

Purpose of This Memo

In July 2023, DOE denied a petition for rulemaking on LNG exports. In the denial, DOE argued that it is "able to take into account new or different facts" and supplement its case-by-case adjudication of export applications with technical analyses.¹

The purpose of this memo is to provide insights from new data that could encourage and assist DOE in updating its technical analysis for assessing the greenhouse gas impact of new LNG authorizations. LNG projects authorized by DOE in the coming year or later will likely not begin exports until 2027 or beyond. The context in which these facilities will operate is substantially different than prior authorizations, with a substantially different impact on greenhouse gas emissions.

DOE's methodology for assessing greenhouse gas emissions has not been updated since 2019, and relies largely on approaches first used in 2014, before the first shipments of US LNG exports. Using the International Energy Agency's *World Energy Outlook 2023*, I provide updated assessments of regional energy markets to illustrate the need for DOE to update its GHG technical analysis when assessing pending or future LNG authorizations, including timeline extensions.

This memo is provided independently and was not requested by DOE.

Background

The Department of Energy has authorized 47 Bcf/d of US-sourced LNG to non-free-trade nations.² Of this amount, at least one-quarter will need new approvals from DOE as the developers are not have not on track to commence exports within the allowable 7-year timeframe.³ Companies have applied for or announced intent to seek DOE authorizations for an additional 15 BCF/day.⁴ If authorized, these projects will have seven years to begin operation, coming on line around 2030 or beyond. When authorizing LNG exports, DOE provides authorization through the year 2050.

Although DOE has yet to take action to update its assessments, DOE acknowledges that each additional LNG authorization will have a different impact. In its most recent LNG authorization, DOE writes: "The market of the future very likely will not resemble the market of today. In recognition of these factors, DOE intends to monitor developments

¹ DOE, "ORDER DENYING PETITION FOR RULEMAKING ON EXPORTS OF LIQUEFIED NATURAL GAS," July 2023, p. 17.

² DOE, "DOE/FECM ORDER NO. 4961," March 2023, pg. 72.

³ DOE, "Policy Statement on Export Commencement Deadlines in Natural Gas Export Authorizations," May 2023.

⁴ Symons Public Affairs, "Status of U.S. LNG Export Permits and Associated Greenhouse Gas Emissions," November 2023.

that could tend to undermine the public interest in grants of successive applications for exports of domestically produced LNG."⁵

In 2014 and 2019, DOE's National Energy Technology Laboratory (NETL) published studies on greenhouse gas emissions from US LNG, concluding that: "the 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." This conclusion has been cited by DOE when conducting public interest determinations (as required by the Natural Gas Act) as grounds for authorizing new LNG export licenses to non-free trade nations.

The NETL/DOE 2019 report also found that "compared to domestically produced and combusted gas, there is a significant increase in the life cycle GHG emissions that are attributed to the LNG supply chain, specifically from liquefaction, tanker transport, and regasification processes." DOE has not referenced this finding in its past authorizations.

Energy Forecasts Have Changed Significantly Since 2019

The energy landscape has changed significantly since 2019, with much stronger renewable energy investments expected globally. The International Energy Agency's (IEA's) <u>World Energy Outlook 2019</u> anticipated that global reliance on coal and natural gas would increase through 2040.⁶ According to IEA's <u>World Energy Outlook 2023</u>, global electricity generation from fossil fuels is now expected to rapidly decline across all regions of the world, as shown in Figure 1. This holds true across all *World Energy Outlook* scenarios (Stated Policies, Announced Pledges, and Net Zero by 2050).

Figure 1 – Global Electricity Generation

Based on IEA's World Energy Outlook (IEA 2023)

	2022	2035		2050			
		Global		Global			
	Electricity	Electricity		Electricity			
	Generation	Generation	Change from	Generation	Change from		
	(TWh)	(TWh)	2022	(TWh)	2022		
Stated Policies Scenario							
- Renewables	8,599	23,051	168%	37,973	342%		
- Fossil Fuels	17,637	13,623	-23%	11,463	-35%		
Net Zero Emissions by 2050 Scenario							
- Renewables	8,599	36,739	327%	68,430	696%		
- Fossil Fuels	17,637	4,467	-75%	1,154	-93%		

DOE Approach

NETL quantified estimates of the lifecycle GHG emissions from US LNG shipped to Asia and Europe (NETL Exhibits 6.1 and 6.2, displayed on the following page), using both 20-year and 100-year global warming potentials (GWPs) for methane. NETL found that the lifecycle GHGs was higher for LNG shipped to Asia rather than Europe (due to shipping distances). NETL also found that lifecycle GHGs were higher when using a 20-year GWP rather than 100-year GWP due to the higher warming impact of methane when evaluated on a shorter time horizon.

⁵ DOE, "<u>DOE/FECM ORDER NO. 4961</u>," March 2023, pg. 77.

⁶ Table A.3, p. 679, Current Policy Scenario.

Exhibit 6-1. Life Cycle GHG Emissions for Natural Gas and Coal Power in Europe





NETL's 2019 conclusions regarding lifecycle emissions of LNG are low compared with other findings (<u>Abrahams et al 2015</u>, <u>Howarth 2023 pre-review</u>).

In making public interest determinations, DOE cites the NETL report but does not calculate emissions associated with each project. DOE provides the following discussion in a <u>2023 authorization</u>:

"DOE further acknowledges that regional coal and imported natural gas are not the only fuels with which U.S.exported LNG will compete. U.S. LNG exports may also compete with renewable energy, nuclear energy, petroleum-based liquid fuels, coal imported from outside East Asia or Western Europe, indigenous natural gas, synthetic natural gas derived from coal, and other resources. However, the net global GHG emission impacts of increased exports will be affected by the market dynamics in importing countries over the coming decades, as well as the potential interventions of numerous foreign governments in those markets. DOE has previously acknowledged the challenges associated with modeling the net change that a specific amount of U.S. LNG exports would have on global GHG emissions. Therefore, based on the evidence in this proceeding, DOE is unable to conclude that an increase in exports of U.S. LNG associated with FLEX's Application will increase global GHG emissions in a material or predictable way." (p. 69)

While DOE argues that it cannot predict whether LNG will compete with renewable energy or fossil fuels, it nevertheless relies on comparisons to fossil fuels to justify LNG authorizations as serving the public interest. In the same document, DOE writes:

"the use of U.S. LNG exports for power production in European and Asian markets will not increase global GHG emissions from a life cycle perspective, when compared to regional coal extraction and consumption for power production. On this basis, DOE found that the 2019 Update supports the proposition that exports of LNG from the lower-48 states will not be inconsistent with the public interest."

In short, DOE has argued the following: absent evidence that LNG will be displacing low-emitting sources of energy, the best that can be done is to compare LNG with coal and gas exclusively. The following sections of this memo provide updated data that demonstrates that new LNG export authorizations will compete more with low-emitting sources of energy than fossil fuels.

Methodology in this Memo

This memo provides practical data to better contextualize the impact of future LNG projects on global greenhouse gas emissions. I compare NETL's (2019) lifecycle emissions for LNG to the average GHG emissions intensity of electric power in the destination region, using IEA's *World Energy Outlook 2023*.

DOE's review process is focused on investments that will take many years to bring LNG to markets. In this context, IEA's forecast of rapid declines in fossil fuel generation and buildout of renewable energy sources suggests that future LNG exports are increasingly likely to compete with renewable energy. Rather than comparing US LNG to coal, it would be more appropriate to compare investment in new US LNG infrastructure to alternative investment in renewable energy, electrification, and energy conservation.

The average greenhouse gas intensity of the electric grid in the regions where LNG is being shipped reflects the relative balance between fossil fuel and non-emitting sources and how it changes over time. This is the appropriate background context within which DOE should model energy substitution for new authorizations.

The following charts compare the lifecycle GHG intensity of US Gulf Coast LNG with the lifecycle GHG intensity of fuels in destination regions that they will replace. All emissions are calculated based on the full lifecycle (methane and CO2) emission intensity for LNG, coal and Russian gas as calculated in the National Energy Technology Laboratory 2019 study (NETL 2019) that DOE relies upon for its public interest determinations of LNG export authorizations. For comparison, these intensities were applied to the total electric power mix forecasted by International Energy Agency in *World Energy Outlook 2023* (October 2023). All calculations are specific to destination region

"THE STATED POLICIES SCENARIO (STEPS) PROVIDES AN OUTLOOK BASED ON THE LATEST POLICY SETTINGS, INCLUDING ENERGY, CLIMATE AND RELATED INDUSTRIAL POLICIES. THE ANNOUNCED PLEDGES SCENARIO (APS) ASSUMES ALL NATIONAL ENERGY AND CLIMATE TARGETS MADE BY GOVERNMENTS ARE MET IN FULL AND ON TIME. YET, MUCH ADDITIONAL PROGRESS IS STILL REQUIRED TO MEET THE OBJECTIVES OF THE NET ZERO EMISSIONS BY 2050 (NZE) SCENARIO WHICH LIMITS GLOBAL WARMING TO 1.5 °C. CALCULATIONS ARE PROVIDED FOR 2022, 2030, AND 2050." – IEA WORLD ENERGY OUTLOOK

(Europe or Asia) and global warming potentials for methane (20 or 100 years).

Calculations are provided for *World Energy Outlook* scenarios (see definitions in above box). I calculated a simple average to identify the average intensity from 2022-2050. Given that DOE authorizes LNG exports through 2050 each time it issues an export permit, the average through 2050 is a useful summary benchmark.

Findings

Findings are provided in Figures 2-6. Across all scenarios, regions and assumptions, the GHG emissions intensity of LNG, as calculated by NETL/DOE, is significantly higher than average expected emissions projected by International Energy Agency. Emissions from US LNG to Europe exceed Europe's average electricity mix by 325-506%. Emissions from US LNG to Asia exceed Asia's average GHG intensity for electricity by 65-115%.

Figure 2 – Lifecycle GHG Intensity of Electricity Generation

Comparing US LNG to the Average Intensity in the World Energy Outlook (IEA 2023)

Scenario	US LNG	Electricity Average (2022-2050)	Increased Emissions from US LNG				
Europe							
Stated Policies, GWP ₂₀	719	169	325%				
Announced Pledges, GWP ₂₀	719	128	461%				
Stated Policies, GWP ₁₀₀	636	140	356%				
Announced Pledges, GWP ₁₀₀	636	105	506%				
Asia							
Stated Policies, GWP ₂₀	783	447	75%				
Announced Pledges, GWP ₂₀	783	365	115%				
Stated Policies, GWP ₁₀₀	688	416	65%				
Announced Pledges, GWP ₁₀₀	688	339	103%				

[Figures 3-6 on Following Pages]



Figure 4 – Lifecycle GHG Intensity of Electric Power Generation in Europe (GWP₁₀₀)





Figure 6 – Lifecycle GHG Intensity of Electric Power Generation in Asia (GWP₁₀₀)



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