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U.S. Department of Energy (FE-34)
Office of Natural Gas Regulatory Activities
Office of Fossil Energy
P.O. Box 44375
Washington, DC 20026-4375

SUBJECT: **2015 LNG Export Study – Comments of the American Petroleum Institute**

These comments are submitted by the American Petroleum Institute (API) in response to the request by the Department of Energy (DOE) for comments on the report "The Macroeconomic Impact of Increasing U.S. LNG Exports" performed by the Center for Energy Studies at Rice University's Baker Institute and Oxford Economics, hereafter called the DOE 2015 report. The API generally agrees with most of the conclusions of the DOE 2015 report. The DOE 2015 report concludes that across all scenarios, the United States stands to gain net economic benefits from allowing LNG exports. Further, that those economic benefits increase with larger volumes of LNG exports. This is a conclusion that is supported by virtually all the studies preceding the DOE 2015 study. The DOE 2015 report also reaffirms the main conclusions of the DOE commissioned Energy Information Administration 2014 report "Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets," which concluded that LNG exports increases economic output with only a very modest increase in expenditures of domestic consumers of natural gas and electricity.[1]

The unique feature of the DOE 2015 study, however, was the fact that it examined LNG export volumes that were significantly greater than previous studies and the fact that the responses of international natural gas markets and international economies were taken into

[1] Energy Information Administration (2014) "*Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets.*" at 12.

account in the impact analysis. The DOE 2015 study clearly demonstrates that even at 20 billion cubic feet per day (bcfd) or even 28 bcfd of LNG exports, the overall economic impacts are positive. The rise in domestic natural gas prices as a result of LNG exports of 28 bcfd are minimal and any potential negative impact of higher natural gas prices on energy intensive manufacturing industries is not large enough to alter the trend in expected output growth for that sector.

The one area where the API does not agree with the DOE 2015 report is in the magnitude of the impacts shown for specific key variables. The API believes that based on DOE's own analysis, the natural gas price impacts shown in the DOE 2015 report could be smaller. Recent historical trends in natural gas production mimic the High Resource Case more than the Reference case used in the DOE 2015 analysis. Moreover, other third party estimates of the domestic natural gas resource base point to a more robust resource base than the resource base assumed in the Reference case in the DOE 2015 report. With a larger resource base, the price impacts would likely be smaller. Also, the DOE 2015 report explicitly states that the analysis of NGLs (natural gas liquids) is omitted. This omission means that the economic impact of LNG exports are underestimated because the increased NGL that results from increased natural gas production to support LNG exports could be exported and/or used to lower input costs for domestic energy intensive manufacturing industries.

The vast supplies of natural gas resources that are now available as a result of the shale gas revolution have fundamentally changed the energy equation, positioning the United States as an energy superpower that can provide ample, affordable supplies to the domestic market and provide for exports to strategic allies with whom a free trade agreement does not exist, including Japan and partners in Europe. Furthermore, the Natural Gas Act creates a presumption that natural gas exports are in the public interest. The burden is on opponents to overcome this presumption – not the other way around. The comments from the opposition are speculative and without merit, and fail to overcome the statutory presumption in favor of exports. Furthermore, each day that we delay affirmative decisions on export applications puts U.S. projects at a competitive disadvantage in the global race to construct LNG facilities. Therefore, DOE should move expeditiously toward the approval of all pending LNG permits.

I. Abundant U.S. Natural Gas Supply and the Global LNG Market Will Serve to Effectively Constrain Prices.

a. There is strong evidence to support the DOE 2015 report conclusion that LNG exports will be met with expanded domestic natural gas production rather than reduction in U.S. consumption.

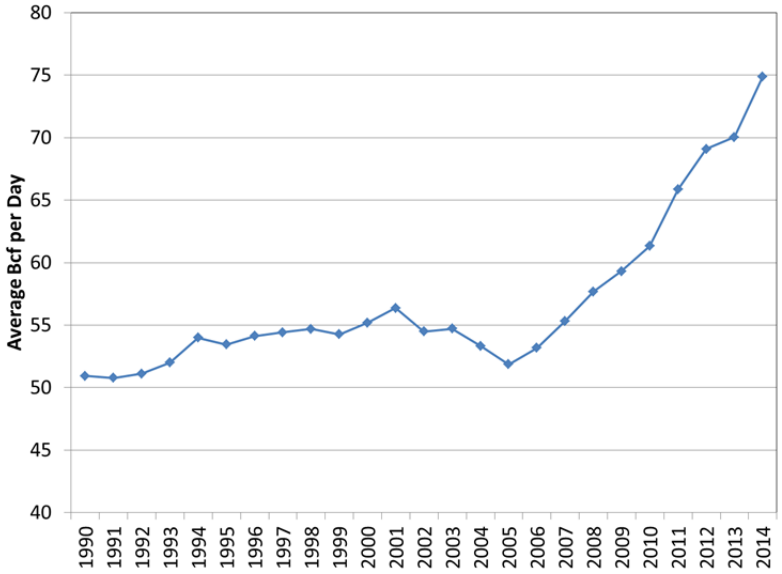
One Key Findings of the DOE 2015 study is that " … the majority of the increase in LNG exports is accommodated by expanded domestic production rather than reductions in domestic demand".[2] This is a conclusion that is overwhelmingly supported by virtually all the studies that have been published on the impact of increasing LNG exports.[3] Unlike the previous studies, however, the unique contribution of the DOE 2015 study is the fact that even at 20 and 28 bcfd of LNG exports, it is increases in domestic production rather than decreases in demand that is supporting LNG exports.

The U.S. domestic natural gas industry has clearly shown that it can ramp up natural gas production quickly. As shown in Figure 1, since 2006 U.S. natural gas production trends have rapidly increased due to production from shale gas formations resulting from widespread application of two key technologies, horizontal drilling and hydraulic fracturing.

[2] DOE Report 2015 at 8.

[3] Examples of previous studies include: ICF International, "*U.S. LNG Exports: Impacts on Energy Markets and the Economy*" (2013), NERA Economic Consulting, "*Macroeconomic Impacts of LNG Exports from the United States*" (2012), Deloitte, "*Made in America, The Economic Impact of LNG Exports From the United States*" (2011), James A. Baker III Institute for Public Policy Rice University, "*US LNG Exports, Truth and Consequence*" (2012), Energy Information Administration, "*Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets*" (2014), Navigant Consulting, "*Market Analysis for Sabine Pass LNG Export Project*" (2010)

Figure 1
U.S. Natural Gas Marketed Production



In 2005, U.S. marketed natural gas production averaged under 52 bcfd. By 2014, average U.S. marketed production grew by over 23 bcfd to nearly 75 bcfd, which equates to a 44 percent increase in just nine years. Three of the years, 2011, 2012, and 2014, had annual production increases in excess of 3.5 bcfd, Within all of the scenarios that are analyzed in the DOE 2015 report, annual growth in net U.S. LNG exports are never greater than 1.7 bcfd per year or less than half of recent year over year U.S. natural gas production increases.

b. **The U.S. natural gas resource base assumed in the DOE 2015 report is conservative and even the High Resource Case resource amounts are less than other 3rd party estimates.**

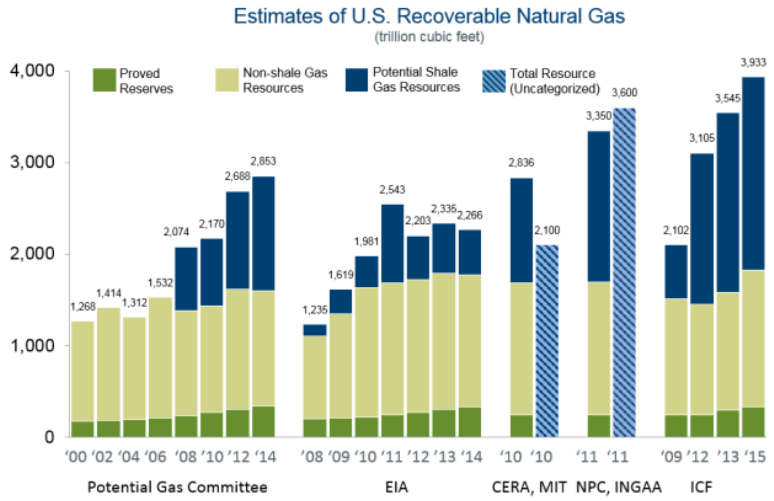
The total U.S. natural gas resource base assumed in the DOE 2015[4] report is 2,075 trillion cubic feet (Tcf) in the Reference case, 1,831 Tcf in the lower gas resource recovery (LRR) case, and 2,525 Tcf in the higher gas resource recovery (HRR) case.[5] The total resource base includes an accessible shale gas resource

[4] Available natural gas resource assumed is based on the earlier Energy Information Administration, "*Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets*" (2014)
[5] DOE Report at 2015

totaling 829 Tcf in the Reference case, 688 Tcf in the LRR case, and, 1,182 Tcf in the HRR case.

These resource estimates are conservative in comparison to other reputable third party estimates. The Potential Gas Committee's (PGC) biennial U.S. natural gas estimate for year-end 2014 (both resource base and reserves) totals 2,853 Tcf —161 Tcf higher than its 2012 assessment—the largest level in its 50-year history. The shale gas portion of PGC's resource base totals 1,253 Tcf. At current levels of consumption, the Potential Gas Committee's assessment indicates that the United States has over 100 years supply of natural gas.

The chart below compares the natural gas resource base estimates from a number of organizations.[6] The 2014 estimates from government, academia, and industry show a natural gas resource range of 2,266 to 3,933 Tcf. The Energy Information Administration is at the low end and ICF International (ICF) is at the high end. ICF estimates that over 1,500 Tcf of natural gas is available at a cost of $5 per million British thermal Unit (MMBtu) or less.



As shown above, the most recent baseline or reference estimates from PGC, Cambridge Energy Research Associates (CERA), National Petroleum Council (NPC), Interstate Natural Gas Association of America (INGAA), and ICF on the

[6] America's Natural Gas Alliance white paper "*Carpe Diem: LNG Exports Are America's Once-in-a-Generation Opportunity"* (April 2015) at 2.

amount of available natural gas resource are 311 to 1,408 Tcf larger than EIA's HRR case. Therefore, we believe that the most reasonable modeling results from the DOE 2015 study are from the cases using EIA's HRR scenario and even those results may be somewhat biased downward due to lower resource estimates.

c. **Modeling results from the DOE 2015 report indicate that U.S. natural gas prices will only modestly increase with LNG exports.**

Although it is not highlighted in the Key Findings section of the DOE 2015 report, the model runs from the 2015 report indicate that significant increases in LNG exports lead to only modest increases in domestic natural gas prices. As mentioned above, since the DOE report's estimated resource base is lower than other reputable estimates, we believe that the results from the HRR cases are the most relevant in terms of describing the future impact of LNG exports.

Table 1 below summarizes Henry Hub projections from the HRR scenarios.[7] The different HRR cases reflect varying assumptions about international demand & supply and LNG export volumes and capacity limits. Also included in Table 1 is the DOE "Reference" scenario. The reference scenario should be considered a supply constrained case due to its low resource base assumptions.

Table 1
Natural Gas Prices by Scenario

Case	International LNG Demand	US Natural Gas Resource	LNG Exports / Capacity Limit 2040 (Bdfd)	Henry Hub Price 2005	2015	2025	2040
Ref_Ref	Reference	Reference*	6.4 / None	$8.79	$3.28	$5.30	$7.42
Ref_HRR	Reference	DOE "High"**	6.7 / None	$8.79	$3.19	$4.93	$6.15
LNG12_HRR	Higher	DOE "High"	16.3 / None	$8.79	$3.19	$4.83	$6.77
LNG20_HRR12	Significantly Higher	DOE "High"	11.8 / 12.0	$8.79	$3.20	$4.91	$6.46
LNG20_HRR20	Significantly Higher	DOE "High"	19.7 / 20.0	$8.79	$3.22	$4.92	$6.96
LNG20_HRR	Significantly Higher	DOE "High"	28.0 / None	$8.79	$3.22	$4.95	$7.21

* Should be considered a supply constrained case due to its low resource base asumptions.
** Since the DOE High resource base is lower than most third party reference cases - these results should be considered conservative and not aggressive.

[7] DOE 2015 Report at D-1.

LNG export levels for cases with DOE's "high" resource assumption reach a level of 6.7 bcfd to 28.0 bcfd by 2040. Projected 2040 Henry Hub natural gas prices remain within a narrow band of $1.06 per MMBtu even though LNG export volumes varied by over a factor of four. The DOE scenarios project that an increase of 318 percent in LNG exports from a level of 6.7 bcfd of LNG exports to a level of 28 bcfd leads to only a 17 percent increase in natural gas prices. There is very little natural gas price difference between the cases prior to 2025. This is due to the fact that LNG export volumes are projected to need significant time to ramp up whether it is due to time needed to construct export facilities or time needed for world demand for LNG to grow.

It should be noted that wholesale natural gas costs are only a portion of the natural gas costs for residential and commercial retail customers. Other costs at the burner tip include pipeline transportation to the citygate, distribution transportation, fees and taxes. From 2010 to 2014 Henry Hub prices averaged only 36 percent of the U.S. average residential and 46 percent of the commercial per unit costs of natural gas.[8]

d. **The DOE 2015 report reaffirms the view that U.S. natural gas prices will be discounted relative to LNG importing markets due to LNG liquefaction, transport and other costs.**

In line with other projections, the DOE 2015 Report does not anticipate that U.S. natural gas costs will rise to the same level as major LNG importing markets as LNG exports increase. In fact there will be significant price differences due in part to the costs of LNG liquefaction and transport. U.S. prices "must" be discounted to foreign trade prices in order for profitable trade to occur. If the domestic-foreign spread closes, or narrows too tightly, then the incentive to trade disappears. The NERA 2012 report[9] estimated that the total LNG transport costs to Europe, Korea/Japan and China/India can range from $6.30, $7.14 to $8.39 per

[8] Source: Energy Information Administration Short-term Energy Report data table.
[9] NERA Economic Consulting *"Macroeconomic Impacts of LNG Exports from the United States"* (2012) at 90.

MMBtu in 2015, respectively. The modeling results for relevant scenarios show similar and possibly greater price differentials as shown in Table 2 below.

Table 2
U.S. / Other World Markets Natural Gas Price Differentials

$2010/MMBtu	Europe - Differential - Henry Hub / National Balancing Point (NBP)				Asia - Differential - Henry Hub / Japan Korea Marker (JKM)			
Case	2005	2015	2025	2040	2005	2015	2025	2040
Ref_Ref *	$1.41	-$4.15	-$3.06	-$4.04	$2.74	-$6.03	-$5.02	-$6.16
Ref_HRR	$1.41	-$4.24	-$3.32	-$5.39	$2.74	-$6.31	-$5.22	-$7.50
LNG12_HRR	$1.41	-$4.30	-$4.11	-$7.40	$2.74	-$6.35	-$6.76	-$9.46
LNG20_HRR12	$1.41	-$4.29	-$4.10	-$7.75	$2.74	-$6.44	-$8.70	-$16.37
LNG20_HRR20	$1.41	-$4.26	-$4.04	-$7.30	$2.74	-$6.48	-$8.56	-$12.85
LNG20_HRR	$1.41	-$4.27	-$4.09	-$6.92	$2.74	-$6.45	-$8.54	-$10.22

* Should be considered a supply constrained case due to its low resource base asumptions.

In 2005, prior to the shale revolution in the U.S., U.S. domestic natural gas sold at a premium to Asian and European markets. However, U.S. natural gas prices currently are selling at a discount to Asian and European benchmark prices and DOE 2015 modeling results project that the discount is expected to continue even with significant LNG exports. Henry Hub discounts relative to the National Balancing Point (NBP) in the United Kingdom range from $5.39 to $7.75 per MMbtu by 2040 in the DOE 2015 "high" resource cases. Henry Hub natural gas prices relative to the Asian Japan Korea Marker prices are projected be lower by a range of $7.50 to $16.37 per MMbtu by 2040 depending on the international demand for LNG and the amount of U.S. LNG export capacity.

A comparison of the HRR case with a lower resource base (Ref_Ref) case clearly indicates that the robust U.S. natural gas resource base can help maintain a lower U.S. natural gas price relative to major natural gas importing markets even with significant levels of LNG exports. U.S. consumers of natural gas, including energy intensive industries that produce globally tradable commodities, are expected to retain a significant cost advantage relative to their international competitors who use higher cost natural gas inputs.

II. The DOE 2015 report concludes that economic benefits increase with higher levels of LNG exports.

a. Increased LNG exports lead to increased economic benefits – there is no "sweet spot".

The DOE 2015 study conclusion that "The overall macroeconomic impacts of higher LNG exports are marginally positive, a result that is robust to alternative assumptions for the U.S. natural gas market." is in agreement with other previous studies on LNG exports. In the relevant "high" resource cases, increasing the LNG export capacity limit from 12 bcfd to 20 bcfd increases average U.S. GDP $7.3 billion per year from 2025 to 2040.[10] Over the same time period, the economy supports an additional 11,300 jobs and the U.S. current account increase by a positive 0.03 percent of GDP.

Under the "high resource" assumption, a comparison of the LNG export case with a 12 bcfd capacity limit to one with no export capacity constraint, indicates that the economic impacts are even greater than the reference case resource assumption. Average U.S. GDP from 2025 to 2040 increases by $20.5 billion per year, employment increases by 35,200 jobs and the current U.S. current account increases by an average of 0.5 percent of GDP. These results emphasize that higher level of LNG exports lead to greater economic gains for the U.S.

This conclusion was also reached in previous analyses of LNG exports. In the 2013 ICF report "U.S. LNG Exports: Impacts on Energy Markets and the Economy," ICF found that in the Middle Export Case which reached a level of 8 bcfd of LNG exports, 20-year average GDP gains were estimated at $25.4 to $37.2 billion per year and job gains averaged 112,800 – 230,200 jobs. ICF's High Export case which reached a level of 16 bcfd averaged an increase of $50.3 to $73.6 billion per year in GDP and 22,100 to 452,300 job gains. ICF conclusion was that increasing LNG exports led to increasing net economic benefits to the U.S.

[10] DOE Report 2015 Table ES2 at 17.

b. Benefits of LNG exports are widespread throughout the economy including the manufacturing and construction sectors.

The DOE 2015 report concludes that the benefits of increased LNG exports will be spread throughout many sectors of the economy. Certainly firms that directly supply the upstream natural gas sector and that are involved with developing infrastructure or those that supply equipment or engineering services will benefit from increased LNG exports. Increasing the capacity limit in the DOE "high" resource case from 12 to 20 bcfd equated to an average increase of 0.02% in output[11] from the overall manufacturing sector and a 0.15 percentage increase in output from the construction sector.[12] Even the agriculture sector showed a modest increase of 0.2 percent . Only the service sector showed a modest decline as other parts of the economy grow and demand more labor and resources. **Clearly, U.S. LNG exports do not benefit a narrowly defined extraction sector at the expense of the rest of the economy.**

The DOE 2015 modeling results project that these nearly economy-wide benefits only increase with even higher levels of LNG exports. When comparing the DOE "high" resource case at 12 bcfd to one where the capacity is endogenously determined, overall output from the manufacturing sector was an average of 0.06 percent larger, the construction sector was 0.34 percent greater, the agriculture sector was 0.4 percent greater and the extraction sector was 3.94 percent greater. The service sector output was a modest 0.02 percent smaller. This again reaffirms the conclusion that greater LNG exports leads to greater economic benefits.

c. Estimated growth in energy-intensive trade-exposed industries in the LNG export cases is only marginally smaller relative to cases with restricted LNG exports.

An important conclusion of the DOE 2015 report is that even though modestly higher natural gas prices associated with LNG exports are negative for some energy-intensive trade-exposed manufacturing sectors, such as glass, cement, and

[11] Based on the value-added contributions of the sector to overall GDP.
[12] DOE 2015 Report Table ES2 at 17.

chemicals—"the impacts are small compared with the expected growth in output through 2040". [13] Therefore, the DOE 2015 modeling results project that these subsectors will still continue to grow but at slightly slower rates relative to a scenario with LNG exports restricted below market levels. The projected impact on the chemical manufacturing subsector may be misstated. The analysis does not take into account the impact of greater NGL production that would be associated with greater natural gas production and would likely benefit the chemical industry[14] (discussed in next section). It should be noted that the output of energy intensive sectors as a whole increase with higher levels of LNG exports. Demand for iron & steel and metal products which are also energy intensive more than offset the decline in output from the other energy intensive subsectors.[15] **The DOE 2015 modeling results project that by restricting LNG exports, energy-intensive trade-exposed industries would marginally benefit but at the expense of even greater costs to other parts of the economy.**

d. Impacts of increased NGL production were not considered in the DOE 2015 analysis. A greater NGL supply would directly benefit the chemical industry and add to the estimated economic benefits of increased LNG exports.

The DOE 2015 report does not account for a major benefit to the U.S. economy from LNG exports, namely increased ethane and other NGL production. As clearly stated in the footnote on page 67 of the DOE 2015 report "It should be noted that the analysis does not account for the potential impacts of higher natural gas production on the production of natural gas liquids (NGL) and the potential impacts of changes in NGL production on the domestic petrochemicals industry …. As such it is possible that the increase in gas production associated with rising exports could provide further benefit to the sector and output overall."

This is an important acknowledgment since incremental LNG exports are likely to increase the supply of ethane, propane, butane and other associated NGLs. The production of ethane, "which comprises approximately half of all

[13] DOE Report 2015 at 15.
[14] DOE Report 2015 Footnote at 67.
[15] DOE Report 2015 Table 6 at 73.

NGLs", is projected to benefit the most because it is highly likely that the majority of ethane will be stripped out of natural gas prior to export and sold in the domestic market since "there are strict limits in quality provisions of pipeline tariffs on how much ethane can be left in the natural gas stream." NGLs (including ethane) are generally removed from natural gas to reduce the gas stream's calorific value not only to meet U.S. pipeline specifications but also to avoid excess liquids that may condense affect transmission. The recovered NGLs are then processed into their saleable hydrocarbon components – notably ethane and propane. Thus, the emergence of an LNG export market should not only stimulate more ethane and propane production that is associated with increased natural gas production, but should also result in a greater abundance of domestic ethane and propane supply than would occur in the absence of an LNG export market.

As observed by the American Chemistry Council, ethane is difficult to transport, and "it is unlikely that the majority of excess ethane supply would be exported out of the United States. As a result, it is also reasonable to assume that the additional ethane supply will be consumed domestically by the petrochemical sector to produce ethylene." A greater supply of propane would likely benefit direct consumers of propane. Propane is used for home heating, cooking, and in some instances transportation fuel.

According to the ICF International 2013 report, increasing LNG exports to approximately 8 bcfd by 2035 from a case with no LNG exports will cause more NGLs to be produced so that by 2035, approximately 90,000 bbl/d of additional ethane and 60,00 bbl/d of propane would be available for domestic consumption[16]. In 2014, approximately 2 million bbl/d of ethane and propane was produced in the U.S.[17] Other NGLs would experience growth as well so that by 2035, approximately 270,000 bbl/d of additional NGLs would be produced with 8 bcfd of additional LNG exports..

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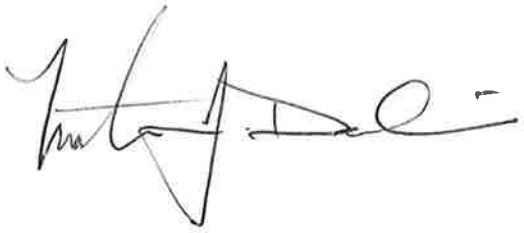
[16] ICF International, "*U.S. LNG Exports: Impacts on Energy Markets and the Economy*" (2013) at 117.

[17] https://www.eia.gov/dnav/pet/pet_pnp_gp_a_EPLLE_FPF_mbblpd_a.htm
https://www.eia.gov/dnav/pet/pet_pnp_gp_a_EPLLPZ_FPF_mbblpd_a.htm

ICF estimates with such an increase in NGL production, the ethylene/ polyethylene production gains would reach 4,500 tonnes/day with an incremental 8 bcfd of LNG exports. For reference, ICF assumes a new ethylene/polyethylene plant to have a capacity of 2,740 tonnes/day, meaning LNG exports require approximately two additional ethylene/polyethylene plants. ICF estimated the ethylene/polyethylene production impact on GDP to be approximately $2.6 billion per year.[18]

Respectfully Submitted,



[18] ICF International, "*U.S. LNG Exports: Impacts on Energy Markets and the Economy*" (2013) at 119.