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Is LNG dirtier than coal? It's complicated.

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The White House decision to pause approvals of liquefied natural gas terminals has fed a contentious debate: Is LNG dirtier than coal?

Many environmentalists argue that it is, challenging the conventional wisdom that gas is a sort of diet fossil fuel that could help reduce climate pollution as the energy system shifts to renewable power.

But the picture is more complicated than that, say many researchers who study the carbon content of fuels. Gas — and LNG exports in particular — most likely contributes more to planetary warming than previously thought, but it still can reduce greenhouse gas emissions compared to coal in some instances.

The idea is a bombshell in the world of energy politics, where gas has long been touted as having about half as many emissions than coal. In December 2023, 170 climate scientists signed onto a letter asking President Joe Biden to reject plans to build more LNG export terminals, mostly along the Gulf of Mexico, on the grounds that liquefied gas is "at least 24 percent worse for the climate than coal."

Biden's announcement last month to temporarily halt the approval of future projects until it examines their climate impact took a step in that direction — and fanned the flames of the gas versus coal debate.

The argument that LNG is dirtier than coal runs against previous academic and government studies, which have found that LNG can reduce planet warming emissions. Claims to the contrary are often based on a forthcoming Cornell University study, which has yet to be peer reviewed.

Robert Howarth, a professor at the university who wrote the study, said previous research about LNG's climate impacts failed to account for the carbon dioxide emissions associated with liquefying the gas, a process that requires chilling it to extremely cold temperatures.

"We need to move away from all fossil fuels. But the U.S. is hugely increasing our production of natural gas. We're the world's largest producer of natural gas. We were not 10-15 years ago. We are the largest exporter of natural gas. We didn't export any 10 years ago," Howarth said in an interview. "It's totally the wrong trajectory."

This is not the first time he has argued that gas's emissions exceed coal's — or courted controversy.

His assertions come as carbon emissions in the U.S. power sector fell by a third between 2005 and 2022, thanks in large part to a shift from coal to gas-fired power generation.

But the climate advantages decrease when methane — the primary component of gas — is flared, vented or leaked into the atmosphere at wellheads, pipelines and other gas industry infrastructure.

Comparing the greenhouse gases that are released by coal and gas is complicated because the characteristics of the emissions are different. Methane is a much more powerful greenhouse gas in the short-term, but it breaks up in the atmosphere after several decades, whereas carbon dioxide can remain in the air for more than a century.

Howarth raised alarms about the climate downside of gas in 2011, when he co-authored a study that found that as much as 7.9 percent of methane associated with gas production was vented or leaked into the atmosphere. His numbers were far bigger than government estimates and, he argued, would make gas a greater contributor to warming than coal, particularly over the short-term.

Subsequent studies found that methane leaks were bigger than the government had suggested, though few duplicated the numbers put forward by Howarth. A peer-reviewed 2018 Environmental Defense Fund study estimated that 2.3 percent of methane entered the atmosphere during gas production, or 60 percent higher than EPA estimates. A peer-reviewed 2020 study estimated that methane emissions in the Permian Basin, America's largest oil-producing region where flaring is common, were 3.3 percent. A peer-reviewed 2022 EDF study estimated that low producing oil and gas wells are a particularly large source of methane emissions, with leakage rates of 11 percent.

Industry groups have frequently criticized Howarth's work as politically motivated, saying his numbers are inflated.

"It's just extremely frustrating to even deal with claims like this, because we talk about settled science," said Dan Byers, vice president of policy at the U.S. Chamber of Commerce, where he works on environmental issues. "The notion that, you know, LNG and natural gas reduce emissions by displacing coal is completely well established. So it feels like we've got like a flat earth situation going on with these claims."

The benchmark study for LNG's climate impact is a 2019 analysis conducted by the Department of Energy. It found that the life-cycle emissions of U.S. LNG that's exported to Asia ranged from 54 percent to 2 percent less than local coal over a 20-year period. In Europe, those figures ranged from 56 percent less than coal to 1 percent more than coal. A peer-reviewed 2015 Carnegie Mellon University study echoed those findings. It found that LNG emitted 32 percent less than coal when used for power generation. But it found LNG emissions were 4 percent higher than coal when used as a substitute for industrial heat over the short-term.

The DOE study assumed methane leaks from the U.S. gas supply chain were 0.7 percent. To critics like Byers, that is evidence that Howarth's numbers are inflated. But his supporters say it shows that DOE needs to update its assumptions. Howarth's newest analysis assumes a leakage rate of 2.6 percent. Carnegie Mellon researchers, for their part, assumed a 3 percent leakage rate for U.S. gas production.

While governments and companies are stepping up their efforts to monitor for methane leaks, it might be years before complete data are available about the climate impact of gas production, said Deborah Gordon, a researcher who co-runs the Oil and Gas Solutions Initiative at RMI, a clean energy think tank. Her research suggests U.S. leakage rates vary widely by region.

In a 2023 study published in the journal *Environmental Research Letters*, Gordon and a team of RMI researchers cited recent aerial surveys that suggested leakage rates range from 0.65 percent of gas production to 66.2 percent across various U.S. gas basins. The study found that gas systems with a 4.7 percent leakage rate are on par with emissions from coal mines, another major source of methane pollution.

"This whole push for LNG writ large because people are still playing this trope that it's half as much CO2 as coal just doesn't hold water," Gordon said in an interview. "The only way to get off coal that's better for the climate is to substitute it with renewables, and it's infinitely doable and affordable."

The U.S. and Canada have abundant natural gas resources, which makes the fuel cheap and has helped displace coal in the power sector, said Sara Hastings-Simon, an associate professor in the Department of Earth, Energy and Environment at the University of Calgary. But whether other countries can reduce their own coal use with imported American LNG is an open question, she said.

Some regions, like Europe, have extensive pipeline networks that would make it relatively cost-effective to swap coal for gas. But European coal plants tend to be older, meaning they are closer to retirement and offer diminishing climate benefits of replacing them with gas.

India, by contrast, has a relatively young coal fleet and could conceivably reduce emissions by switching to gas. But that would require a massive build-out of gas infrastructure, which would be expensive and make gas even less competitive with coal, Hastings-Simon said. It would also risk locking in gas infrastructure for decades, diminishing its climate benefits, she added.

In 2022, Hastings-Simon co-authored a study published in *Environmental Research Letters* that found expanded LNG use was incompatible with limiting global temperature rise to 2 degrees Celsius or less. But it also concluded the fuel could help stave off temperature increases in excess of 3 degrees Celsius by preventing additional coal consumption, making LNG a sort of "insurance policy" against runaway warming.

"The nature of LNG is that it is lower-emitting, but it's not zero emissions," Hastings-Simon said.

She declined to comment on Howarth's research showing that LNG is dirtier than coal, but she said, "This idea of, well, gas is better than coal, therefore LNG is better for the climate, full stop — it's pretty clear, that's not the case."