Unprecedented Measurements Provide Better Understanding of Methane Emissions during Natural Gas Production

Completion emissions are lower than previously estimated; Data show emissions from pneumatic controllers and equipment leaks are higher than EPA national emission projections; Estimates of total emissions are similar to the most recent EPA national inventory of methane emissions from natural gas production.

AUSTIN, Texas — A new study from The University of Texas at Austin reports on extensive measurements of methane emissions — including the first measurements for methane emissions taken directly at the well pad — during completion operations for hydraulically fractured wells. A team of researchers from UT Austin's Cockrell School of Engineering and environmental testing firms URS and Aerodyne Research completed measurements at 190 natural gas production sites across the United States. The study was published today in the *Proceedings of the National Academy of Sciences*.

The study, a unique partnership between the Environmental Defense Fund, participating companies, an independent Scientific Advisory Panel and the study team:

- Is based on measurements made directly at 190 production sites throughout the United States, with access provided by nine participating energy companies.
- Found that the majority of hydraulically fractured well completions, which were sampled during the study, had equipment in place that reduces methane emissions by 99 percent. Because of this equipment, methane emissions from well completions are 97 percent lower than calendar year 2011 national emission estimates, released by the Environmental Protection Agency (EPA) in April 2013.
- Found that emissions from certain types of pneumatic devices are 30 percent to several times higher than current EPA estimates for this equipment; combined, emissions from pneumatics and equipment leaks account for about 40 percent of estimated national emissions of methane from natural gas production.
- Found that the total methane emissions from natural gas production, from all sources measured in the study, were comparable to the most recent EPA estimates.

"The way in which wells are drilled and brought into production has been evolving," said David Allen, professor of chemical engineering at UT's Cockrell School of Engineering and principal investigator for the study. "The overall goal was to measure methane emissions during production at a large number of recently developed sites, and to assess the national implications for methane emissions. The team performed the first-ever direct measurements of methane emissions from some of these sources."

The UT-led field study was a cooperative effort involving experts from the Environmental Defense Fund; Anadarko Petroleum Corporation; BG Group plc; Chevron; Encana Oil & Gas (USA) Inc.; Pioneer Natural Resources Company; SWEPI LP (Shell); Southwestern Energy; Talisman Energy USA; and XTO Energy, an ExxonMobil subsidiary. The collaboration of the energy companies and unprecedented access to their natural gas production facilities and equipment allowed researchers to acquire direct measurements of methane emissions from natural gas production operations where hydraulic fracturing is used.

The study's measurements will help inform policymakers, researchers and industry, providing information about some of the sources of methane emissions from the production of natural gas and better inform and advance national and international scientific and policy discussions with respect to natural gas development and use.

"This study tackles one of the most hotly debated issues in environmental science and policy today," said Mark Brownstein, associate vice president and chief counsel of the US Climate and Energy Program, Environmental Defense Fund. "It shows that when producers use practices to capture or control emissions, such as green completions, methane can be dramatically reduced. The study also demonstrated, however, that certain methane emissions are larger than previously thought, indicating that there are many further opportunities to reduce emissions."

During the yearlong study, the UT-led study team selected times and general locations for sampling activities, and companies provided access to completions that occurred during those periods. Production sites near the completions were selected by the study team for sampling based on lists of available sites in the region provided by the participating companies. The sampling was designed to be representative of company operations in the Gulf Coast, Mid-Continent, Rocky Mountain and Appalachian regions. Measurements of active equipment at 150 production sites with 489 wells, 27 well completion flowbacks, nine well unloadings and four well workovers were included in the study. The types of sources measured account for two-thirds of methane emissions that occur during natural gas production, as estimated in the most recent national greenhouse gas inventory.

Measured emissions from completion flowbacks were much lower than previously estimated. During hydraulic fracturing, liquids that typically consist of water, sand and additives are injected at high pressure into low-permeability formations. After a well is fractured, it is cleared of sand and liquids that were injected into the well in a process called completion flowback. Two-thirds of the well completion flowbacks measured in the study either captured or combusted emissions, resulting in emissions measurements that were 99 percent lower than would have occurred in the absence of capture and combustion. The remaining one-third of completion flowbacks vented

methane, but these were low-emitting wells, so in total, the emissions from completion flowbacks were 97 percent lower than current EPA estimates.

“The net emissions for completion flowbacks is significantly lower than previous estimates, indicating the type of emission control activities observed during these events are very effective,” Allen said.

The study’s measurements of methane emissions from equipment leaks on well sites were comparable to current EPA estimates for this type of equipment; when scaled to national emission estimates, however, the study’s estimated emissions are higher than EPA estimates that include assumed voluntary reductions. The study also showed higher emissions for certain types of pneumatic devices used for controlling mechanical processes. Pneumatic devices, which are designed to release small amounts of methane in normal operation, were found to have emissions that were on average 70 percent higher than estimates in the EPA national inventory.

The study team made the first reported measurements of unloading emissions, collecting data for nine wells. In a liquids unloading, wells are cleared of water and other liquids that are inhibiting production. Wells may be unloaded daily, weekly, monthly, yearly, or not at all, depending on the geology of the formation. Because unloadings are intermittent, complex, and vary in frequency and characteristics between production regions, the researchers believe that a larger sample size is required to accurately characterize an average emissions rate.

“Understanding the level of methane emissions during unloadings will be important in establishing both national and regional inventories," said Allen, who will lead a study team that plans to collect additional data on both unloadings and pneumatic controllers, beginning later this month and concluding in early 2014. The additional measurements, which represent a second phase to the study, are being funded by Environmental Defense Fund, Anadarko Petroleum Corporation; BG Group plc; Chevron; Encana Oil & Gas (USA) Inc.; Pioneer Natural Resources Company; SWEPI LP (Shell); Southwestern Energy; and XTO Energy, an ExxonMobil subsidiary, ConocoPhillips and Statoil.

A Scientific Advisory Panel made up of six independent academic experts reviewed the study. The panel reviewed project plans before data collection and preliminary findings during data collection. Its members reviewed the draft final report and co-authored the published manuscript. Prior to publication, the study also went through the peer review process of the *Proceedings of the National Academy of Sciences*.

This study, focused on natural gas production, is part of a larger research effort spearheaded by the Environmental Defense Fund to measure methane emissions throughout the natural gas supply chain. Results for the studies addressing other parts of the supply chain will be reported during the next 12-18 months.

The University of Texas at Austin is committed to transparency and disclosure of all potential conflicts of interest of its researchers. Lead researcher David Allen serves as chair of the Environmental Protection Agency's Science Advisory Board, and in this role is a paid Special Governmental Employee. He is also a journal editor for the American Chemical Society and has served as a consultant for multiple companies, including Eastern Research Group and ExxonMobil. He has worked on other research projects funded by a variety of governmental, nonprofit and private sector sources including the National Science Foundation, the Environmental Protection Agency, the Texas Commission on Environmental Quality, the American Petroleum Institute and an air monitoring and surveillance project that was ordered by the U.S. District Court for the Southern District of Texas.

Financial support for this work was provided by the Environmental Defense Fund (EDF); Anadarko Petroleum Corporation; BG Group plc; Chevron; Encana Oil & Gas (USA) Inc.; Pioneer Natural Resources Company; SWEPI LP (Shell); Southwestern Energy; Talisman Energy USA; and XTO Energy, an ExxonMobil subsidiary.

Major funding for the EDF's 30-month methane research series, including their portion of the University of Texas study, is provided for by the following individuals and foundations: Fiona and Stan Druckenmiller, Heising-Simons Foundation, Bill and Susan Oberndorf, Betsy and Sam Reeves, Robertson Foundation, Tom Steyer and Kat Taylor, and Walton Family Foundation.

For more information and press materials go to:
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