"If we don't control methane or black carbon, and only control CO2, we will reach irreversible tipping points with a couple decades."

"Preventing unconventional gas extraction could be the number one thing we could do in the short term to control U.S. greenhouse gas emissions."

Contact: Robert Howarth, Professor of Ecology and Evolutionary Biology, Cornell University, howarth@cornell.edu

Climate Impacts of Hydraulic Fracturing

Hansen: controlling methane critical to staying below 2°C threshold

- James Hansen published that to avoid melting of natural methane hydrates, leading to runaway climate change, we must prevent reaching global temperature rise of 1.8°C
- While most climate activists and scientists are focused on reducing carbon dioxide emissions, Hansen concludes trace gases are more important drivers climate change than previously thought
- Methane is the most important -- 105 times powerful than carbon dioxide in trapping heat in the atmosphere on a 20-year timescale, and 33 times more powerful at 100 years[1]
- Hansen concludes reducing methane emissions along with CO_2 is critical to avoid 1.8°C threshold and climate

New U.N. report: cutting methane and black carbon delays 2°C threshold

- Building on Hansen's work, UNEP and WMO published a report in July 2011 finding that timing is critical for controlling methane and black carbon
- The report found that curbing only methane and black carbon emissions (blue line) hits the 2°C threshold 10-20 years later than curbing only CO2 emissions (red line). Controlling all of these gases leads to far less warming (green line)
- The report has not yet been widely discussed
- "If we don't control methane or black carbon, and only control CO_2, we will reach irreversible tipping points with a couple decades," says Robert Howarth, Ecology Professor at Cornell University

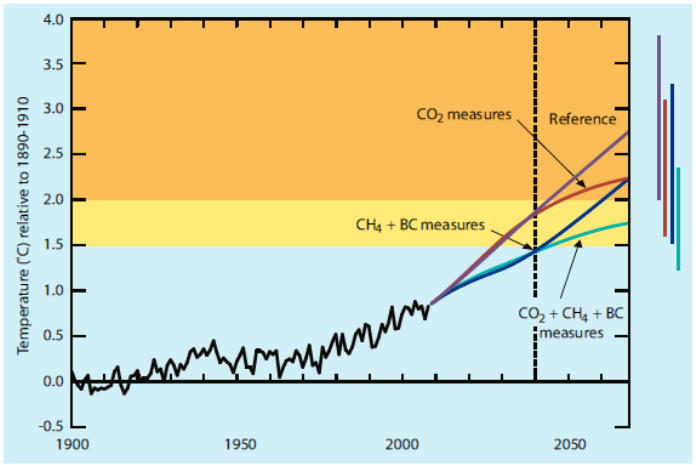


Figure 3. Observed deviation of temperature to 2009 and projections under various scenarios. Immediate implementation of the identified BC and CH_4 measures, together with measures to reduce CO_2 emissions, would greatly improve the chances of keeping Earth's temperature increase to less than 2°C relative to pre-industrial levels. The bulk of the benefits of CH_4 and BC measure are realized by 2040 (dashed line).

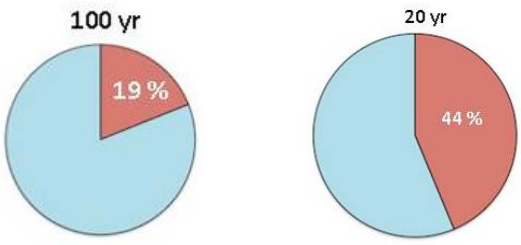
Reducing Methane Emissions Now Buys Time: Curbing methane and black carbon emissions (blue line) delays reaching the 2°C threshold by 10-20 years compared to curbing CO_2 emissions (red line)

Source: UNEP and WMO 2011

New EPA Inventory: methane is 44% of U.S. GHG emissions; natural gas is biggest source

- The updated EPA Inventory of U.S. Greenhouse Gas shows that 19% of U.S. greenhouse gas emissions are methane (on 100-year timescale)
- Using the new EPA inventory, Professor Robert Howarth at Cornell University calculates that on 20 year timeframe, methane is 44% of entire total U.S. greenhouse gas emissions
- The inventory reports natural gas is the biggest source of methane; drilling, piping, and burning natural gas is fully 39% of U.S. of methane emissions
- The world has been systematically undervaluing gas's role in climate change; previous estimates of the natural gas's climate impacts were underestimated by half

Emissions, (1)



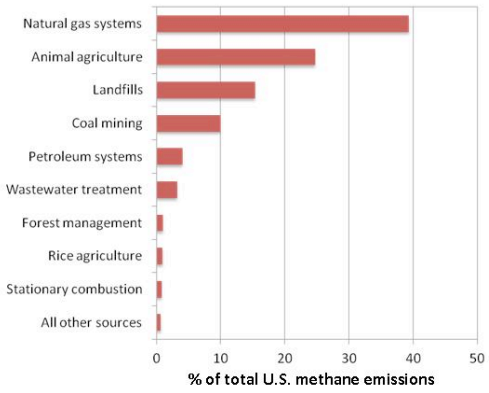
% total U.S. methane emissions of total U.S. GHG emissions

Fully 44% of U.S. greenhouse gas emissions are methane on 20-year timescale

Source: EPA 2011, Howarth, et al (in press)

Hydraulic fracturing for natural gas is "dirtier" than coal

- Although methane is 60% cleaner burning than coal, those numbers do not include methane leakage or CO2 emissions from drilling, transmission, which contribute to lifecycle emissions from gas drilling
- Fracking is even worse for our climate than conventional gas drilling; research by Cornell's Professor Robert Howarth found that, due to methane released and energy-intensive drilling practices, greenhouse gas pollution from unconventional "fracked" gas is greater than coal
- Howarth's research, reprinted in *Nature*, is based on methane in a 20 year time scale and shows that "fracking" is a more powerful contributor than coal to climate change



Natural gas is the largest source of methane in the U.S.: 17% of U.S. greenhouse gas emissions on 20-year timescale

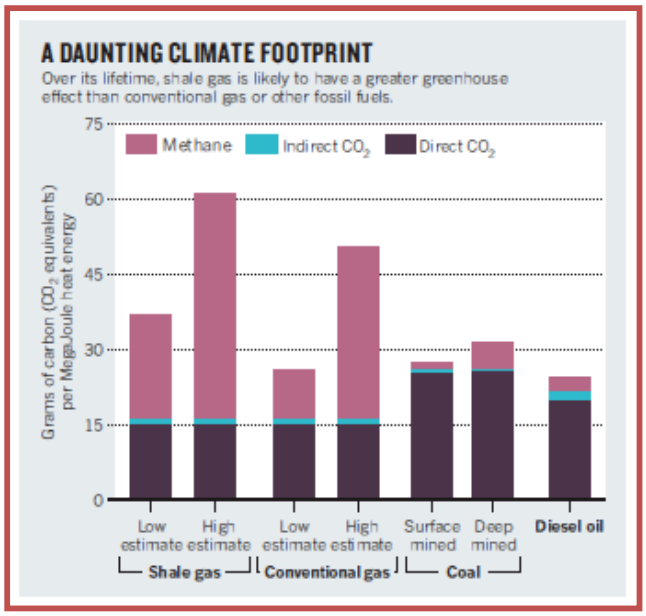
Source: EPA 2011, Howarth, et al (in press)

Unconventional shale gas extraction projected to displace conventional gas production

- Shale gas contributed less than 2% of natural gas production in the U.S. in 2005, but grew to 14% by 2009, and is projected to grow to 46% by 2035
- The US DOE predicts that unconventional shale gas extraction from hydraulic fracturing is projected largely to displace conventional vertical gas, and lead to little new energy
- The replacement of conventional gas by shale gas will increase greenhouse gas emissions from methane leakage and energy-intensive drilling practices

Stopping hydrologic fracking is priority for controlling U.S. methane emissions

- As shown above, the world has an urgent need to control methane emissions to stay below 1.5 to 2°C threshold
- Natural gas extraction is our biggest opportunity to control methane as it is the biggest source
- Unconventional gas extraction (fracking for shale gas) is low-hanging fruit for cutting methane emissions: it the biggest new source new of methane emissions, and therefore total greenhouse gas emissions, and also the easiest to control



Total greenhouse gas emissions from fracking for shale gas (left) are greater than conventional gas (middle) or coal (right)

Source: Howarth & Ingraffea (2011)

1. Numbers are from a paper by Drew Shindell and others in Science in 2009. Shindell works for Hansen at NASA Goddard Space Inst., and is one of the lead authors on the latest IPCC effort now under way.

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