CU Study Points to Larger Carbon Footprint for Shale Gas Wells

by Sue Smith-Heavenrich
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"From a CO2 emissions standpoint [shale gas] is 60 percent cleaner than coal," says William Colton, VP of Exxon Mobile's corporate planning division.

That may be true, counters Cornell professor Robert Howarth, but combustion emissions are only part of the story. Not only that, the comparison is misleading. Instead of helping to alleviate the problem, developing natural gas in Marcellus and other shale formations is likely to aggravate global warming, Howarth says.

Over the past year, Howarth, collaborating with colleagues Tony Ingraffea and Renee Santoro, has been assessing the total contribution of greenhouse gas emissions generated from unconventional drilling. Next month their research, funded in part by the Park Foundation, will be published in the journal, *Climate Change Letters*. Earlier this month they discussed the numbers behind their findings.

Although no one has definitively calculated the contribution of greenhouse gases from gas drilling, the Cornell team's numbers show a big difference between conventional and unconventional drilling. Shale gas comes out worse, emitting anywhere from 30 percent to twice as much carbon into the atmosphere than conventionally drilled gas.

That's because unconventional gas wells are bigger, says engineering professor Tony Ingraffea. Longer horizontal wellbores require more drilling time and heavier drilling equipment, which means burning more diesel. Bigger wells mean more fracturing stages, heavier fracking equipment and more cement plugs in the horizontal bore – plugs that must be removed before the gas flows.

Bigger wells mean more flowback waste and more produced drilling fluids. And at every one of these stages carbon is lost, mostly in the form of methane that's released into the atmosphere either through venting or by flaring.

Before they could determine the amount of greenhouse gases emitted by an unconventional well, the Cornell team had to figure out what the "typical" shale gas well was like. They used data from Chesapeake wells drilled in Pennsylvania Marcellus shale that, Ingraffea said, reflect current drilling practices. Then they determined how much carbon was emitted from each stage of drilling and production.

While CO2 emissions are important, Howarth noted that methane is a more critical problem. Natural gas is 85 to 95 percent methane, a far more potent greenhouse gas than carbon dioxide. No one has measured actual methane emissions from gas wells throughout the various stages, so the Cornell relied on data from the gas industry, the General Accountability Office and EPA.

"A shale gas well can lose up to 3.2 percent of its lifetime production of methane in the first 12 days," Howarth said. The amount of gas vented during initial drilling activities varies with the rock formation, so the team calculated an average using industry data from five different formations.

Even with their conservative estimate, the Cornell team figures that 1.9 percent of a shale well's lifetime methane production escapes during initial drilling and completion. For conventional gas wells that figure is 0.1 percent. That difference, says Ingraffea, is due to hydro-fracking.

Once a gas well begins producing, gas continues to leak at the wellsite, said Howarth. This holds for conventional wells and unconventional wells, with little difference between the two. Additional methane is lost during processing, when sulfur is removed from the gas.

Even more gas is vented from storage tanks and lost from pipelines. That's not hard to believe, Howarth said, because half of the long-distance pipelines in the U.S. are more than 50 years old. The question is: how leaky are they? According to Texas companies operating in the Barnet shale, 3.6 percent of the gas shipped through pipelines never makes it to the end consumer.

When you tally up all the numbers from drilling to production to transport, something like 3.6 to 7.9 percent of the gas from a shale well disappears into the atmosphere over the lifetime of the well. That amount is 30 percent to two times greater than the amount lost during conventional gas production and development.

All the methane that is vented and flared during gas drilling ends up in the atmosphere where it contributes to global warming. The question, Howarth explained, is how to translate methane emissions into "carbon dioxide equivalents". Previously, scientists multiplied the amount of methane by 21. The Cornell team believes that multiplier should be much higher. Their conclusion: shale gas contributes twice as much greenhouse gas as coal.

These numbers are higher than current estimates, Howarth admits. "So how does our research compare to other peer-reviewed literature? For one thing, there *are* no other peer reviewed papers on methane emissions from shale gas," he says. The paper by the Cornell team will be the first, and they hope other scientists will challenge their numbers by conducting additional research.

You can see the slides from their talk and a list of upcoming lectures on gas exploration posted online at http://www.sustainablefuture.cornell.edu/news/NatGas-CSeq/index.php