U.S. Department of Energy (FE-34)
Office of Regulation, Analysis, and Engagement,
Office of Fossil Energy and Carbon Management
1000 Independence Avenue SW
Washington, DC 20585

RE: "Energy, Economic, and Environmental Assessment of U.S. LNG Exports" - Request for comments

To whom it may concern:

We submit this letter in response to the Request for Comments by the Office of Fossil Energy and Carbon Management (FECM) of the U.S. Department of Energy (DOE), which is seeking input on its December 2024 report on the "Energy, Economic, and Environmental Assessment of U.S. LNG Exports" (DOE LNG study).

We appreciate the thorough analysis undertaken in the DOE LNG study, which provides a much needed update to prior economic and environmental analyses used by DOE to inform its determination of public interest in the authorization of non-FTA exports from U.S. liquefaction facilities. We would like to offer a number of suggestions on aspects of the DOE LNG study that we believe could be clarified and improved for its future use.

Comments/Recommendations:

1. **Evidence on the effect of LNG exports on the internationalization of domestic gas prices needs to be considered**

LNG exports increase U.S. natural gas prices by *two* channels: they increase domestic demand - a channel modeled in the DOE study - and they also have reconnected U.S. prices to global prices - a channel *not* modeled in the DOE study.

The second channel, reconnecting Henry Hub prices to global prices, is documented in a 2024 research paper, Stock and Zaragoza-Watkins (2024)[1], which we hereby submit for the record.

This paper uses statistical (time series) methods to show that the surge in LNG exports since 2015 reconnected U.S. gas prices to world market prices, after a hiatus of "shut-in" fracked gas. The paper provides two estimates of the effect of this recoupling on Henry Hub prices: a retrospective estimate of $2.30/MMBtu and a prospective estimate of $1.60/MMBtu. Stock and Zaragoza-Watkins (2024) finds suggestive evidence that the surge in U.S. LNG exports from 2016 reconnected domestic gas prices to world market prices, after a hiatus of "shut-in" fracked gas. This increased connection between domestic and international prices through LNG exports becomes more likely in the future given relevant market changes, e.g.

[1] Stock, James H. and Matthew Zaragoza-Watkins, "The Market and Climate Implications of U.S. LNG Exports," National Bureau of Economic Analysis Working Paper 3228, March 2024, at https://www.nber.org/papers/w32228.

the increasing reliance on spot market transactions and changes in contracting discussed in Stock and Zaragoza-Watkins (2024).

The DOE LNG study argues that “global supply and demand shocks have historically had little impact on domestic prices” and that “the long-term, take-or-pay nature of U.S. contracted LNG exports has sheltered short- and medium-term domestic natural gas prices from significant and sustained price surges”. [S-36] DOE seems to suggest that U.S. LNG exports do not adjust in response to international price shocks and thus do not affect domestic natural gas prices. There are several reasons to question this assertion:

- U.S. prices responded during the leadup to the Ukraine war, when increased global demand and redirecting of U.S. shipments to Europe. This is true both statistically (see Figure 1 and the statistical analysis in Stock and Zaragoza-Watkins 2024) and based on industry insider knowledge.
- Although the first LNG export terminals were financed using nearly-complete long-term offtake agreements indexed to Henry Hub, there has been a trend, accelerated by the Ukraine war, for LNG exporters to sell a fraction of their production on the spot and near-term market. What matters for Henry Hub pricing is where the marginal production of natural gas is going - if marginal production is being exported on the spot or short-term market, then international pricing will put pressure on Henry Hub pricing.
- The key here is whether LNG exporters have the ability to increase or decrease capacity based on international demand. Recently, capacity utilization has been very high so an argument could be made that U.S. production has returned to a state of being “shut in” so that pricing is below international pricing. That said, there have been countervailing factors domestically that have held down demand, in particular the historically warm winters of 2022-23 and 2023-24 and historically high storage volumes, so it is difficult to dissociate these short term effects from international pricing connection.
- Looking forward - as does the DOE study - the relevant question is whether the additional export capacity will keep Henry Hub connected to the international price. A key part of that assessment is whether there will be a range of slack capacity in LNG exporting that makes LNG exports a marginal destination of natural gas. Based on the analysis in Abuin (2025), discussed below, there are reasons to think that this will be the case - that international demand will be more than met by projects under consideration and/or near FID. If so, then U.S. domestic pricing will be connected to global pricing (with slippage for local conditions such as local weather and storage).
- Finally, it is worth noting that, as of the date of this letter, January 2026 Henry Hub futures and Dutch TTF futures are trading at approximately $5.50/MMBtu (CME) and 12.60 USD/MMBtu (NYMEX), respectively, a spread of $7.10, which after adjusting for inflation is within the range of estimates of the current cost of liquefaction, transportation, and regasification.

2. **Methodological disconnection between domestic and international modules creates potential for result inconsistencies**

DOE correctly points out that a “key factor driving U.S. LNG export levels and their emissions implications is the economic competitiveness of U.S. natural gas relative to natural gas from other producers” [A-34]. The economic competitiveness of any natural gas supply region is tightly linked to the shape of its natural gas resource supply curve, which determines the rate of increase of domestic natural gas prices as production levels increase. Thus, export levels and domestic prices are intrinsically linked and should not be analyzed in isolation.

As described in Appendix A of the DOE LNG study, DOE uses the Global Change Analysis Model (GCAM) to project the evolution of U.S. LNG exports under alternative assumptions on the path of global climate policies and the evolution of technological costs. While GCAM endogenously solves for changes in U.S. natural gas prices resulting from changes in LNG exports, these results are not reported in the DOE LNG study. Instead, the domestic component of the DOE analysis relies on projections from a different model, FECM24-NEMS, a variation of the Energy Information Administration (EIA's) National Energy Modeling System (NEMS) run by OnLocation, Inc. Although FECM24-NEMS can be used to yield endogenous projections of U.S. LNG exports over the forecast period, the approach taken by DOE is to feed export levels predicted by the *Defined Policies* scenario from GCAM into FECM24-NEMS. Given these LNG export levels, FECM24-NEMS then yields projections on domestic outcomes such as natural gas prices by U.S. supply region, primary energy consumption levels, and natural gas consumption by sector.

We believe that the DOE analysis would benefit from using an unified framework to consider domestic and international outcomes. Both global GHG emissions and domestic price effects are key considerations when evaluating whether LNG export approvals are in the public interest, and these two outcomes are determined jointly by market forces. In a recent working paper which we hereby submit for the record, Abuin (2025)[2] develops a global model of fossil fuel and electricity markets to examine how an increase in U.S. LNG export capacity affects fossil fuel prices, investment in electricity generation assets, and greenhouse gas emissions both in the U.S. and abroad. The model features forward-looking entry and exit of power generators in response to changes in fossil fuel prices, which are determined in a global trade equilibrium. The paper compares the evolution of global prices, investment and greenhouse emissions under two main scenarios: one in which only the U.S. LNG export projects that are already under construction or scheduled to start construction are completed (*Baseline* scenario), with one in which all projects that have been submitted to DOE for consideration move forward (*U.S. LNG Expansion* scenario). Relative to the *Baseline* scenario, the *U.S. LNG Expansion* scenario considers a case in which U.S. LNG export capacity is more than twice as large by 2030. In this scenario, the paper finds that U.S. domestic gas prices increase by an average 5.4% over 2025-2070. Global life-cycle emissions show a moderate decrease (equivalent to a monetary value of USD 75bn when translated to EPA SC-GHG estimates), driven primarily by an increase in U.S. power sector renewable adoption due to higher domestic natural gas prices.

Relative to the DOE LNG Study, Abuin (2025) finds that the potential for U.S. LNG export expansion is limited by two forces: the stagnation of global LNG demand over the coming years (due to decarbonization efforts already underway around the world) and the already scheduled increase in LNG export capacity from U.S. competitors (e.g. Qatar and Canada).

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[2] Abuin, Constanza, "Power Decarbonization in a Global Energy Market: The Climate Effect of U.S. LNG Exports", March 2025. Available at https://constanzaabuin.github.io/assets/pdf/Abuin-GlobalPowerDecarbonization.pdf

Together, these forces create excess capacity in global LNG markets and help constrain domestic price increases resulting from higher U.S. LNG export capacity.

Given that DOE is not using a unified modeling framework for its analysis of the domestic and international effects of U.S. LNG exports, it would be important to ensure that U.S. LNG export levels predicted by GCAM are consistent with domestic prices projected by FECM24-NEMS under these export levels. In the *Defined Policies* with reference U.S. supply scenario, the expansion of U.S. LNG exports comes at the expense of a 30% increase in Henry Hub prices. It is unclear whether GCAM would yield a comparable level of exports given that price increase. DOE does not disclose U.S. natural gas price projections from the *Defined Policies* scenario of GCAM, so this is impossible to evaluate. However, it is particularly concerning that reported projections from GCAM and FECM24-NEMS on U.S. natural gas consumption and production exhibit considerable differences, as shown in Table 1 below. By 2050, FECM24-NEMS projections for natural gas consumption in the *Defined Policies* scenario are 23% lower than those in GCAM's *Defined Policies* scenario, while natural gas production is 15% lower in FECM24-NEMS projections for 2050 compared to GCAM's.

Table 1 .- U.S. natural gas consumption and production projections from GCAM and FECM24-NEMS, *Defined Policies* scenario

	U.S. Natural gas consumption (In Bcf/d)			U.S. Natural gas production (In Bcf/d)		
Year	GCAM	FECM24-NEMS	Difference	GCAM	FECM24-NEMS	Difference
2020	83.0	83.6	0.6	90	90.9	0.9
2025	85.0	81.1	-3.9	102	102.7	0.7
2030	85.0	77.0	-8.0	105	102.1	-2.9
2035	84.0	75.1	-8.9	112	106	-6
2040	87.0	77.0	-10.0	129	120.4	-8.6
2045	96.0	80.0	-16.0	150	133.7	-16.3
2050	104.0	80.3	-23.7	165	139.6	-25.4

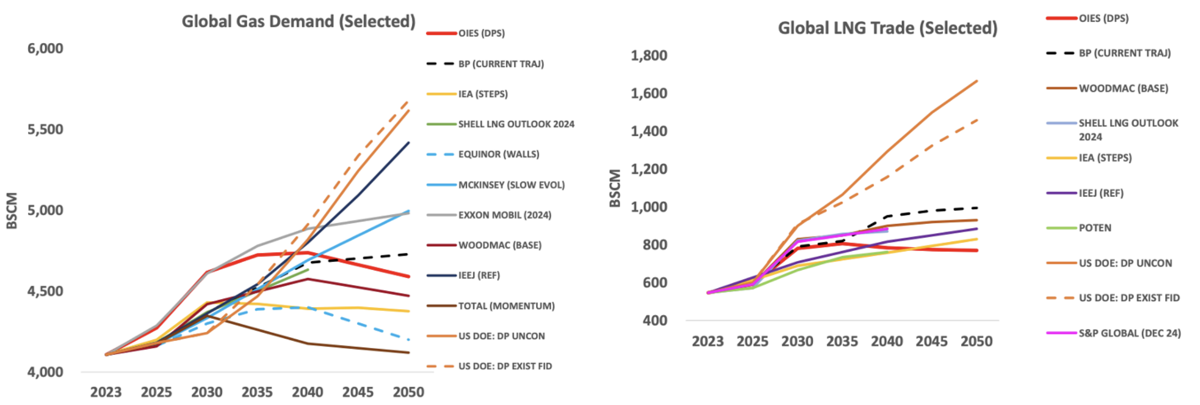
Notes: authors' calculations based on projections provided in Appendix A and B of DOE LNG Study. FECM24-NEMS projections for U.S. natural gas consumption figures reported in trillion cubic feet (tcf) in DOE LNG study, converted to to billion cubic feet per day (bcf/d) by authors. Both GCAM and FECM24-NEMS projections correspond to the Defined Policies: Model Resolved scenario.

3. Further discussion on GCAM *Defined Policies* scenario assumptions is warranted

While the DOE LNG study provides an overview of the GCAM model, the analysis would greatly benefit from a more detailed description of modeling assumptions, particularly those used in the *Defined Policies* scenario. Although DOE cautions that it "does not attach probabilities to any of the scenarios examined" [S-v], the *Defined Policies* scenario is the only one considered to examine how an increase in U.S. LNG exports would affect the U.S. economy and domestic greenhouse emissions. As such, it implicitly serves as a reference case throughout the DOE report.

Clarifying *Defined Policies* scenario assumptions is specially relevant given that model-resolved U.S. LNG exports are 41 to 69% lower by 2050 in all other global scenarios described in Appendix A of the DOE LNG Study. As Figure 1 below illustrates, the *Defined Policies* scenario also features considerably higher projections for global gas demand and global LNG trade than most existing projections from other industry sources.

Figure 1 .- Global natural gas demand and LNG trade projections



Source: reproduced from The Oxford Institute for Energy Studies (2025), available at: https://www.oxfordenergy.org/publications/doe-report-on-us-lng-exports-implausible-scenarios-and-flawed-assumptions/. Demand and trade projections are based on U.S. DOE LNG study, IEA and various industry sources.

Drivers of the high levels of U.S. LNG exports in the *Defined Policies* scenario are unclear, although DOE does explicitly mention that levels of carbon capture and storage (CCS) deployment in GCAM “are higher than in comparable scenarios in the existing literature and current deployment levels” [A-14]. Indeed, higher CCS deployment levels are consistent with a higher demand for natural gas around the world. Notwithstanding, it is not possible to infer from the DOE LNG Study whether this higher deployment of CCS in the *Defined Policies* scenario is itself driven by technological cost assumptions, by climate policy assumptions, or by both. Given the evolving nature of both climate policy and technological development, understanding the underlying mechanisms driving DOE headline results becomes especially important for future applications of the DOE LNG Study in public interest determinations. A simple breakdown of scenarios, holding climate policies in *Defined Policies* constant and varying assumptions on CCS technology (as done, for instance, when analyzing the *Net Zero 2050* scenario under both *Moderate CCS* and *High CCS* technology availability), would be useful in this regard. It would also be important for DOE to explicitly state what regional emission caps it is imposing in *Defined Policies*, and its rationale to introduce some recent Environmental Protection Agency’s (EPA) provisions (e.g. the recently finalized power plant rules based on Section 111 of the Clean Air Act), but not others (e.g. EPA’s Waste Emissions Charge or methane fee, included under *Commitments* and *Net Zero 2050* scenarios).

4. **The use of the ratio of the Social Cost of Methane to the Social Cost of Carbon as a method to compute CO2-equivalents is warranted, based on the best scientific literature, and a significant improvement over using arbitrary 20, 50, or 100 year Global Warming Potentials**

One challenge in the DOE study is providing an estimate of the climate impact of LNG exports when that impact comes from two different greenhouse gases, CO2 and methane. The standard approach of using Global Warming Potentials is well known to be flawed - in particular, it requires making a choice of measuring impact over a given time scale. The reason this arises is because methane is more potent than CO2 but resides in the atmosphere for a shorter period. A natural and justifiable way to address this is to use the monetary value of the damage produced by climate change induced by a marginal ton of emissions of CO2 or methane. Once those damages are expressed as a stream in monetary terms, they can be discounted to the present. Just as financial markets have no difficulties valuing bonds of different duration or with different payouts, the tools of finance, in particular net present value, can be used to value those damages and put them on the same basis. In practice, this means valuing methane emissions using the Social Cost of Methane (SCM) and CO2 emissions using the Social Cost of Carbon (SCC). Or, to put the emissions in CO2-equivalent units, a ton of methane has the same monetary damages as SCM/SCC tons of CO2.

Thank you for providing this opportunity to comment on this important study.

Respectfully,

Constanza Abuin
Department of Economics, Harvard University

James Stock
Department of Economics, Harvard University