively.

4.4. Potential US LNG Export Scenarios

This section describes how there will be a global LNG capacity shortfall as demand will double by 2030 in the Likely Export scenario and by 2025 in the High Export scenario. The United States will likely play a major role in filling the expected capacity shortage.

As of January 11, 2013, 22 unique projects had submitted DOE applications to export to FTA countries. Of those, 16 had submitted an additional application to extend those export privileges to non-FTA countries.[30] Approval of all projects could result in exports of 29.4 Bcf/d of domestically produced LNG.[31]

Sabine Pass is the only LNG export project to complete both the DOE and FERC permitting processes. It was approved to export 2.2 Bcf/d to either FTA or non-FTA countries and is expected to be in service by the end of 2015. Two other projects—the Cameron LNG and Freeport LNG Expansion—have advanced beyond the application process as they have made announcements of contracts with international oil and gas entities like Total, Osaka Gas, and BP. Together, these three projects would add 5-6.7 Bcf/d of export capacity by 2018.

Of the proposed export capability, more than 60%, or 18.4 Bcf/d, would be from reworks of existing LNG import terminals, with the rest coming from greenfield projects. Existing import terminals have an advantage over greenfield projects because significant infrastructure is already in place, such as pipelines and shipping terminals. Therefore, financing should be easier for an existing import terminal than for a greenfield project to add export capacity.

Given the high cumulative size of export applications and 5-6.7 Bcf/d already in advanced stages, two critical questions emerge: What is a likely LNG export scenario by 2025, and what is a potentially high LNG export scenario by 2025?

Based on our analysis, we forecast a global LNG capacity shortage of 9–20 Bcf/d by 2025 and 20–35 Bcf/d by 2030. We project that the United States likely will achieve 6.7 Bcf/d by 2018 based on projects in advanced stages and will fill the remainder of the 2025 and 2030 gaps with part or all of the remaining 22.7 Bcf/d of active LNG export applications, depending on the scenario. This level of exports from the United States can be supported for the following reasons:

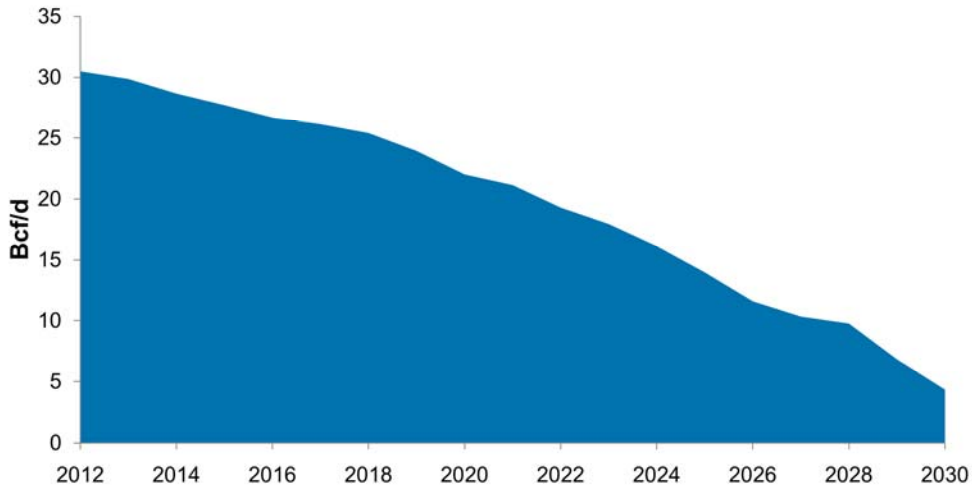
1. The United States will have a greater opportunity than just filling the gap between liquefaction capacity and demand. With contracted supply falling starting in 2019 for Japan, South Korea, Taiwan, and China, there also is opportunity for US exporters to take share from suppliers who already have installed capacity (see Figure 12). As such, assuming the United States likely can fill the shortage gap is conservative.
2. Asian oil-linked LNG prices will continue to be favorable, inclusive of the netback cost (costs of liquefaction, shipping, and regasification) to the United States.

[30] DOE/FE, Summary of LNG Export Applications, 11 January 2013.

[31] Detailed information about the proposed projects can be found in Appendix A.1.

3. Exports will continue even at higher domestic prices because of price-induced demand destruction from other sectors that "frees up" supply. This is discussed in further detail in Section 6.

Figure 12: LNG Supply Contracts (Above Four Years) in Force in 2011



Source: *The LNG Industry in 2011*, GIIGNL, pp. 27-30.

Our analysis of future US LNG export supply potential contradicts the findings in the NERA Report, which concluded that the potential is limited except for a few cases in which there is an international demand shock and/or supply shock:

> *NERA concluded that in many cases the world natural gas market would not accept the full amount of exports specified by FE in the EIA scenarios at prices high enough to cover the U.S. wellhead price projected by EIA. In particular, NERA found that there would be no U.S. exports in the International Reference case with U.S. Reference case conditions. In the U.S. Reference case with an International Demand Shock, exports were projected but in quantities below any of the export limits.*[32]

The reason that NERA came to this conclusion is that it grossly overstated the netback costs to the United States from major LNG markets, which decided the analysis from the beginning. Netback costs defined here are the costs of liquefaction, shipping, and regasification. Figure 13 shows the netback costs that NERA assumed compared to publicly available sources.

[32] NERA Report, p. 4.

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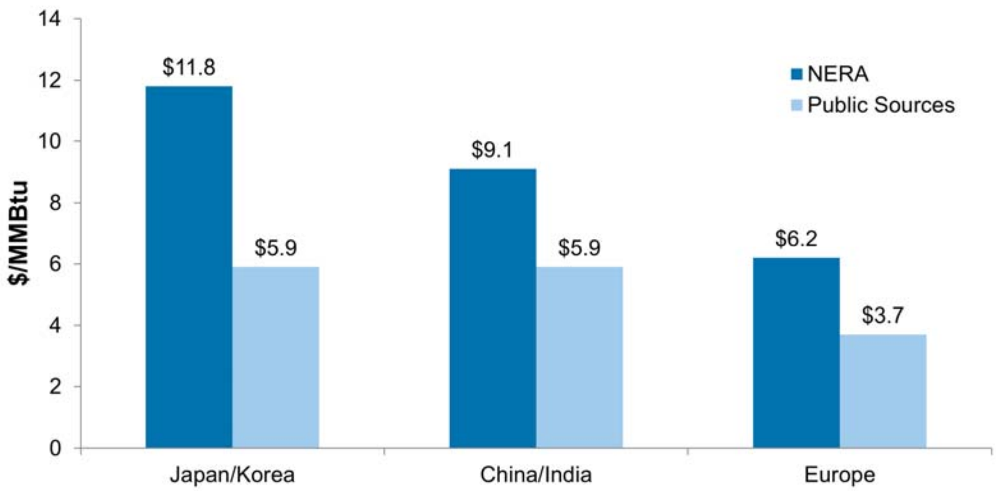
Figure 13: Netback Costs to the US Wellhead from Major LNG Markets



Source: NERA Report, pp 84–92; CRA analysis of publicly available data

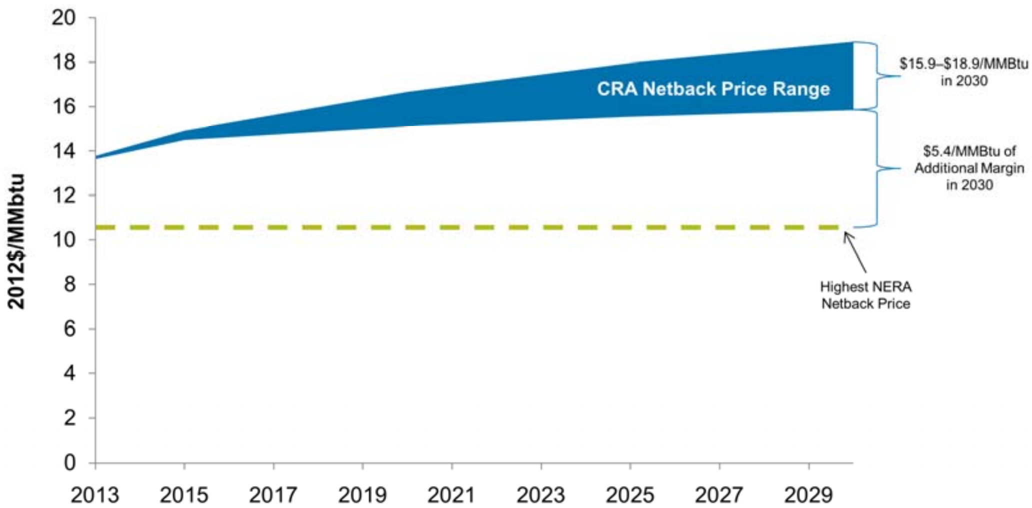
The NERA Report shows a base cost similar to public sources and CRA's estimates for the three major markets analyzed by NERA. However, NERA tacked on Shipping Cost Adders[33] that increase their total netback costs that were not detailed except for a few brief paragraphs in an appendix.[34] It is our contention that the size of NERA's netback costs inclusive of the adders strong-armed the model into producing results that show exports are not profitable except for cases involving international shocks.

As shown in Figure 14, the highest netback price that NERA projects across all its scenarios is $10.5/MMBtu. We estimate, however, that the implied netback price range could be $15.9–18.6/MMBtu by 2030 if Asian LNG prices remain linked to an oil index. At $18.60, US wellhead prices could increase more than 500% from current prices before US LNG exports to Asia would be curtailed.

33 NERA Report: Figure 66: LNG Cost Adders Applied to Shipping Routes ($/MMBtu).

34 NERA Report, Appendix B, p. 96.

Figure 14: Range of Netback Prices to the US Wellhead under Oil Indexation[35]



Source: International Energy Agency's 2012 World Energy Outlook; CRA Analysis

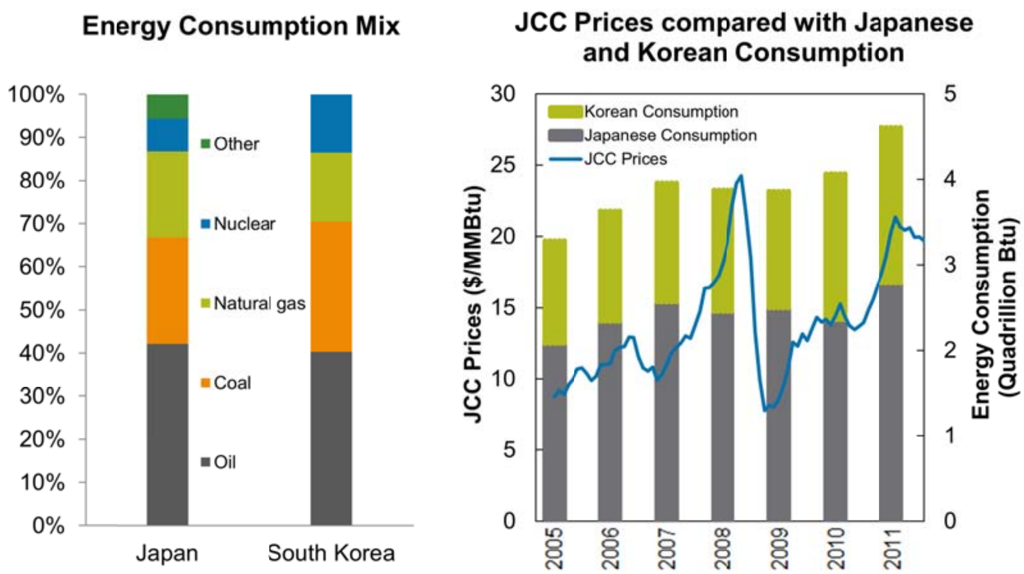
NERA's analysis contradicts the business model that investors are relying upon in evaluating LNG export terminals. Effectively, the NERA Report concludes that building LNG export terminals does not impact domestic natural gas prices because the terminals will not be used in most future scenarios. If that were true, why are investors proposing to spend billions to build LNG export facilities?

In addition to using excessive netback costs, NERA also drove its results by assuming all non-US countries would have the same price elasticity of demand. This is an approach that does not comport with reality. For highly industrialized countries like Japan and Korea with limited native resources, natural gas is a critical component of the energy mix (see Figure 15). The next closest substitutable fuel source to LNG is refined oil products: thus the pricing of LNG at crude. As a result, Japan and Korea have little leverage in driving the spot market for LNG. This is supported by evidence of rising natural gas demand for Japan and Korea prior to 2011 (pre–Fukushima Daiichi disaster) while JCC prices were rising (see Figure 15). As such, we contend that the short-term (through 2020) price elasticities of natural gas demand for Japan and Korea are zero as opposed to the –0.10 to –0.13 range NERA applied for 2013–2013.[36]

[35] CRA netback price range is based on the crude oil import forecast in the International Energy Agency's 2012 World Energy Outlook for the Current and New Policies scenario. Netback costs of $5.9/MMBtu to Japan/Korea are subtracted from the forecasted oil prices.

[36] NERA Report, p. 91.

Figure 15: Energy Consumption Mix and Demand Response to JCC Prices for Japan and Korea



Source: EIA; Bloomberg; CRAAnalysis

In conclusion, we find that a number of factors make a compelling case for exports of 9–20 Bcf/d in 2025 and 20–35 Bcf/d in 2030:

- **Capacity Shortage:** The 2025 and 2030 supply-demand gap warrants the need for at least this amount of capacity to supply global demand. The United States is already on the way to adding 6.7 Bcf/d of US LNG exports that are under construction or in advanced phases of development.
- **Existing Contracts Expiring:** Contracted supply starting in 2019 for Japan, South Korea, Taiwan, and China will open up more opportunities for the United States to compete with existing liquefaction terminals.
- **High Margins in the LNG Value Chain:** Oil-indexed prices in Asia create large-margin opportunities in the LNG value chain. Even if LNG prices were to disconnect from oil prices and fall by 50% from current levels, the margins would be sufficient for the investment return required at current domestic natural gas prices.

Our analysis contradicts the conclusions in the NERA Report in that US exports can occur without the need for international supply or demand shocks to occur. We contend that NERA came to a flawed conclusion because it used excessive netback costs and price elasticities that ultimately dissuaded US LNG exports in most scenarios.

5. Other Drivers of Future US Natural Gas Demand

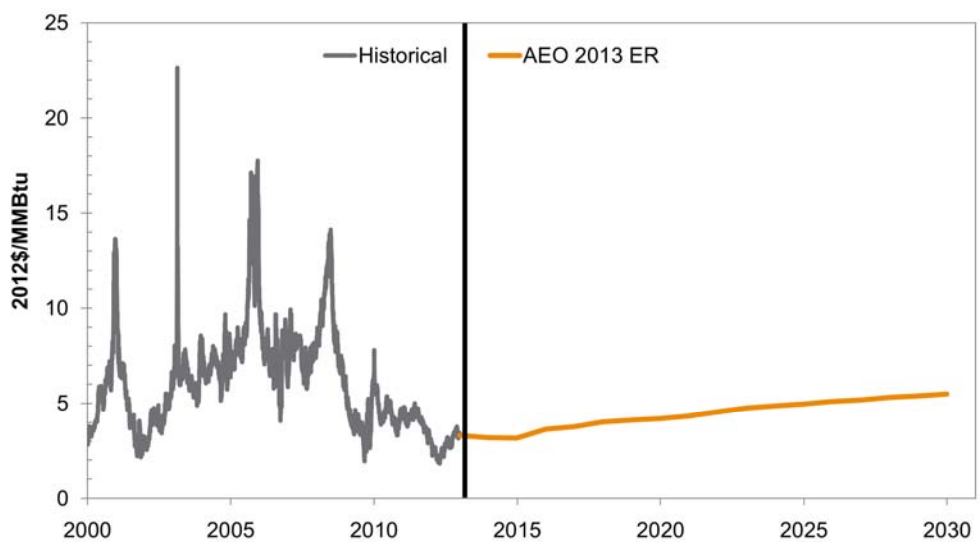
In addition to LNG exports, there will be three major drivers of future natural gas demand over the next 10–20 years:

- ***Manufacturing renaissance*** due to currently favorable US natural gas prices relative to internationally priced industrial products
- ***Coal–to–gas switching in the electric sector*** due to currently competitive natural gas prices and regulation induced coal retirements
- ***Natural gas vehicle (NGV) penetration***, particularly in the vehicle fleet market such as heavy-duty trucks (freight trucks) and medium-duty trucks (local and regional delivery trucks)

While residential and commercial natural gas demand represent sizable portions of the overall natural gas consumption mix, their growth rates are expected to be negligible for the foreseeable future.[37]

In the previous section, we outlined a plausible high scenario for LNG exports. In this section, we examine the degree of additional natural gas demand that would arise from the three other major drivers in a price environment similar to AEO 2013 ER. We examine the demand growth of these drivers assuming the natural gas price forecast in the EIA's AEO 2013 Early Release price forecast, which some commenters contend is representative of a flat supply resource. Over the course of 17 years, the AEO 2013 ER price rises from $3.3/MMBtu to only $5.5/MMBtu in 2030 (see Figure 16).

Figure 16: Comparison of Henry Hub Prices: Historical and AEO2013 ER (2012$)



Source:EIA

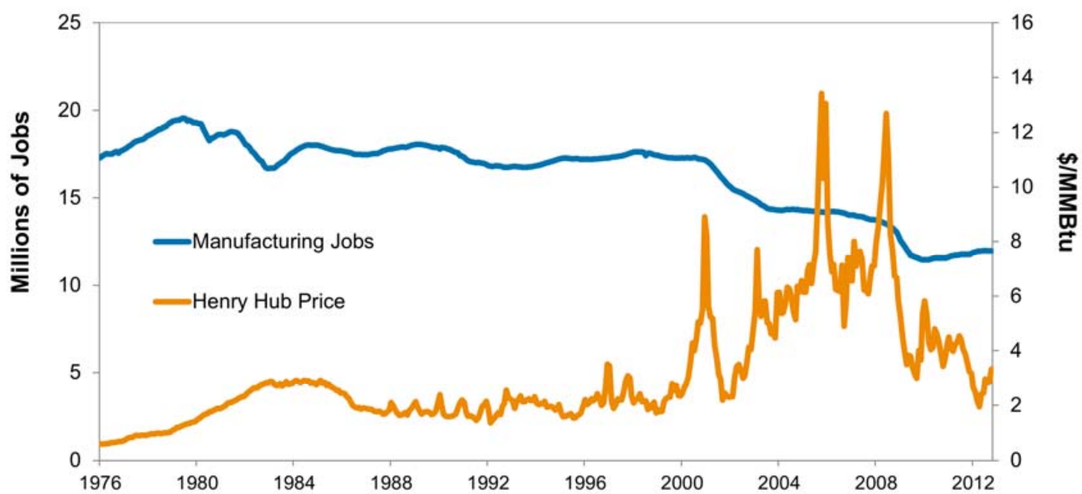
[37] EIA's AEO 2013 Early Release forecasts that residential and commercial gas consumption will slightly decline through 2030.

Combining these demand forecasts with our LNG export scenarios creates Likely Export and High Export scenarios. At the end of this section, we discuss how these scenarios compare to historical demand and production growth and the degree to which they are reasonable. This analysis then leads into Section 6, where we discuss the slope of the natural gas supply curve and the degree to which natural gas prices would increase in the Likely and High Export scenarios.

5.1. Manufacturing Renaissance

From 2000 through the end of 2007, the United States experienced a 21% decline in manufacturing jobs, losing 3.6 million jobs in total.[38] During the same period, as shown in Figure 17, Henry Hub natural gas prices increased dramatically. The average Henry Hub nominal natural gas price during this period was $5.7/MMBtu. In the prior eight-year period leading up to 2000, the average Henry Hub price was $2.1/MMBtu. While correlation does not always lead to causation, anecdotal evidence from 2000 to 2007 indicate that increasing natural gas prices were a major driver of decisions to idle and shut down manufacturing plants.[39]

Figure 17: Manufacturing Jobs and Henry Hub Price Trend



Source: Bureau of Labor Statistics; EIA

The return of low natural gas prices in recent years has enabled the US manufacturing industry to become more competitive internationally, which in turn has sparked the hopes of a manufacturing renaissance. The expectation of continued favorable natural gas prices has led to announcements of more than 95 capital investments in the gas-intensive manufacturing

[38] Bureau of Labor Statistics.

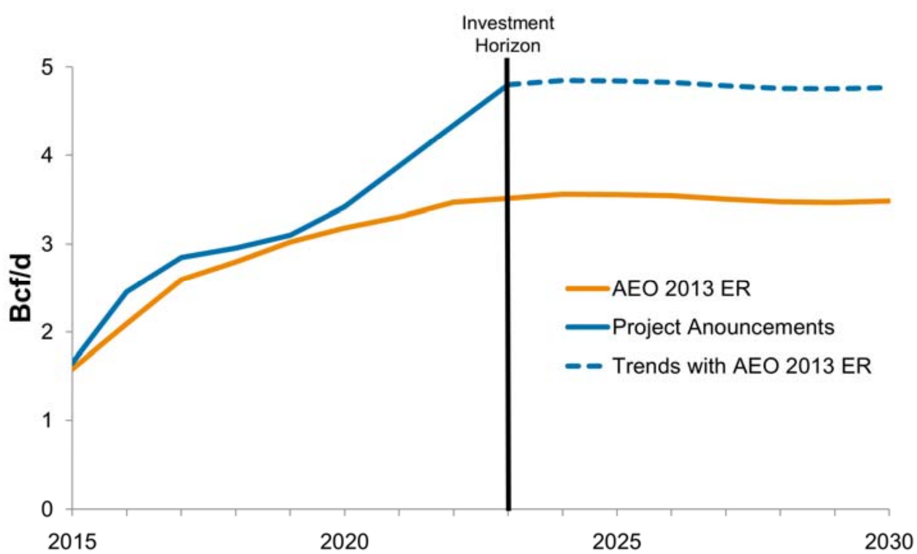
[39] See: http://www.icis.com/Articles/2005/05/02/673723/terra-to-mothball-louisiana-ammonia-plant-indefinitely.html; http://www.icis.com/Articles/2005/09/06/1004542/celanese-to-close-canadian-methanol-plant-end-06.html

sector, representing more than $90 billion in new spending and thousands of new jobs. Section 2 details what the manufacturing renaissance means in terms of GDP, jobs, and trade balance to the United States.

The announced natural gas-intensive manufacturing investments we identified are expected to add about 4.8 Bcf/d of industrial natural gas demand by 2023, as seen in Figure 18. We developed this figure by collecting data on each announcement and applied product-specific energy intensity factors to each announcement based on reported production volumes. Project timelines ranged from 2011 to 2018.[40]

In the same figure, we have also compared the natural gas demand from the announced projects to AEO 2013 industrial demand. From 2015 to 2019, the announced projects line and the AEO 2013 forecast are quite close in terms of incremental natural gas demand, but they begin to separate in 2020 when the GTL plants are added to the mix. After full ramp-up of the GTL facilities by 2023, the Project Announcements model flattens according to the AEO 2013 ER model. It is worth noting that the announced project timeline is a conservative estimate of the manufacturing renaissance. Our reasoning is that the announced project line in the chart represents the known, publicly announced investments, whereas undoubtedly a number of investments are occurring or planned that have not or will not be announced in the public arena.

Figure 18: Industrial Natural Gas Demand Addition: Announced Projects vs. AEO 2013 Forecast

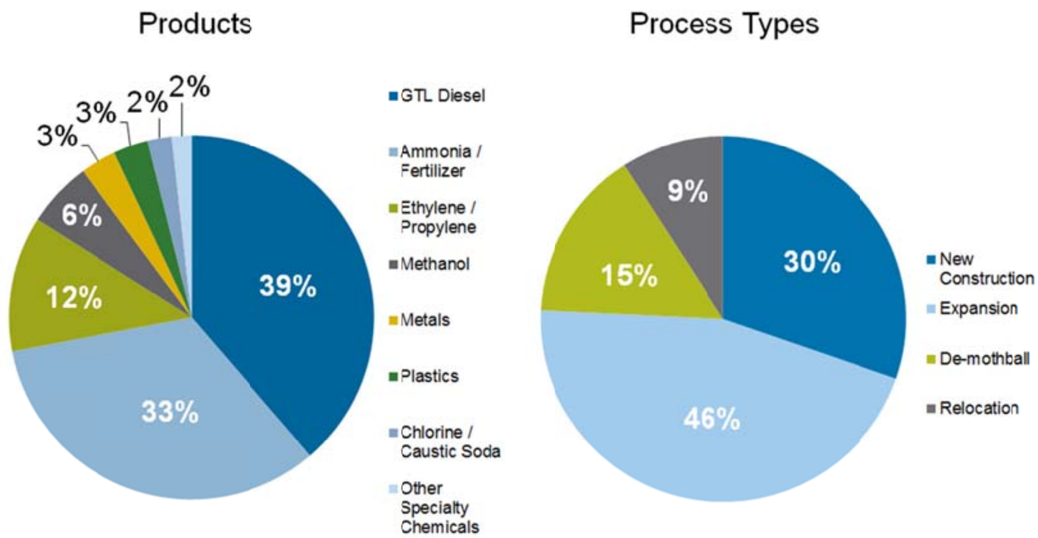


Source: EIA; CRA analysis

[40] Two GTL facilities, announced in 2012 by Sasol and Shell were estimated by CRA to begin production from 2020 to 2023 based on previous GTL construction schedules and ramp-up profiles.

Investments will be varied across the manufacturing industry, and will be a combination of new builds, expansions, de-mothballs (recommissioning of idled plants), and transfers of plants from overseas to the United States (relocation). Figure 19 shows the variation in products and plant type by incremental gas demand.

Figure 19: Plant Products Announced (left) and Plant Types Announced (right), 4.8 Bcf/d



Source: CRA analysis of public announcements in the gas-intensive portion of the manufacturing sector

5.2. Coal–to–Gas Switching in the Electric Sector

Current coal–to–gas switching in the electric sector is being led by two drivers: low natural gas prices competing with coal prices and plant retirements due to impending regulations. The implementation of multiple environmental regulations over the next 10 years will have a significant impact on the US electric sector. Recent proposed and finalized rules from the US Environmental Protection Agency (EPA) target the regulation of air quality, water quality, solid waste disposal, and greenhouse gas (GHG) emissions associated with electric power generation. The various rules are poised to come into effect over the next decade and will most impact the coal-burning units. Table 2 provides more detail on the individual regulations currently proposed and finalized.

Table 2: Regulations Impacting Switching of Coal to Natural Gas–Fired Electric Generation [41]

Policy	Category	Description	Regulatory Stage	Implementation Timing
Mercury and Air Toxics Rule (MATS)	Air Quality	Places maximum emissions limits on mercury, acid gases, and particulates for new and existing coal units.	Finalized	2015–2017
Clean Air Interstate Rule (CAIR)	Air Quality	Cap-and-trade policy to control NO_x and SO_2 emissions in the eastern United States.	In Place (waiting to be replaced)	In Place with caps tightening in 2015
NAAQS	Air Quality	Standards for atmospheric criteria pollutant concentrations (e.g., SO_2, NO_x, ozone, particulates).	Finalized and Proposed	2013–2015
New Source Performance Standards	Air Quality and CO_2	Emissions limits for new and modified units. It would preclude the construction of new coal plants that do not utilize carbon capture.	Proposed	2013–2014
Water Intake Rule (a.k.a. 316(b) Clean Water Act)	Surface Water	Regulates fish impingement and entrainment in water intake structures and affects the addition of cooling towers.	Proposed	2020
Effluent Guidelines	Water	Would tighten EPA's guidelines for pollutant and metal concentrations in wastewater.	Awaiting Proposal	Uncertain
Coal Combustion Residuals (CCR or Coal Ash)	Solid Waste	Intended to reduce the possibility of coal ash release from surface impoundments.	Proposed	Uncertain

Many electric generating units will have to invest in new retrofit technologies and/or update their current operating systems in order to comply with these regulations. The US coal fleet is especially susceptible to these rules. Coal plants will increasingly be forced to either undergo significant capital expenditure programs to meet the compliance standards or retire. Furthermore, the plants that choose to retrofit and comply with the standards will incur higher dispatch costs due to the costs of operating the retrofits. With coal capacity either retiring or facing higher costs in the near term, the share of natural gas generation will increase due to its relatively low operating cost in the near term and the need to replace the lost or more expensive coal generation.

We have modeled a scenario using our proprietary North American Electricity and Environment Model (NEEM) to forecast the effects of these EPA regulations on coal and natural gas generation. This analysis includes the finalized MATS Rule, CAIR, a moderate 316(b) implementation, and the GHG NSPS. We have not modeled any future CO_2 policy, which would induce more coal–to–gas switching.

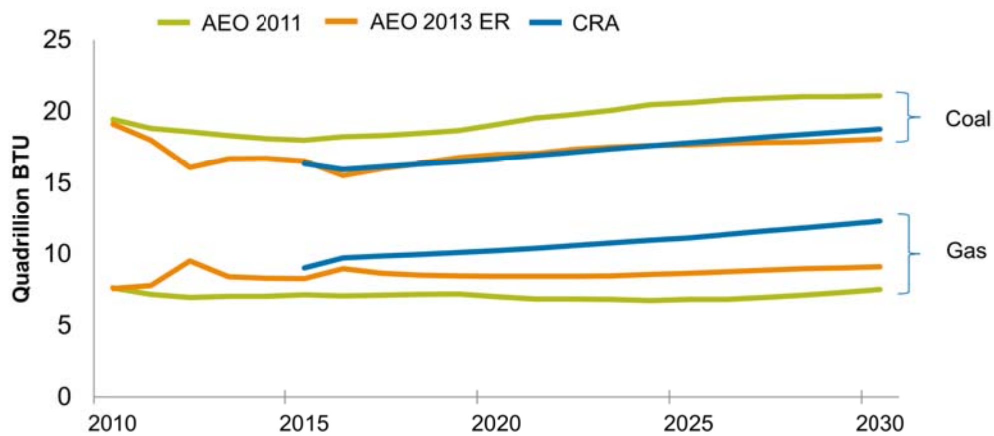
In addition to environmental regulation assumptions, we make two other major input adjustments to our NEEM model. First, we use the AEO 2013 Early Release Henry Hub price

[41] Based on CRA review of regulations in different phases of development and implementation.

forecast through 2030. Second, we base our demand growth forecast on the FERC 714, which is approximately 12% higher than AEO 2013 Early Release in 2030.

The results of our analysis show more than 56 GW of the US coal fleet retiring by 2020, with no additional retirements after 2020. The majority of these retirements consist of smaller and older coal units that have not already installed pollution control retrofits. During this same period, CRA modeling finds that the electric sector increases natural gas consumption by 7 Bcf/d in 2020 and by 13 Bcf/d in 2030, as shown in Figure 20.

Figure 20: Electric Power Sector Fuel Consumption



Gas Consumption – Bcf/d

	2010	2015	2020	2025	2030
AEO 2011	20.4	19.1	18.8	18.2	20.1
AEO 2013	20.2	22.1	22.6	23.1	24.4
CRA		24.1	27.3	29.7	32.8

Source: CRA Analysis

5.3. Market Penetration of Natural Gas Vehicles

Historically, natural gas has had little relevance in the transportation sector. However, with the growing spread between diesel and natural gas prices, natural gas is becoming more economical. Despite this trend, infrastructure still limits the rate at which natural gas vehicles (NGV) can penetrate the market.

Natural gas can be used as a transportation fuel in two forms, compressed natural gas (CNG) or liquefied natural gas (LNG). CNG is primarily used in light-duty vehicles (LDVs), like cars, and in medium-duty vehicles (MDV), like buses and small trucks. LNG is targeted more toward heavy-duty vehicles (HDVs), such as freight trucks, because it allows for extended range necessary for such vehicles.[42]

[42] Annual Energy Outlook 2012, Issues in Focus.

To date, natural gas penetration has been low. In 2012, natural gas demand across all vehicle types was only 0.12 Bcf/d, or 0.16% of energy consumed across the transportation sector.[43] The early release of AEO 2013 predicts low natural gas penetration of LDV, but higher penetration in HDVs, as shown in Table 3. The economies of scale provide greater incentives for fleet-based vehicles like buses and freight trucks, but the EIA's projections are conservative and they do not reflect changes already under way in the sector.

Table 3: EIA Projections of CNG/LNG Consumption by Transportation Mode

Mode	2012	2015	2020	2025	2030	CAGR
LDVs-Cars (Bcf/d)	0.06	0.06	0.06	0.06	0.06	0.4%
% of Total Energy	0.1	0.1	0.2	0.2	0.2	
Transit Buses (Bcf/d)	0.03	0.04	0.07	0.09	0.13	*8.7%*
% of Total Energy	10.8	15.0	23.2	32.3	42.2	
School Buses (Bcf/d)	0.00	0.00	0.00	0.01	0.01	4.3%
% of Total Energy	1.0	1.1	1.2	1.4	1.7	
HDV-Freight (Bcf/d)	0.03	0.05	0.06	0.15	0.49	17.3%
% of Total Energy	0.2	0.3	0.4	0.9	2.9	
All (Bcf/d)	**0.12**	**0.15**	**0.20**	**0.31**	**0.69**	**10.4%**
% of Total Energy	**0.2**	**0.2**	**0.3**	**0.4**	**1.0**	

Commercial and government vehicle fleet owners recognize this spread and are looking to NGVs for cost savings. Companies that have made NGV investments have realized benefits such as fuel cost savings, more predictable fuel expenditures, and lower emissions. Such companies come from a range of industries such as transit, refuse collection, and trucking and include UPS[44] and Waste Management.[45] In 2011, governors from 22 states issued an RFP for Ford, GM, and Chrysler to provide NGVs for state-run fleets that are priced comparably to equivalent gasoline models and subject to the same reliability standards.[46] The success of this initiative will drive down vehicle costs. Since then, several companies and municipalities have put out similar RFPs for refueling stations and vehicles.

Looking at the fuel costs alone, NGV adoption makes sense in the HDV market. However, NGV HDVs have a $75,000–100,000 higher sticker price than comparable diesel vehicles, which includes their prorated share of infrastructure costs.[47]

[43] EIA 2013 Early Release.

[44] http://www.pressroom.ups.com/Fact+Sheets/LNG+Fact+Sheet.

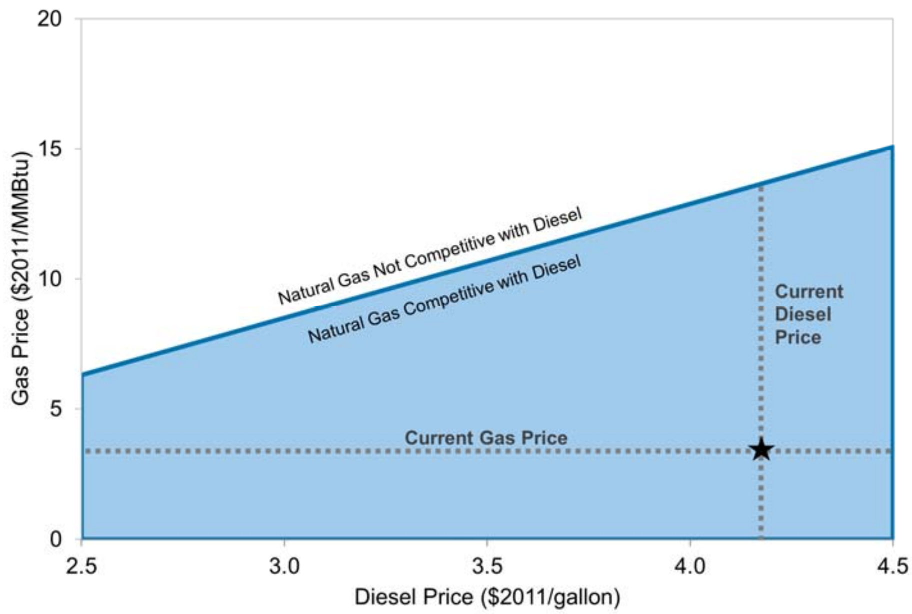
[45] http://www.wm.com/about/press-room/pr2011/20110712_Waste_Management_Reaches_1000th_Natural_Gas_Truck.pdf.

[46] NGV Journal, Governor Mary Fallin.

[47] Price difference and infrastructure costs are based on CRA analysis.

Figure 21 shows CRA's analysis of the break-even cost per mile of natural gas relative to diesel for NGV HDVs.[48] In today's current diesel environment of $4/gallon, the natural gas break-even price at the filling station is $12.5/MMBtu. Note that this analysis focused on HDVs, but similar comparisons can be made for other vehicle types.

Figure 21: NGV Economics vs. Diesel



Source: CRA Analysis

With current market prices well below the line, NGVs are a better investment, but penetration is still low due to in-place diesel fleets and lack of NGV infrastructure. As of May 2012, there were 1,047 CNG fueling stations and 53 LNG fueling stations in the country, only half of which are open to the public. This pales in comparison to the over 157,000 gasoline fueling stations in the United States.[49]

The infrastructure challenge is expected to improve as companies move to build out the necessary technology. Since May 2012, 143 more CNG stations and 13 more LNG fueling stations have been reported by the Alternative Fuels Data Center (AFDC). Clean Energy Fuels Corp. (Clean Energy) is the largest provider of natural gas fuel for transportation in North America. They are a network of 150 LNG truck fueling stations connecting major freight trucking routes across the United States, as shown in Figure 22. Additionally, they have recently partnered with GE, who will finance LNG production facilities. State municipalities and other diversified natural gas companies are also building up infrastructure across the country.

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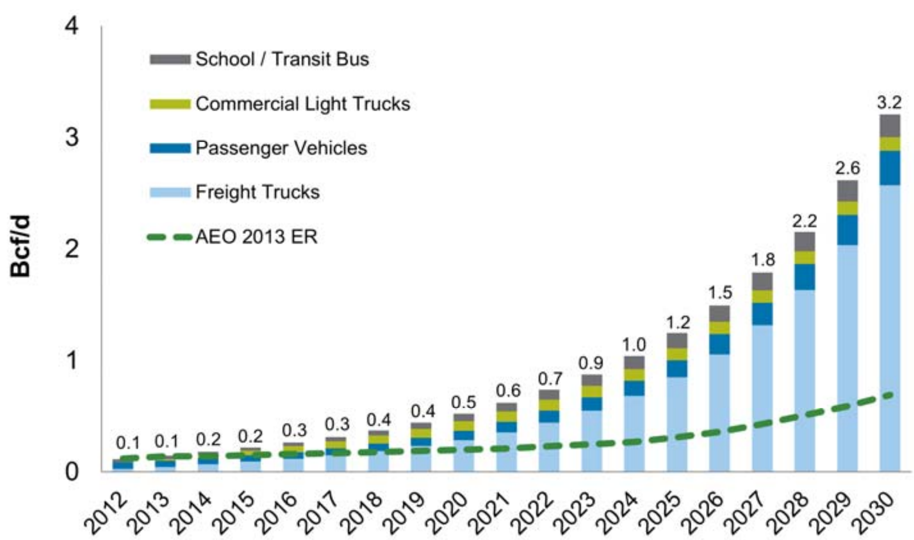
[48] See Appendix A.4 for assumptions and calculations.

[49] EIA 2012 and Alternative Fuels Data Center's Alternative Fueling Station Locator which can be accessed at http://www.afdc.energy.gov/locator/stations/.

Figure 22: Clean Energy's Natural Gas Highway[50]

As shown in Figure 23, we expect the compelling economics for NGVs to drive an infrastructure build-out, leading to 3.2 Bcf/d of natural gas demand by 2030. This rate of penetration implies a market share of 2.2% of the EIA's projected fuel consumption for transit buses, school buses, LDVs, and HDVs in 2020 and 6.0% in 2030.

Figure 23: NGV Gas Demand: CRA vs. AEO 2013[51]



Source: EIA; CRA Analysis

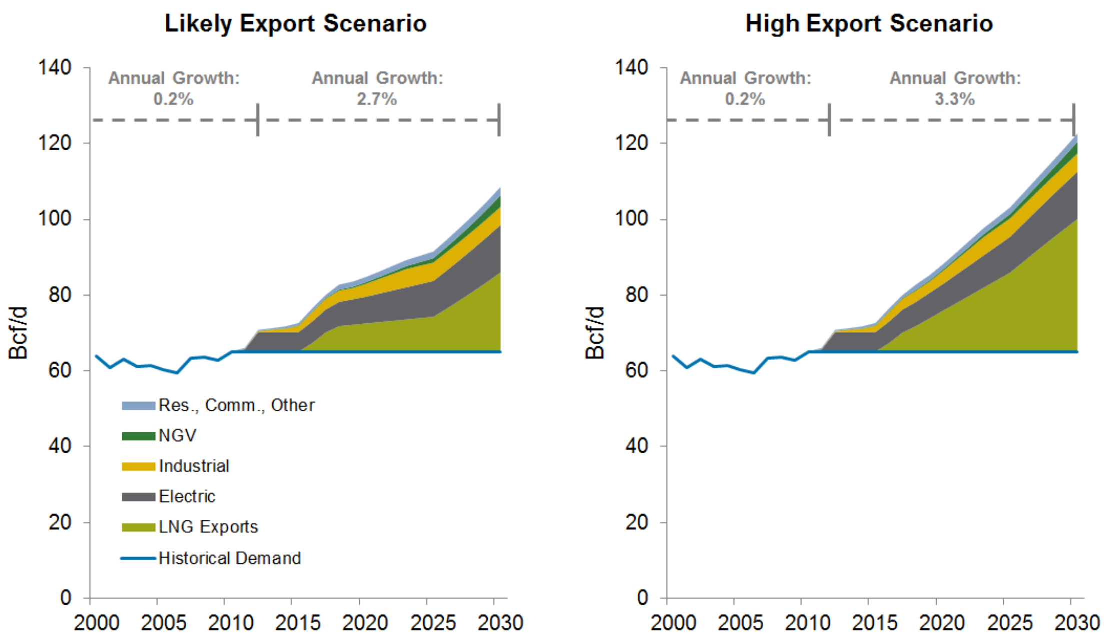
50 Clean Energy Fuels Corp. Q1 2013 Investor Presentation.

51 Based on CRA analysis of penetration rates.

5.4. Cumulative Effects of Demand Drivers

The combination of natural gas demand by the four major drivers—manufacturing, electric generation, NGVs, and LNG exports—is shown in Figure 24. In the Likely and High Export scenarios, demand rises in 2030 to 109.6 Bcf/d and 123.7 Bcf/d, respectively. The Likely Export scenario amounts to an increase of 69% over 20 years, or 2.7% annually, while the High Export scenario amounts to an increase of 91% over 20 years, or 3.3% annually. To put these growth rates into context, US demand grew 1.1% from 1990 to 2010, or less than half of what is projected in these scenarios. During this same period, historical US production grew similarly by 0.9%.

Figure 24: Cumulative Natural Gas Demand under the AEO 2013 ER Gas Price Forecast



Source: EIA; CRA Analysis

Production will need to rise at the same levels as demand for the United States to maintain balance in this scenario. The last time the United States was able to maintain an average annual growth rate of 2.3% or higher for the preceding 20 years was 1980, at which point production was growing from a smaller base.

As we explain in Section 6, this rate of natural gas demand is not sustainable without higher natural gas prices. This is because CRA's analysis of individual shale plays shows that the supply curve is rising, not flat like many commenters contend. At higher prices, demand destruction will occur mostly in the electric and manufacturing sectors because LNG and CNG demand are more immune to natural gas price increases since the competing fuel is refined crude products.

6. Assessment of the Shale Gas Supply Resource and Future Price Implications

For decades, the common understanding was that US natural gas production potential was on the decline. Recent technological advances in horizontal drilling and hydraulic fracturing, however, have reversed this thinking as shale gas has become significantly more economical to access. These technological successes have placed the United States in its current low natural gas price environment of $3–4/MMBtu after a 2002–2009 time period of sustained higher natural gas prices with spikes up to $14.5/MMbtu.

As we have been in a declining price environment for three years now, prognosticators, including the EIA, are changing their forecasts and hypothesizing that shale advancements will flatten the US natural gas supply curve for decades.

In this section, we examine and challenge the notion that the US natural gas supply curve is relatively flat like some commenters to DOE have suggested. We do this by assessing the economics of three different shale types. In addition, we examine the high export demand scenarios under a CRA natural gas supply curve view. We find that this scenario induces significant price increases, which in turn would invoke demand destruction using a fully integrated modeling approach.

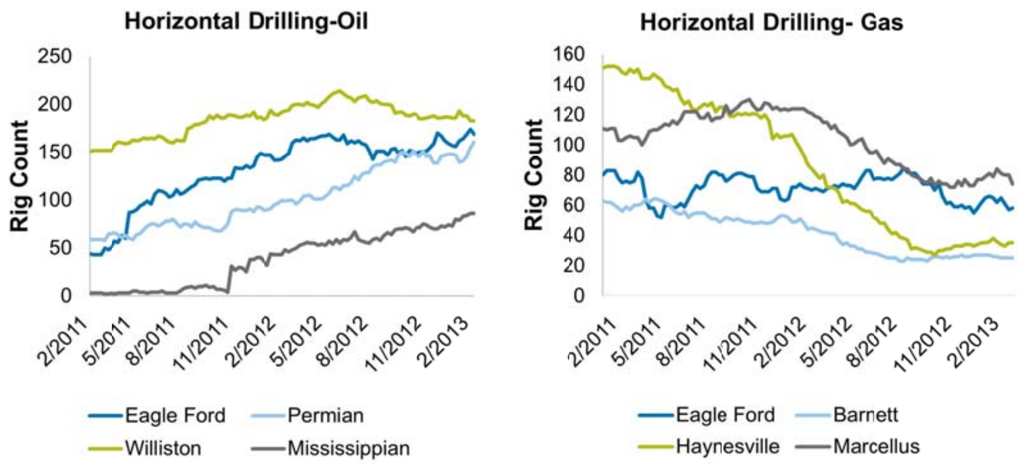
6.1. Assessment of US Shale Supply Curve

Recent natural gas price history and the resulting actions by shale investors show that the shape of the natural gas supply curve is not flat. In April 2012, natural gas prices fell below $2/MMBtu, which represented the lowest nominal price level in almost 10 years. It is important to note that this price was not reflective of the marginal well cost at the time. In fact, there were many wells being drilled at costs above this price. The reason for continued drilling was perceived option value. Natural gas producers needed to produce from leases in order to hold on to them. In addition, producers were fearful of losing leases in the event of a market rebound. As a result, the producers kept drilling. This overproduction coupled with a warm winter left the United States in a massive oversupply situation. Some prognosticators assumed the low price was here to stay, even with LNG exports.[52]

The $2/MMBtu market quickly evaporated as producers losing cash on investments switched drilling from out-of-the-money dry plays to in-the-money wet plays and oil plays. This trend can be seen in the rig counts as they changed by play (see Figure 25). The left side of the figure shows that producers added rigs to oil plays as the profits for dry gas production evaporated. The right side of the chart shows rigs exiting dry gas plays while the rig count in the wet Eagle Ford play remained within its annual range.

[52] "LNG: Cheniere CEO Souki Says US Could See $2 Natural Gas," E&E TV's *OnPoint*, aired 19 March 2012; http://www.eenews.net/tv/transcript/1502.

Figure 25: Changes in 2012 Rig Counts by Oil and Natural Gas Play



Source: Baker Hughes

The above figure shows that natural gas drilling went down across many major plays, except the Eagle Ford shale play, and that oil drilling increased in major plays. This switch was purely for economics as the market no longer supported dry gas production unless it was a by-product of wet gas or oil production. The Eagle Ford play in South Texas is a prime example. In this play, a high percentage of the average production is NGLs and condensate. Natural gas is viewed as a by-product and has no bearing on the economic justification for drilling.

So what does the supply curve look like now that more attention and investment is being directed toward wetter plays? The answer depends on the size of the resource, the relative economics across resources, infrastructure limitations, and intertemporal constraints that limit production in different plays.

In the CRA natural gas model, we use a shale technically recoverable resource (TRR) size of 707.6 TCF that is disaggregated by major plays. The resource size we assume is slightly higher than the 2012 USGS and 2010 NPC Low resource assessments. TRR is a category often used to size a natural resource and is defined as the volume of natural gas that is recoverable using current exploration and development technology. TRR does not represent the amount of resources that are economically recoverable.

In terms of relative economics, each shale play by its own nature has a different production cost due to four overriding characteristics:

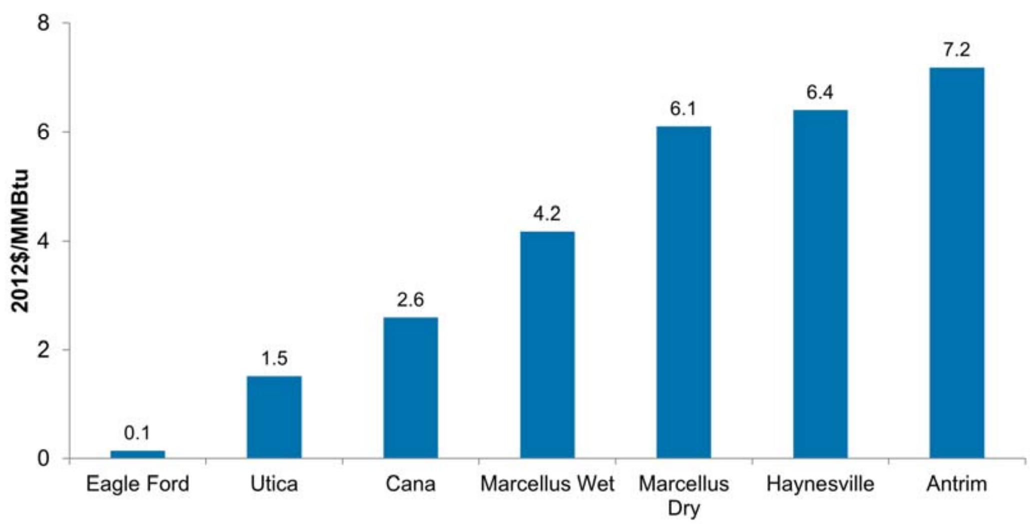
- **Well cost:** the cost to drill a well and fracture the shale rock containing dry gas, natural gas liquids, and/or condensate.
- **Initial production (IP) and decline rates:** the rate at which dry gas, NGLs, and condensate are produced. The typical reported figure is the 30-day IP rate; for shale, the decline rate is very steep (60%+) over the first year.
- **Natural gas liquid (NGL) production:** NGLs include ethane, propane, normal butane, isobutane, and pentane. The pentanes with a few hexanes are called natural

gasoline, which typically has an API gravity of ~80 and is used as a direct gasoline blend stock (hence the name) or as petrochemical feedstock. Plays containing a lot of NGLs are considered wet plays as compared to those containing few NGLs, or dry plays.

- **Condensate production:** Condensate is like a very light crude oil; it primarily contains hydrocarbons heavier than pentanes and has an API gravity around 55. Condensate trades closer to crude than NGLs.

Other important factors in determining the average cost of a shale play include environmental costs, operation and maintenance costs, taxes and royalties, and the discount rate. Figure 26 shows the levelized cost of producing an average well for seven shale plays. These costs do not represent the better or worse performing locations within a play that result from natural variations in cost and performance.[53]

Figure 26: Average Cost of Production of Different Shale Plays



Source: CRA US Gas Model

New conventional onshore and offshore natural gas plays, along with many tight gas and coalbed methane plays, generally are not competitive with shale. As a result, shale dominates the cost structure of the US resource base and drives the shape of the natural gas supply curve. This figure therefore illustrates that the US natural gas supply curve is upward sloping and not flat.

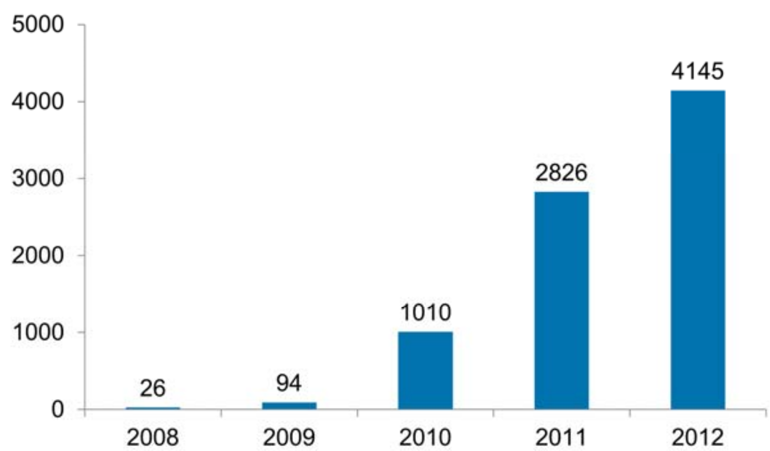
It is important to note that future regulations also can change the shape of the supply curve (these are not reflected in Figure 26). For example, a number of relevant regulatory proposals are currently under consideration by several federal agencies, including the Department of the Interior and the Environmental Protection Agency, as well as by various state legislative

53 The levelized cost of production represents the cost a producer would need to achieve in order to receive the return necessary to cover capital costs along with fixed and variable costs.

and regulatory authorities. These regulations would raise the cost of supply and impact the slope of the supply, depending on how they are distributed at the state or federal level.

Two other factors that can drive the shape of the natural gas supply curve, especially in the short term (one to three years), are intertemporal and infrastructure limits. Intertemporal limits represent constraints such as the movement of labor, capital, and equipment to a play. Activity in the Eagle Ford play serves an example. While it is one of the lowest-cost plays, it did not ramp up immediately. Instead, it took three years to go from 94 permits to 4,145 permits as shown in Figure 27.

Figure 27: Eagle Ford Drilling Permits Issued



Source: http://www.rrc.state.tx.us/eagleford/index.php

Finally, infrastructure constraints or hard assets also limit what would be optimal production levels from economic plays. Continuing with the Eagle Ford example, the dry gas TRR is approximately 50 TCF based on EIA/US Geological Survey estimates. The Eagle Ford resource, therefore, could supply US natural gas demand for two years. Infrastructure constraints (e.g., natural gas processing plants and pipelines) of moving all the natural gas from South Texas to the rest of the United States, however, would make this impossible.

The cost structure of different plays along with infrastructure and intertemporal constraints explain why the supply curve often is not reflective of the lowest-cost natural gas resource. The combination of these factors creates an upward sloping supply curve.

6.2. Forecast of Natural Gas Prices

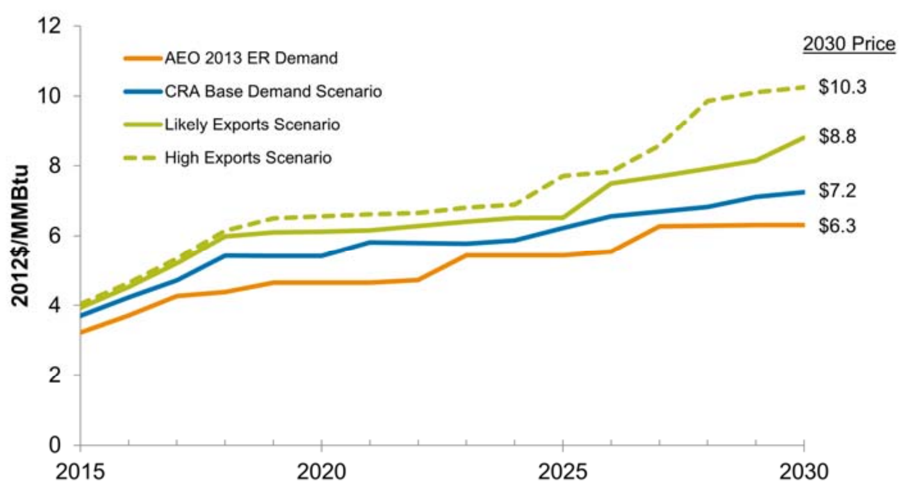
In this section we forecast natural gas prices through 2030 under one base scenario and three higher-demand scenarios. To do so, we use our natural gas model, which includes cost and performance outlooks for shale plays and subplays, resource size, and intertemporal constraints. Table 4 shows the three scenarios that we examine:

Table 4: Future US Demand Scenarios

Demand Scenario	Description	Cumulative 2013–2030 Natural Gas Consumption (Tcf)
AEO 2013 ER	EIA's latest forecast for US natural gas consumption is matched. This includes EIA's projection of approximately 4 Bcf/d of LNG exports by 2030.	480
CRA Demand	Includes CRA's adjustments on AEO 2013 ER's demand projections for electric generation, NGVs, and manufacturing sectors as described in Section 5.	540
Likely Export Scenario	US LNG exports reach 9 Bcf/d by 2025 and 20 Bcf/d by 2030. This is added on top of the CRA Demand scenario.	580
High Export Scenario	US LNG exports reach 20 Bcf/d by 2025 and 35 Bcf/d by 2030. This is added on top of the CRA Demand scenario.	630

The modeling results from our scenario analysis are shown in Figure 28.

Figure 28: Results from Demand Scenario Analysis



Source: CRA Analysis

Figure 28 shows that all four scenarios begin at \$3–4/MMBtu in 2015, but diverge to a range of \$6.3-10.3/MMBTU by 2030. In the Likely Export scenario, prices more than double from current prices. The High Export scenario shows that prices almost triple from current prices in today's dollars.

It is important to note that our analysis does not incorporate demand feedbacks (demand destruction) caused by higher prices. In the two higher-demand scenarios, rising prices would result in some demand destruction from the demand projection modeled. The two sectors most elastic to rising prices are the electricity generation and manufacturing sectors. NGVs and then LNG exports would be less impacted as they compete closer to oil-price parity. For the electricity sector, coal and renewable generation would increase to offset any price-induced decrease in natural gas generation. For the manufacturing sector, natural gas–intensive manufacturers would reduce production or relocate. The economic impacts of the trade-off between LNG exports and energy-intensive manufacturing and manufacturing's sensitivity to natural gas prices are illustrated in Section 2 and Section 3. Our analysis clearly shows that the GDP, employment, and trade balance improves more with manufacturing than with LNG exports, assuming the same level of natural gas demand.

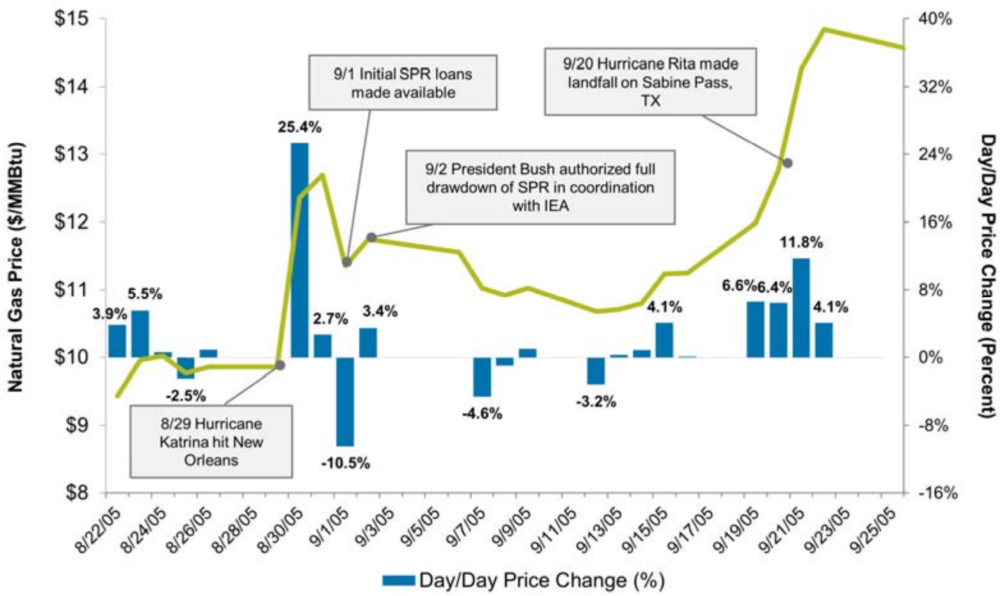
6.3. Impact of US LNG Exports on Domestic Natural Gas Price Spikes

The potential for price spikes resulting from exporting LNG is important to address. We define price spike as times of high price volatility outside the typical range. Here, we discuss the potential for price spikes that would result from LNG exports by examining times of gas shortage to meet domestic.

Price spikes are driven by the margin or tightness between supply and demand and are frequently driven by expectations rather than current reality, and expectations of increased demand often outpace expectations of increased supply since supply takes years to come online. Natural gas traders routinely count increased demand as soon as the contracts are signed, even though the contracts may run for years and the actual level of demand will not increase significantly for several years down the line. That is, expectations run far ahead of reality on the demand side. In contrast, traders and other market participants recognize that it will take years for new production and pipelines to come online and supply to increase. So, on the supply side, expectations and reality are more closely aligned. These dynamics exacerbate price spikes during inflection periods (i.e., periods of market change).

In recent years we have witnessed price spikes where markets price in opportunity cost due to known and perceived supply constraints. Hurricanes Katrina and Rita in August and September 2005 serve as useful examples. Days in advance of Hurricane Katrina entering the Gulf of Mexico, natural gas prices began to rise. The same result occurred for Hurricane Rita. Figure 29 depicts how dramatically energy commodity prices fluctuated during this event.

Figure 29: Effect of Hurricane Katrina and Hurricane Rita on Natural Gas Prices



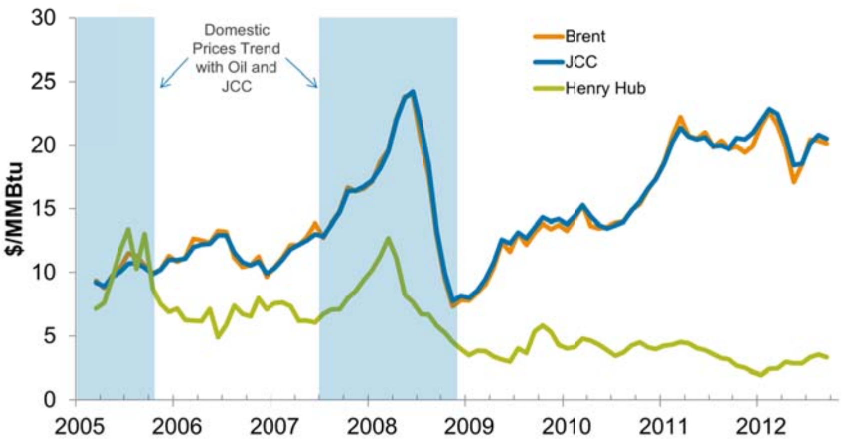
Source: EIA; CRA Analysis

The Rita and Katrina example given is short term in nature, but reflects how energy traders price in the presumed impacts of an event. This example provides insight into what could potentially happen on a long term basis if the United States oversells its natural gas capabilities with long-term LNG sales. That is, large increases in natural gas demand from LNG exports could tighten the US supply-demand balance to where spikes above the average range of volatility will occur. The reason is that, once the LNG export commitments are made, the means of solving domestic supply issues are limited. The NERA Report does not address the take-or-pay nature of the contracts and is acutely skeptical about demand increases (other than from exports) and profoundly optimistic about new supply.

Short-term price spikes could occur as well prior to a terminal's operation. The reason stems from the economic principle of opportunity cost. By selling a natural gas molecule now instead of in the future (when prices are expected to be higher due to increased demand all else equal), the seller gives up on a more profitable opportunity. The discounted price differential between the future and now is the opportunity cost that gets priced into the market.

We recently witnessed these short-term price spikes and a higher gas price trend from 2002 to 2009. During this period, the United States was supply short and required net imports of LNG. Market participants then feverishly began building LNG import terminals based on an expectation that the United States would need, at the margin, to buy LNG. This drove natural gas price ups markedly. The result was periods where gas prices reflected LNG import prices, which were based on oil indices.

Figure 30: Henry Hub Linkage to Brent and JCC Prices During Times of Short Supply



Source: EIA; Bloomber

In conclusion, we recommend that further investigation be given to likelihood of price spikes tied to LNG export facilities. In particular, analyzing the degree of the price spikes and the duration of occurrence would be important to understanding their detrimental impact to the US economy. Such a study would provide a better understand as to the ramifications of connecting domestic gas supply with the global LNG market that is indexed to higher regional gas prices and oil.

7. Conclusions

Our analysis disproves the notion that the shale-driven natural gas supply curve is flat and instead shows that it is upward sloping. The result is that natural gas prices will rise under an extremely conservative demand outlook, such as the one projected in the AEO 2013 ER (see Figure 28). Under a more reasonable demand forecast, we find that gas prices will almost double from $3.3/MMBtu today to $6.3/MMBtu by 2030. Layering in additional demand from LNG exports in the Likely and High Export scenarios would raise prices to $8.8/MMBtu and $10.3/MMBtu in 2030, respectively, assuming no price-induced demand feedback.

At these higher scenario prices, growth in the three main sectors driving the natural gas economy going would be stunted:

- **Manufacturing –** A significant, gas-intensive sub-sector exists that will be challenged in passing through high natural gas costs in the competitive, global market. This is illustrated in our ammonia case study. Manufacturers will look to establish new plants and relocate existing operations in more favorable gas markets around the world. The historical precedence of companies exiting US manufacturing is well documented and can happen again if LNG exports rise too high.
- **Electric Generation –** For the electric sector, generation providers will migrate to other generation technologies, such as wind and nuclear, but only at higher relative costs. This will raise prices for the full spectrum of electricity consumers. Our results show that electricity prices in 2030 will increase 60-170% in the Likely Export scenario and will increase 70-180% in the High Export scenario. The wide variation is due to differences in regional electricity markets.
- **Natural Gas Vehicles –** As shown in earlier in Figure 21, NGV HDVs are economical at delivered natural gas prices below $14/MMBtu at current diesel prices of $4.2 per gallon.[54] While this is well above our Henry Hub natural gas price forecast in 2030, the costs of pipeline transportation and compression and liquefaction services will raise the delivered price. CRA estimates that these costs could be $3–4/MMBtu, which would put NGV economics at the margin under the High Export scenario.

LNG exporters are the most immune to higher natural gas prices. Asian LNG import prices are tied tightly to an oil index, which currently trades around $20/MMBtu. Subtracting the costs of liquefaction, shipping, and regasification (netback costs) of $6/MMBtu, exports to Asia are attractive with domestic natural gas prices up to $14/MMBtu. This netback price is well above our 2030 Henry Hub forecast price across all scenarios and, as a result, would induce LNG exports.

We find that the economy will lose at the expense of the sizable LNG exports modeled in the Likely and High Export scenarios. The manufacturing sector serves as an example of the unintended loss that would occur as the economic benefits of increased manufacturing in the US economy are superior to LNG exports. These benefits are highlighted in Section 2 and recounted below:

[54] Average US retail diesel price is from EIA as of 18 February 2013. See http://www.eia.gov/petroleum/gasdiesel/

Manufacturing's Economic Contribution Advantage Relative to LNG Exports

- **Higher GDP.** Manufacturing produces $4.9 billion of additional, direct GDP, which is at least double the GDP contribution of LNG exports at the same level of natural gas consumption.
- **High Employment Added.** Manufacturing investment is significantly higher than the investment required for LNG terminals at a given level of gas demand. At an additional 5 Bcf/d, manufacturing would produce more than 180,000 jobs in the economy compared to 22,000 for LNG exports. In addition, construction jobs would increase by a factor of 4 to 5 relative to LNG exports.
- **Reduced Trade Deficit.** Announced manufacturing projects would reduce the trade deficit by $52 billion annually, compared to $18 billion for exporting the same level of natural gas as LNG. This discrepancy is important for a country focused on expanding exports and reducing imports.

Our analysis of the NERA Report reveals that they did not properly reflect these benefits. The reason is that NERA made two fundamental flaws in its assumptions:

- **NERA did not separately represent the gas-intensive components of the manufacturing sector.** Like NERA, CRA has a computable general equilibrium model and understands the nuances of the model they employed. NERA grouped gas-intensive manufacturing with a much larger subset of manufacturing. This grouping produced a weighted average representation that muted the impact of sectors highly sensitive to changes in gas prices. NERA's authors are well aware of the "averaging" impact as stated in public testimony.[55]
- **NERA massively overestimated both the netback costs of delivering US exported LNG to Asian markets and the price elasticity of Asian importers.** The result from NERA's overestimations was that LNG would be exported only under extreme scenarios of supply and/or demand shocks. This finding is contrary to market signals. The magnitude of LNG export terminal applications reveals a strong interest in LNG export investment, and it is not likely that proposed exporters are banking on extreme scenarios in order to satisfy their required return on investment. LNG investors have already seen their investments turn sour with the substantial overbuild of US LNG import capacity. As a result, they likely are applying a healthy amount of discounting to their bullish view on US LNG export potential.

These flaws likely were critical in driving the outcome of NERA's modeling results. These flaws should be taken into consideration when weighing the merits of the NERA Report.

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[55] *Prepared Testimony of W. David Montgomery, before the Committee on Energy and* Commerce *Subcommittee on Energy and Environment, U.S. House of Representatives, Hearing on Allowance Allocation Policies in Climate Legislation* (9 June 2009) at 3, available at http://democrats.energycommerce.house.gov/Press_111/20090609/testimony_montgomery.pdf.

In conclusion, we believe that the United States will have to consider trade-offs in its assessment of the public interest of LNG exports as there is a finite natural gas resource, a non-flat supply curve, and significant options for increased demand. These trade-offs are highlighted in our report. In particular, we show the unintended consequences of high LNG export scenarios, namely lower economic benefits of GDP, employment, and trade balance. Our finding is that, if left unmonitored, high LNG exports could prevail at the cost of the broader economy.

Appendix A: Additional Data Tables and Figures

A.1 LNG Export Applications Filed with DOE, as of January 30, 2013

Project	State	Quantity (Bcf/d)	Existing or Green Site	Cost ($Billion)
Main Pass Energy Hub, LLC	LA	3.22	Existing	$14.0
Gulf Coast LNG Export, LLC (i)	TX	2.8	Green	$12.0
Golden Pass Products LLC	TX	2.6	Existing	$10.0
Sabine Pass Liquefaction, LLC	LA	2.2	Existing	$6.0
Cheniere Marketing, LLC	TX	2.1	Green	$13.8
Trunkline LNG Export, LLC/ Lake Charles Exports, LLC *	LA	2	Existing	$5.7
Cameron LNG, LLC	LA	1.7	Existing	$6.0
Gulf LNG Liquefaction Company, LLC	MS	1.5	Existing	$7.0
Freeport LNG Expansion, L.P., and FLNG Liquefaction, LLC	TX	1.4	Existing	$10.0
Freeport LNG Expansion, L.P., and FLNG Liquefaction, LLC (h)* Additional requested	TX	1.4	Existing	
Excelerate Liquefaction Solutions I, LLC	TX	1.38	Existing	$1.4
LNG Development Company, LLC (Oregon LNG)	OR	1.25	Green	$6.3
Jordan Cove Energy Project, L.P.	OR	1.2	Green	$5.0
Pangea LNG (North America) Holdings, LLC	TX	1.09	Green	$6.5
CE FLNG, LLC	LA	1.07	Green	
Dominion Cove Point LNG, LP	MD	1	Existing	$1.4
Magnolia LNG, LLC	LA	0.54	Green	$2.2
Southern LNG Company, L.L.C.	GA	0.5	Green	
Gasfin Development USA, LLC	LA	0.2	Green	
Waller LNG Services, LLC	LA	0.16	Green	
SB Power Solutions Inc.		0.07	Green	
Carib Energy (USA) LLC		0.03	Green	

A.2 Economic Contributions of Manufacturing Activity Consuming 5 Bcf/d Compared to LNG Terminals Exporting 5 Bcf/d

Manufacturing Activity

State	# Projects	Investment (Millions)	Natural Gas Demand Bcf/d	Direct Employment	Construction Employment
LA	19	$41,668	2.401	4,288	31,825
TX	31	$22,667	0.870	2,308	35,381
OH	6	$1,783	0.020	690	2,486
MN	2	$1,650	0.083	615	1,310
ND	3	$2,980	0.330	226	2,809
IA	2	$3,100	0.280	223	6,233
PA	4	$2,257	0.048	213	2,287
AL	2	$540	0.002	206	696
IN	2	$1,590	0.194	189	1,350
AR	2	$215	0.004	88	472
TN	3	$502	0.031	59	794
CA	1	$49	0.000	25	108
WV	1	$300	0.008	23	283
IL	2	$120	0.007	17	264
NC	2	$32	0.001	7	44
OK	1	$19	0.012	4	18
MI	1	$3	0.000	2	7
GA	1	$3	0.000	0	7
Location under Consideration	*10*	*$10,083*	*0.511*	*1,018*	*13,348*
Total	**95**	**$89,560**	**4.803**	**10,199**	**99,721**

*Note that the employment impacts have not been scaled to 5 Bcf/d and therefore do not match what is seen in the figures and main body of the report.

LNG Exports

State	Investment (Millions)	Direct Employment (jobs/yr)	Construction Employment (person-yrs)
TX	$8,970	325	9,940
LA	$7,790	285	8,635
OR	$1,720	60	1,905
MS	$1,050	40	1,170
MD	$700	25	780
GA	$350	15	390
Total	**$20,580**	**750**	**22,820**

A.3 About the Input-Output Model IMPLAN

IMPLAN is a widely used, peer-reviewed model that represents the interactions between the different sectors of the economy and shows how direct spending in specific sectors filters through the economy creating additional value. IMPLAN presents results as “direct, indirect or induced” impacts. Indirect impacts are those along the supply chain. Induced impacts are primarily the result of employees spending their incomes in the local economy. Induced impacts are not included anywhere in this report.

About IMPLAN

IMPLAN (IMpact analysis for PLANning) was originally developed by the US Department of Agriculture Forest Service in 1979 and was later privatized by the Minnesota IMPLAN Group (MIG). The model uses the most recent economic data from public sources such as the US Bureau of Economic Analysis (BEA), the US Department of Labor’s Bureau of Labor Statistics (BLS), and the US Census Bureau. It uses this data to predict effects on a regional economy from direct changes in employment and spending. Regions, or study areas, may include the entire US, states, counties, or multiple states or counties. Over 500 sectors and their interactions are represented in the data set.

Details of the IMPLAN model can be found on their website: www.implan.com

A.4 Natural Gas versus Diesel Fuel Breakeven Analysis

CRA conducted a breakeven analysis for an LNG HDV under certain assumptions at various diesel and delivered natural gas prices. Assumptions were based on publicly available data and CRA research. While the analysis was done with assumptions made for HDVs, similar calculations can be done for smaller vehicles as well. Assumptions and explanations are noted in black text in Table 5.

Table 5: Inputs to Breakeven Analysis

Criteria	Diesel	Natural Gas	Notes
Capital Cost ($)	100,000	200,000	Capital cost for NGV includes share of infrastructure cost[56]
Lifetime (Years)	20	20	
Efficiency (Miles/Gallon)	8.00	7.27	10% fuel efficiency decrease for natural gas vehicle
Miles Travelled (Miles/Year)	120,000	120,000	50 weeks/year, 5 days/week, 8 hours/day, at 60 miles/hour
Fuel Consumed (Gallons/Year)	15,000	16,500	Diesel equivalent gallons

*Assumes operating and maintenance costs are assumed to be an equivalent percentage of capital for both diesel vehicles and NGVs.

[56] CERA, 2012, *Natural Gas Vehicles Poised to Penetrate US Long Haul Trucking*, states an incremental cost of $40,000–75,000.

Attachment B

Presentation of Professor Wallace Tyner

PURDUE UNIVERSITY

Economic and Environmental Impacts of Increased U.S. Natural Gas Exports

Wallace E. Tyner
James and Lois Ackerman Professor
Global Policy Research Institute
Purdue University

Shale Gas Benefits

- Shale gas is a game changer.
- It is part of the reason behind the manufacturing resurgence in the U.S.
- It will stimulate much more conversion of old coal fired electric power plants in the U. S. to natural gas, thereby providing environmental benefits.
- The IEA estimates that shale gas done right is only 7% more expensive than business as usual, so it can be done with minimal adverse environmental impact.

Impacts of Increased Natural Gas Exports

- Free trade is beneficial in almost all cases from a global perspective.
- However, that does not mean that free trade in all cases is good for every country. In fact, there are many examples of countries or regions losing from trade liberalization.
- The question, then, is what are the impacts on the U.S. economy and environment of permitting increased natural gas exports.

Impacts of Increased Natural Gas Exports

- We use a model called MARKAL-Macro to evaluate the impacts of increased natural gas exports.
  - MARKAL is a bottom-up energy model that solves for the lowest cost mix of meeting energy service demands over the specified time horizon.
  - MARKAL-Macro adds a macroeconomic sector to provide two way feedback on energy service costs and demands.

Impacts of Increased Natural Gas Exports

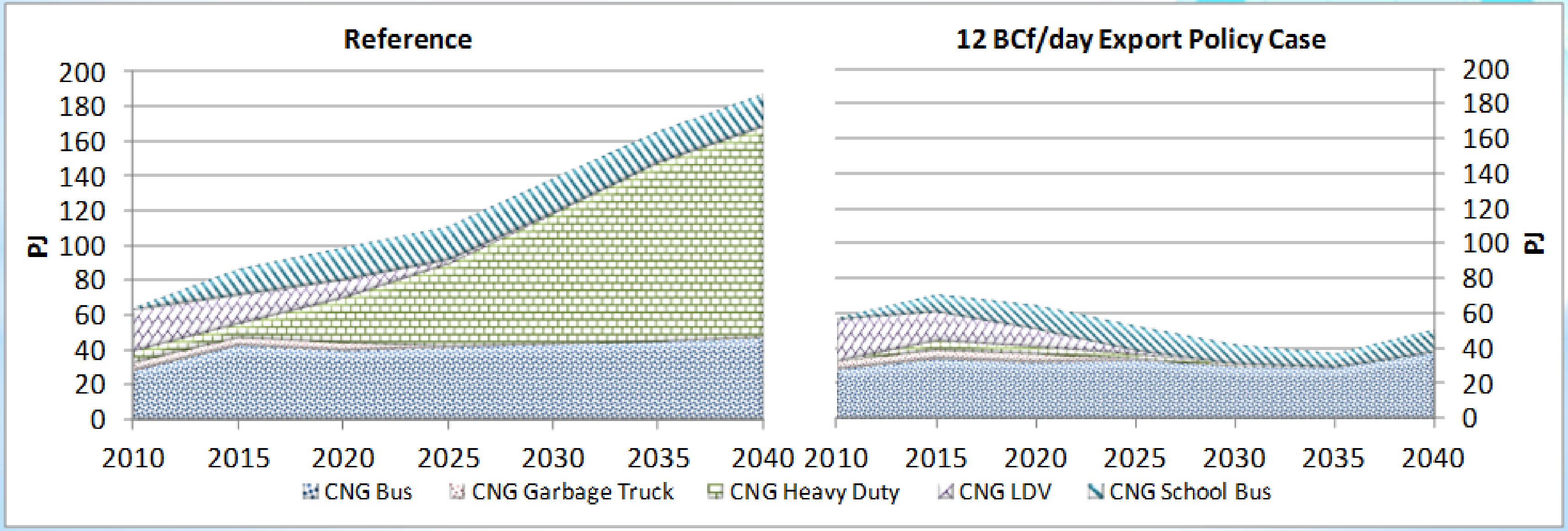
- We conducted our analysis for three cases: export increases of 6, 12, and 18 BCF/day.
- Our results suggest that all of these levels of increased export actually reduce GDP by a small amount – 0.04%, 0.11%, and 0.17% for the year 2035 for the three cases respectively.
- Natural gas prices increase 16%, 41%, and 47% for the three cases.
- The biggest change in the energy resource mix is less domestic use of gas and more use of coal.

Electricity Sector Impacts of Increased LNG Exports

- The main impacts are higher electricity prices and higher GHG emissions with higher exports.
  - Electricity prices are 1.1%, 4.3%, and 7.2% higher than in the reference case for the three export levels.
  - The change in GHG emissions varies over the time period and by level of exports, but ranges between +2% and +12%.

Transportation Impacts of Increased LNG Exports

- Transport use of CNG rises substantially in the reference case, is flat in the 6 BCF export case, and declines in the 12 and 18 BCF/day cases.
- The main impact is on LNG use for trucks

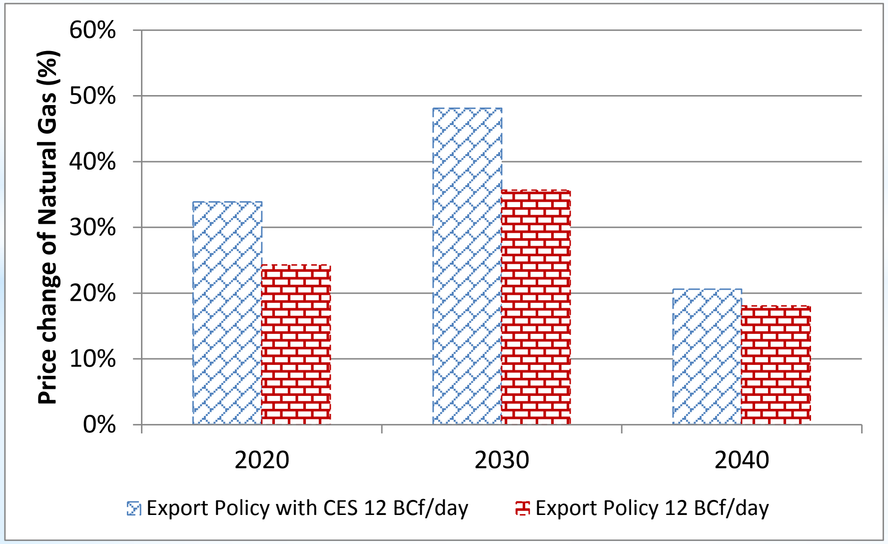


Energy Intensive Sector Impacts of Increased LNG Exports

- Energy use in the manufacturing sectors is a proxy for level of economic activity.
- Energy use declines in primary metal, non-metals manufacturing, paper, and chemicals
- For the 12 BCF/day case, the declines range from 2 to 3.1%.

Combination of Clean Energy Standard and Increased LNG Exports

- Imposition of the CES by itself leads to increased natural gas prices because of the greater use of gas for electricity.
- The combination of CES and increased exports causes the electricity price increase to be greater



DOE-NERA Study

- This study concluded that there is a net economic gain from LNG exports, about $12 billion.
- For 2030, labor and capital income and indirect taxes fall about $45 billion, and natural gas resource income and net transfers increase about $57 billion.
- Wage income falls in agriculture, energy intensive sectors, and the electricity sector. The % wage declines are greater than the increase in net national income.
- Natural gas price increases always < 20%.

Comparison of NERA and Purdue Analyses

- Different models, different data sets, and different model parameters.
- Many differences, but some similarities. Income change in both is small – positive in NERA and negative in Purdue MARKAL-Macro.
- Purdue MARKAL-Macro gets much larger natural gas price increases than NERA.
- Trade policy changes are as much about who wins and who loses as about the net change.

Comparison of NERA and Purdue Analyses

- We agree that the global net impact is positive from larger US exports, but differ in the direction of impact on the US – driven mainly by the size of natural gas price increases.
- Within the US, there is also the distributional question. Winners are natural resource owners, and losers are labor and capital in other sectors.
- NERA does not estimate changes in GHG emissions, but US emissions clearly increase with higher LNG exports.

Conclusions

- Whether the net gains are positive or negative, they are quite small.
- Decisions must turn at least partly on distributional issues.
  - With such a large drop in labor income (NERA), and the high unemployment rate in the US, this is an important issue.
- Policy makers need to be cautious in approving higher LNG exports.