

Climate Benefits of Natural Gas May Be Overstated

Policy-makers and the energy industry have been looking to natural gas in recent years as a more climate friendly fuel with half the greenhouse gas emissions of coal, but EPA research is casting doubt on that plan.

By Abraham Lustgarten and ProPublica | Wednesday, January 26, 2011 | 3 comments

The United States is poised to bet its energy future on natural gas as a clean, plentiful fuel that can supplant coal and oil. But new research by the Environmental Protection Agency—and a growing understanding of the pollution associated with the full "life cycle" of gas production—is casting doubt on the assumption that gas offers a quick and easy solution to climate change.

Advocates for natural gas routinely assert that it produces 50 percent less greenhouse gases than coal and is a significant step toward a greener energy future. But those assumptions are based on emissions from the tailpipe or smokestack and don't account for the methane and other pollution emitted when gas is extracted and piped to power plants and other customers.

The EPA's new analysis doubles its previous estimates for the amount of methane gas that leaks from loose pipe fittings and is vented from gas wells, drastically changing the picture of the nation's emissions that the agency painted as recently as April. Calculations for some gas-field emissions jumped by several hundred percent. Methane levels from the hydraulic fracturing of shale gas were 9,000 times higher than previously reported.

When all these emissions are counted, gas may be as little as 25 percent cleaner than coal, or perhaps even less.

Even accounting for the new analysis, natural gas—which also emits less toxic and particulate pollution—offers a significant environmental advantage. But the narrower the margins get, the weaker the political arguments become and the more power utilities flinch at investing billions to switch to a fuel that may someday lose the government's long-term support.

Understanding exactly how much greenhouse gas pollution comes from drilling is especially important, because the Obama administration has signaled that gas production may be an island of common political ground in its never-ending march toward an energy bill. The administration and Congress are seeking not just a steady, independent supply of energy, but a fast and drastic reduction in the greenhouse gases associated with climate change.

Billions of cubic feet of climate-changing greenhouse gases—roughly the equivalent of the annual emissions from 35 million automobiles—seep from loose pipe valves or are vented intentionally from gas production facilities into the atmosphere each year, according to the EPA. Gas drilling emissions alone account for at least one-fifth of human-caused methane in the world's atmosphere, the World Bank estimates, and as more natural gas is drilled, the EPA expects these emissions to increase dramatically.

When scientists evaluate the greenhouse gas emissions of energy sources over their full lifecycle and incorporate the methane emitted during production, the advantage of natural gas holds true only when it is burned in more modern and efficient plants.

But roughly half of the 1,600 gas-fired power plants in the United States operate at the lowest end of the efficiency spectrum. And even before the EPA sharply revised its data, these plants were only 32 percent cleaner than coal, according to a lifecycle analysis by Paulina Jaramillo, an energy expert and associate professor of engineering and public policy at Carnegie Mellon University.

Now that the EPA has doubled its emissions estimates, the advantages are slimmer still. Based on the new numbers, the median gas-powered plant in the United States is just 40 percent cleaner than coal, according to calculations ProPublica made based on Jaramillo's formulas. Those 800 inefficient plants offer only a 25 percent improvement.

Other scientists say the pollution gap between gas and coal could shrink even more. That's in part because the primary pollutant from natural gas, methane, is far more potent than other greenhouse gases, and scientists are still trying to understand its effect on the climate—and because it continues to be difficult to measure exactly how much methane is being emitted.

In November the EPA announced new greenhouse gas reporting rules for the oil and gas industry. For the first time under the Clean Air Act, the nation's guiding air quality law, thousands of small facilities will have to be counted in the pollution reporting inventory, a change that might also lead to higher measurements.

The natural gas industry, in the meantime, has pressed hard for subsidies and guarantees that would establish gas as an indispensable source of American energy and create a market for the vast new gas reserves discovered in recent years. The industry would like to see new power plants built to run on gas, automobile infrastructure developed to support gas vehicles and a slew of other ambitious plans that would commit the United States to a reliance on gas for decades to come.

But if it turns out that natural gas offers a more modest improvement over coal and oil, as the new EPA data begin to suggest, then billions of dollars of taxpayer and industry investment in new infrastructure, drilling and planning could be spent for limited gain.

"The problem is you build a gas plant for 40 years. That's a long bridge," said James Rogers, CEO of Duke Energy, one of the nation's largest power companies. Duke generates more than half of its electricity from coal, but Rogers has also been a vocal proponent of cap-and-trade legislation to limit greenhouse gas emissions.

Rogers worries that a blind jump to gas could leave the country dependent on yet another fossil resource, without stemming the rate of climate change.

"What if, with revelations around methane emissions, it turns out to be only a 10 or 20 percent reduction of carbon from coal? If that's true," he said, "gas is not the panacea."

The American Petroleum Institute said in an e-mailed response that federal offshore drilling rules are already cutting down on the emissions tallied by the government. Spokesmen for the Independent Petroleum Association of America and the natural gas lobbying groups Energy in Depth, American Clean Skies Foundation and America's Natural Gas Alliance, which have all been pushing to expand the use of gas, declined to comment on the EPA's new figures and what they mean for the comparison between gas and coal.

But industry groups point out that gas looks attractive compared to the alternatives.

Nuclear energy is less polluting than gas from a climate-changing perspective, but it is costly and viewed skeptically in the United States because of the dangers of disposing of radioactive waste. So-called "clean coal"—including underground carbon sequestration—could work, but the technology has repeatedly stalled, remains unproven, and is at least 15 years away. Renewable sources like wind and solar are being developed rapidly, but the energy is expensive and won't provide a commanding supply of electricity for decades.

Gas, on the other hand, is plentiful, accessible and local.

Methane Is a Potent Climate Gas

Measuring the amount of natural gas that is leaking during drilling is one challenge. Getting a grip on how that gas—which is mostly methane—affects the environment, and what effect it will have on global warming, is another. And on that, some scientists still disagree.

Greenhouse gases include carbon dioxide, as well as methane, propane and lesser-known gases that also affect climate change. For the purposes of standardization, all these gases are described together using the unit Co₂e, or carbon dioxide "equivalent." But because each gas has a different potency, or "warming" effect on the atmosphere, a factor is applied to convert it to an equivalent of carbon dioxide.

Methane, the primary component of natural gas and among the more potent greenhouse gases, has far more of an effect on climate change than carbon dioxide. But determining the factor that should be applied to measure its relative warming affect is still being

debated.

To crunch its numbers, the EPA calculated the average concentration of methane in the atmosphere over a 100-year period and determined that over that period methane is 21 times more potent than carbon dioxide. Using that equation, a ton of methane emissions is the equivalent of 21 tons of carbon dioxide.

But some scientists argue that the impact of methane gas should be calculated over a shorter time period, because methane degrades quickly, and because gas drilling releases large quantities of methane into the atmosphere all at once, likely concentrating and amplifying the effect.

Robert Howarth, an environmental biology professor at Cornell University, used research from the United Nations to calculate that if methane's potency were considered over 20 years rather than 100 years, it would be 72 times as powerful as carbon dioxide in terms of its warming potential.

Figured that way, the climate effect of methane from natural gas would quickly outpace the climate effect of carbon dioxide from burning coal. Howarth's research is incomplete and has been criticized because at first he failed to figure in methane emissions from coal mining. But he said that after correcting his error, the emissions from coal barely changed, and the data still showed that the intensity of methane could erase the advantages of using natural gas.

"Even small leakages of natural gas to the atmosphere have very large consequences," Howarth wrote in a March memorandum [2], which he says is a precursor to a more thorough study that could begin to scientifically answer these questions. "When the total emissions of greenhouse gases are considered ... natural gas and coal from mountaintop removal probably have similar releases, and in fact natural gas may be worse in terms of consequences on global warming."

Howarth says his latest calculations show that the type of shale gas drilling taking place in parts of Texas, New York and Pennsylvania leads to particularly high emissions and would likely be just as dirty as coal.

Environmental groups say factual data on how much methane is emitted from gas fields—and what the warming affect of that methane is—should be locked down before major policy decisions are made to shift the nation toward more reliance on gas.

"You can't just assume away some of these sources as de minimus," said Tom Singer, a senior policy analyst for the Natural Resources Defense Council who focuses on emissions reporting in New Mexico. "You need to get a handle on them before you can make a determination."

Less Pollution Means More Profit

The EPA tracks fugitive and vented methane emissions through a program called Natural Gas STAR and then works to get drilling companies to save money by stanching their leaks and selling the gas they capture for profit. It was a discrepancy in the Gas STAR data that prompted the EPA to sharply revise the government's greenhouse gas statistics late last year.

According to Gas STAR's most recent figures, at least 1.6 percent of all the natural gas produced in the United States each year, about 475 billion cubic feet, is assumed to be leaked or vented during production. But those numbers were reported before the EPA adjusted its greenhouse gas estimates, and they are expected to rise when the new estimates are plugged into the calculation. If companies could capture even the gas leaked in Gas STAR's current estimates, it would be worth \$2.1 billion a year at today's prices and would cut the nation's emissions by more than 2 percent right off the bat. Several studies show that maintaining and installing equipment to capture the emissions pays for itself within 24 months.

Gas STAR has seen some success in pushing companies to use these capture tools. The EPA's 2010 greenhouse gas inventory, using 2008 data, shows that even though more gas is being produced from more wells, total emissions from that production have decreased by more than 26 percent since 1990, mostly due to the progress of Gas STAR. But while these figures demonstrate that Gas STAR is effective in lowering the annual rate of emissions, the EPA's new figures essentially move the starting point, and, when recalculated, 2008 emissions are now understood to have been 53 percent higher than emissions in 1990.

That doesn't mean the program isn't working—it is. It simply means that the road to making reductions significant enough to affect the rate of climate change is much longer than expected.

The EPA now reports that emissions from conventional hydraulic fracturing are 35 times higher than the agency had previously estimated. It also reports that emissions from the type of hydraulic fracturing being used in the nation's bountiful new shale gas reserves, like the Marcellus, are almost 9,000 times higher than it had previously calculated, a figure that begins to correspond with Robert Howarth's research at Cornell.

Clean Enough to Count On?

Getting a solid estimate of the total lifecycle emissions from natural gas is critical not only to President Obama's—and Congress'—decisions about the nation's energy and climate strategy, but also to future planning for the nation's utilities.

Even small changes in the lifecycle emissions figures for gas would eventually affect policy and incentives for the utility industry, and ultimately make a big difference in how gas stacks up against its alternatives.

Rogers, the Duke executive, says the country's large promised reserves of natural gas must also hold up for gas to prove beneficial, in terms of both cost and climate. If domestic reserves turn out to be smaller than predicted, or the nation runs out of gas and turns to liquefied gas imported from overseas, then the greenhouse gas footprint of natural gas would be almost equal to coal, Jaramillo pointed out in her 2007 lifecycle analysis, published in the journal *Environmental Science and Technology* [3]. That's because the additional processing and shipping of liquefied gas would put even more greenhouse gas pollution into the atmosphere.

"In the 60's we put a needle in one arm—it was called oil," Rogers said. "If the shale gas doesn't play out as predicted, and we build a lot of gas plants in this country, and we don't drill offshore, we're going to be putting the needle in the other arm and it's going to be called gas."

The utilities are in a bind because they have to build new power plants to meet the nation's demand for energy, while anticipating an as-yet-undefined set of federal climate and emissions regulations that they believe are inevitable. Do they build new gas-fired plants, which can cost \$2 billion and take three years to bring online? Or do they wait for proven systems that can capture carbon from coal-fired plants and sequester it underground?

If carbon sequestration works, coal-based power emissions could drop by 90 percent, said Nick Akins, president of American Electric Power, the nation's largest electric utility and the number-one emitter of greenhouse gas pollution. That suggests to Akins that natural gas may not be the solution to the nation's energy needs, but rather the transitional fuel that bridges the gap to cleaner technologies.

"Going from a 100 percent CO₂ emitter to a 50 percent solution when you could go beyond that is something we need to turn our attention to," said Akins. "If there is a 90 percent solution for coal, and other forms like nuclear, and renewables, then obviously you want to push in that direction as well."

Correction: The article originally misstated that methane, at least 21 times more potent than CO₂, is the most potent of greenhouse gases. The article should have stated that it is among the more potent greenhouse gases.