Methane Production Related to Shale Gas Life-Cycle: Environmental and Economic Implications.

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Background

Natural gas is widely proposed as a clean bridge fuel to a lower carbon economy; however, the full life-cycle greenhouse gas (GHG) emissions of shale gas development is poorly constrained and suffers from a chronic lack of information.

The most recent science indicates:

- Immediate control of short-lived climate forcers such as methane is essential to limit long-term climate change (UNEP/WMO, 2011).
- The 20 year global warming potential (GWP) of methane is 45% greater than that reported by the IPCC 2007 when interactions with aerosols and other indirect effects are considered (Shindell et al. 2009).
- The fossil fraction of the global methane budget may be 50% greater than previously thought and is increasing (Lassey et al. 2007).
- Fugitive methane emissions related to shale gas development may be 30% to 2-fold greater than that of conventional gas (Howarth et al. 2011).

Importance of short-lived climate-forcing gases

Methane emissions from shale-derived gas

Eddie co-variance measurements

Observed deviation of temperature to 2009 and projections under various scenarios show that immediate controls on short-lived climate forcers such as methane are essential to limit long-term climate change (UNEP/WMO, 2011).

Quantify the flux of methane to the atmosphere associated with shale gas development

Approach

We will use the eddy covariance method to measure the flux (i.e., degree of transfer to the atmosphere) of methane downstream of areas of intensive hydrofracturing activity and downwind of areas not experiencing hydrofracturing. Measurements from both areas will reflect other methane sources (e.g., wetlands, cattle production, etc.) and the difference between sites will represent the contribution of hydrofracturing to total methane emission.

All measurements will be made from a portable tower system that can be moved among sites. On the tower is a high precision sonic anemometer for the measurement of wind speed and direction and a laser-based methane instrument. The combination of these instruments (pictured to the right) allows for an integrated measurement of methane entering the atmosphere and methane consumption (methane returning and consumed at the surface). We will coordinate our measurements with well operations and hydrofracturing to total methane emission.

We will use the eddy covariance method to measure the flux of methane to the atmosphere associated with shale gas development.

Future Related Work

Re-assess the global methane budget - We will use the eddy measurements of methane flux from well sites as well as the most recent literature values for other methane sources and isotopic composition of atmospheric methane to update the global methane budget.

Economic implications - We will conduct a sensitivity analysis explicitly considering the interaction of methane emissions with a carbon tax.

References


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