October 21, 2019
Amy Sweeney
U.S. Department of Energy
Office of Regulation, Analysis, and Engagement
Office of Fossil Energy
Forrestal Building
1000 Independence Ave. SW, Washington, DC 20585

RE: LCA GHG Update Comments

Dear Ms. Sweeney,

On behalf of the Center for Liquefied Natural Gas (CLNG), I write in support of the U.S. Department of Energy's (DOE) study, *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States: 2019 Update* (2019 LCA GHG Update) commissioned by the DOE and prepared by the National Energy Technology Laboratory (NETL). CLNG requests that these reply comments be considered in all pending proceedings before DOE and in subsequent filings in which the various applicants seek authorization from DOE to export liquefied natural gas (LNG).

I. Statement of Interest

The Center for LNG advocates for public policies that advance the use of LNG in the United States, and its export internationally. A committee of the Natural Gas Supply Association (NGSA), CLNG represents the full value chain, including LNG producers, shippers, terminal operators and developers, providing it with unique insight into the ways in which the vast potential of this abundant and versatile fuel can be fully realized.

II. Background

On June 4, 2014, DOE issued a report titled *Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States* (LCA GHG Study). That report was intended to inform DOE's public interest review required under section 3(a) of the NGA. The results of that study clearly show that exporting U.S. LNG will have environmental benefits. The key finding of the 2014 LCA GHG Study is:

- "This analysis has determined that the use of U.S. LNG exports for power production in European and Asian markets will not increase GHG emissions, on a life cycle

perspective, when compared to regional coal extraction and consumption for power production."[1]

Since the publication of the 2014 LCA GHG Study, DOE has approved several LNG export projects, finding that the proposed exports are not inconsistent with the public interest. The 2019 LCA GHG Update Study adds to the already robust evidence that LNG exports are in the public interest. In fact, the 2019 LCA GHG Update reaffirms that:

- "[T]he use of U.S. LNG exports for power production in European and Asian markets will not increase GHG emissions from a life cycle perspective, when compared to regional coal extraction and consumption for power production."[2]

III. Comments on the 2019 LCA GHG Update Study

CLNG offers the following comments on the study for DOE's consideration.

- The 2019 study compared the GHG footprint of U.S. LNG to various alternative natural gas and coal supplies used for power generation in Europe and Asia. Several updates were made to the model used for the 2014 study, which reflect the latest science and understanding of new technology. The key updates to the 2019 study involved:
    - Incorporation of the updated NETL characterization of upstream natural gas production;
    - Update to the unit processes for liquefaction, ocean transport, and regasification characterization; and
    - Update to the global warming potential for methane to reflect current United Nations figures for 100- and 20-year time periods.

- The 2019 study included the upstream (production through transmission) emissions based on a recent analysis that was released by NETL in April 2019, which has 30 distinct scenarios across 14 onshore production basins and 5 types of extraction technologies. Over 127 distinct unit processes (or emission source categories) were modeled including vented and fugitive emissions that arise from one-time construction and well completions, steady state operations, and episodic maintenance events, resulting in the most comprehensive upstream LCA model. The report includes a range of associated methane leakage rates of delivered natural gas, reflecting the heterogeneity in production processes and emissions profiles.

- We note that in the United States, there are a number of industry-led initiatives to further reduce methane emissions across the natural gas value chain, and these efforts will

[1] National Energy Technology Laboratory, "*Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas form the United States"* May 2014, https://www.energy.gov/sites/prod/files/2014/05/f16/Life%20Cycle%20GHG%20Perspective%20Report.pdf., pg. 18.
[2] National Energy Technology Laboratory, "*Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States: 2019 Update"* September 2019, https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf., pg., 32.

further improve the environmental benefits of LNG from a life cycle GHG emissions perspective.

- Moreover, when DOE corrects some technical matters, even greater benefits of U.S. LNG exports would be represented.[3]

- The 2019 study relies on peer-reviewed studies on updates for the LNG liquefaction segment.[4,5,6] The updates to the shipping and regasification modules incorporate latest technical reports and industry understanding. With the implementation of the International Maritime Organization's rules restricting fuel oil sulphur content, we expect further improvement in the GHG emissions profile of the shipping segment, which further improves the competitive position of LNG from an environmental perspective.

IV. Benefits of LNG for the Environment

Natural gas is the cleanest burning hydrocarbon and the use of natural gas for power generation here in the United States has had clear environmental benefits. In the United States, CO_2 emissions fell by 28 percent between 2005 and 2017 in large part because of the increased use of natural gas in power generation.[7] Further, a global shift from coal to less carbon-intensive natural gas helped avert 500 million metric tons of CO_2 emissions globally between 2010 to 2018. Going forward, globally, there is a further potential for 1.2 Gt of near-term CO2 reductions due to fuel switching to natural gas.[8] Further, while greater use of natural gas will help reduce carbon emissions, it will also help reduce traditional pollutants – burning natural gas creates little to no emissions of sulfur dioxide, nitrogen oxides or particulate matter that can lead to smog.[9]

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[3] NETL actually overestimated the GHG emissions associated with compressor stations (and pipelines, by extension) when compared with data compiled by the DOE and reported annually in the DOE/EIA NG Annual, as well as by using an inflated Global Warming Potential (GWP). First, NETL's estimates of GHG emissions throughout the U.S. are reported in "Exhibit 6-3. Detailed GHG Emission Sources for the U.S. Natural Gas Supply Chain". Their estimates of combustion emissions for gas gathering ("Reciprocating Compressors") imply that 5.7% of the gross gas is consumed by gathering compression. This is considerably more than the consumption reflected in DOE's own Natural Gas Annual 2017 (https://www.eia.gov/naturalgas/annual/), which reports that the gas consumed by the sum of production operations, heaters, dehydrators, and compressor drivers (e.g. gas engines) is 3.4% of gross. Second, NETL's figures imply that 8% of the gross gas is consumed by transmission pipeline compressor stations ("Transmission: Reciprocating Compressors" and "Transmission: Centrifugal Compressors"). By contrast the DOE/EIA Natural Gas Annual 2017 reports "Pipeline and Distribution Use" of 2.2% of gross production. Finally, NETL used a GWP of 36 for methane, which is larger than the official number in the latest assessment report of the IPCC. This subjective choice is outside of mainstream LCA science which has largely adopted the GWP of 30 (some practitioners use 28). While NETL found a low fugitive methane emission rate across the natural gas value chain -- NETL reports 1.08% of methane being emitted from well to wire ("Exhibit ES 1. Life Cycle CH4 Emissions from the U.S. Natural Gas Supply Chain") – the subjective inflation of methane's GWP out of line with most LCA practitioners improperly inflates the impact of this low fugitive emission rate.

[4] Mallapragada, D.S., Reyes-Bastida, E., Roberto, F., McElroy, E.M., Veskovic, D., Laurenzi, I.J. 2018. Life cycle greenhouse gas emissions and freshwater consumption of liquefied Marcellus shale gas used for international power generation. *Journal of Cleaner Production*, 205, 672-680.

[5] Dobrota, D., Lalic, B., Komar, I. 2013. Problem of Boil-off in LNG Supply Chain *Transactions in Maritime Science*, 2, 91-100.

[6] Li, Y., Wen, M. 2016. Boil-Off Gas Two-Stage Compression and Recondensation Process at a Liquefied Natural gas Receiving Terminal. *Chemical Engineering & Technology*, 40, 18-27.

[7] The U.S. Energy Information Administration, "*U.S. Energy-Related Carbon Dioxide Emissions, 2017*," September 2018, https://www.eia.gov/environment/emissions/carbon/.

[8] International Energy Agency, "*The Role of Gas in Today's Energy Transitions*," 2019.

[9] Leidos, Inc., A Comparison of Emissions from Major Fuels Used to Generate Electricity in the U.S., 2016.

When countries increase their use of natural gas for power generation, not only will they reduce their GHG emissions through fuel switching to natural gas, they will also have the opportunity to increase their use of renewable energy; further reducing emissions. This is because natural gas is an ideal partner to renewable energy resources. Natural gas makes a perfect ally to ramp up and support renewable resources allowing for more generation to be powered by renewables. In fact, for every 1% increase in natural gas-powered electric generation, renewable power generation increases by 0.88%.[10] The natural gas industry is a partner in transitioning to a lower-carbon future and exporting U.S. LNG is one of the ways that we are helping reduce emissions on a global scale. Natural gas and LNG are part of a clean energy future for all.

I. Natural Gas Supply

The good news is that the United States has a tremendous supply of natural gas. The latest Potential Gas Committee's (PGC) biennial assessment concluded that we have a "strong supply of natural gas in the U.S. for many years to come." The assessment found that the U.S. has a total mean technically recoverable resource base of 3,374 trillion cubic feet (Tcf) as of year-end 2018, the highest evaluation in the Committee's 54-year history and exceeding 2016's evaluation by 20 percent.[11] And, as new technologies in extraction are developed these estimates will continue to grow.

While assessments of our natural gas resources have grown, so has our production. Between 2005 and 2018, U.S. natural gas production rose by 70 percent and the U.S. Energy Information Administration (EIA) expects production to continue to grow.[12] Over that 2005-2018 period, despite increasing domestic demand and increasing exports, U.S. natural gas prices declined from over $10 per MMBtu in 2005 to current levels of under $2.50 per MMBtu.[13] All of this is to say, that the U.S. has plenty of natural gas at affordable prices to increase our domestic use of natural gas while also exporting LNG to our partners abroad.

V. Conclusion

CLNG supports the topline conclusion of DOE's 2019 LCA GHG Update: U.S. LNG will not increase GHG emissions from a life cycle perspective, when compared to regional coal extraction and consumption for power production. This conclusion is consistent with the positive findings of the 2014 study, and further bolsters DOE's prior findings of other benefits associated with U.S. LNG exports.[14] We believe that this study adds to the robust evidence

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[10] National Bureau of Economic Research, "*Bridging The Gap: Do Fast Reacting Fossil Technologies Facilitate Renewable Energy Diffusion?,"* July 2016, https://www.nber.org/papers/w22454.pdf,pg. 3.
[11] U.S. Potential Gas Committee, *"Biennial Estimate of North American natural Gas Resource Base",* September 2019, http://potentialgas.org/wp-content/uploads/PGC_2019_Press_Release_Final.pdf.
[12] U.S. Energy Information Administration, "*U.S. Natural Gas Gross Withdrawals,"* https://www.eia.gov/dnav/ng/hist/n9010us2A.htm.
[13] U.S. Energy Information Administration, "*Natural Gas Prices*," https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm/.
[14] *See EIA, Effect of Increased Natural Gas Exports on Domestic Energy Mar*kets (January 2012); NERA, *Macroeconomic Impacts of LNG Exports from the United States* (December 2012); EIA, *Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets (October 2014)*; CES, *The Macroeconomic Impact of Increasing U.S. LNG Exports* (October 2015); and most recently NERA, *Macroeconomic Outcomes of Market Determined Levels of U.S. LNG Exports (*June 2018) ("For each of the supply scenarios, higher levels of oil and gas supply and LNG exports in response to international demand consistently lead to higher levels of GDP. [. . .] Consumer welfare, expressed in dollar

supporting the benefits of U.S. LNG exports, although CLNG does request consideration and correction of certain technical matters noted in footnote 3.

The U.S. LNG industry believes that U.S. LNG exports can help reduce emissions and combat climate challenges globally, while our abundant domestic resources provide affordable energy here at home. Each study, regardless of Administration, conducted by DOE on LNG exports has upheld the environmental benefits of exporting U.S. natural gas. Transitioning to a lower-carbon future is a goal we all share, and the U.S. LNG industry stands ready to support our customers and countries to meet the challenges of improving air quality and reducing greenhouse gases. Given the findings of this Study, as well as the previous DOE LNG studies, we believe DOE has enough evidence to approve LNG exports without delay.

Respectfully Submitted,

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terms, is also higher when there is greater domestic oil and gas supply, and higher levels of LNG exports.". "Throughout the entire range of scenarios, this study finds that overall U.S. economic output is higher whenever global markets call for higher levels of LNG exports, assuming that exports are allowed to be determined by market demand.").