3 Questions: Francis O'Sullivan on the climate impact of 'leaky methane'

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Natural gas has been touted as a "bridge fuel" to a less carbon-intensive future, as it generates far less carbon dioxide than energy produced by burning coal. But the natural gas production, processing, and distribution system leaks methane, another powerful greenhouse gas. A study published today in the journal *Science* reports that federal estimates of methane emissions have consistently underestimated the methane leaking from the natural gas system over the last 20 years. The study's new estimates raise questions about natural gas's actual climate benefit.

MIT News spoke with co-author Francis O'Sullivan, director of research and analytics at the MIT Energy Initiative, about what the new estimates mean for the future of natural gas.

Q: What is "leaky methane," and what impact does it have on climate?

A: Leaky methane, or "fugitive" methane, is methane that is produced from natural gas or oil wells, but does not make it to the burner tip at the end of the pipe, or isn't combusted to fuel pipelines. Methane as a molecule is a very potent greenhouse gas—about 30 times more potent than carbon dioxide on a 100-year basis, and much more so over a shorter-term basis. So even small leaks can have a very significant impact on climate change.

Currently, the [Environmental Protection Agency's] best guess is that the U.S. system leaks about 1.5 percent of gross production—28 million tons of methane per year. That is considered a very significant leak, because methane itself represents an appreciable portion of the total greenhouse gas emissions of the United States. So there's a need for focusing on minimizing fugitive methane emissions.

Q: You found that the U.S. has been underestimating methane leakage over the past 20 years. How did you determine this, and what was the result?

A: Our study synthesized about 200 studies that involved everything from continental-scale atmospheric measurements to measurements of leaks from individual devices. Based on this work, the evidence consistently shows that actual measurements are about 1.5 times greater than what the EPA's inventorying method suggests. That's a gap of approximately 14 trillion grams of methane.

The EPA method assigns an emissions factor to everything. Take natural gas as one example: They say a particular operation or facility will leak a certain amount of methane per year. Then they multiply that factor by the number of stations or activities that took place—the activity factor—building up their inventory.

What our work shows is that [the EPA's] methodology underestimates the amount of methane being released because emissions and activity levels are not always accurate. There's a lot of work now involving going to facilities and measuring individual processes, and you find there's this broad distribution: Most pieces of equipment don't leak at all, while a few are "super-emitters" that release large amounts of methane. If you had a consistent level of emissions, you could build a reasonable statistical representation. But likely the EPA's emission factors were built on a data set that didn't quite capture these extreme events appropriately. And in that setting, you end up with underestimates.

Q: What do these new estimates of methane leakage mean in gauging the climate benefit of natural gas production?

A: There's a heated debate now with regard to the climate-change-mitigation benefits of moving from coal to gas in the power system. Although our study found natural gas leaks more methane than previously thought, the shift to natural gas is still a positive move for climate-change-mitigation efforts.

While a good move within the power sector, the shift to natural gas may not be positive for other sectors, like transportation. Substituting natural gas for gasoline appears to yield no appreciable climate benefits. In the case of diesel fuel, switching to natural gas would actually be a negative change for climate efforts. That's quite an important implication.

With that said, the fact that super-emitters are a significant source—and these super-emitters are often simply a mistake, like someone left a hatch or valve open in the system—[means that] you can have a very significant impact on reducing fugitive emissions if you can more effectively sample, sense the system, identify those super-emitters, and then deal with the problem. That opens up the vista for more rigorous sampling and monitoring campaigns, and new technology for remote sensing that would allow us to identify these leaks on a more cost-effective basis. This new technology is critical because if our policy is going to continue to focus on using gas as a "bridge fuel," we need to double down our efforts to mitigate the leaks.

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