'Problem wells' source of greenhouse gas at unexpected stage of natural gas production

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Researchers used the Purdue Airborne Laboratory for Atmospheric Research, a specially equipped airplane, to measure plumes of methane gas above shale gas wells in southwestern Pennsylvania. Credit: Paul Shepson

High levels of the greenhouse gas methane were found above shale gas wells at a production point not thought to be an important emissions source, according to a study jointly led by Purdue and Cornell

universities. The findings could have implications for the evaluation of the environmental impacts from natural gas production.

The study, which is one of only a few to use a so-called "top down" approach that measures methane gas levels in the air above wells, identified seven individual well pads with high emission levels and established their stage in the shale-gas development process.

The high-emitting wells made up less than 1 percent of the total number of wells in the area and were all found to be in the drilling stage, a preproduction stage not previously associated with significant emissions.

"These findings present a possible weakness in the current methods to inventory methane emissions and the top-down approach clearly represents an important complementary method that could be added to better define the impacts of shale gas development," said Paul Shepson, a professor of chemistry and earth atmospheric and planetary sciences at Purdue who co-led the study with Jed Sparks, a professor of ecology and evolutionary biology at Cornell. "This small fraction of the total number of wells was contributing a much larger large portion of the total emissions in the area, and the emissions for this stage were not represented in the current inventories."

The researchers flew above the Marcellus shale formation in southwestern Pennsylvania in the Purdue Airborne Laboratory for Atmospheric Research, a specially equipped airplane. The aircraft-based approach allowed researchers to identify plumes of methane gas from single well pads, groups of well pads and larger regional scales and to examine the production state of the wells.

This shows a well pad in southwestern Pennsylvania. A Purdue and Cornell study found high levels of the greenhouse gas methane above shale gas wells during the drilling stage -- a production point not thought to be a significant emissions source. Credit: Dana Caulton

"It is particularly noteworthy that large emissions were measured for wells in the drilling phase, in some cases 100 to 1,000 times greater than the inventory estimates," Shepson said. "This indicates that there are processes occurring - e.g. emissions from coal seams during the drilling process - that are not captured in the inventory development process. This is another example pointing to the idea that a large fraction of the total emissions is coming from a small fraction of shale gas production components that are in an anomalous condition."

The bottom-up inventories have been produced from industry

measurements of emissions from individual production, transmission and distribution components and then scaling up to create an estimate of emissions for the region. However, with thousands of wells, and a complex processing and transmission system associated with each shale basin, obtaining a representative data set is difficult, he said.

A paper detailing the results will be published in the *Proceedings of the National Academy of Sciences* on Monday (April 14). The David R. Atkinson Center for a Sustainable Future at Cornell University funded this research.

"We need to develop a way to objectively measure emissions from shale gas development that includes the full range of operator types, equipment states and engineering approaches," Shepson said. "A whole-systems approach to measurement is needed to understand exactly what is occurring."

More information: Toward a better understanding and quantification of methane emissions from shale gas development, www.pnas.org/cgi/doi/10.1073/pnas.1316546111

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