Background on Methane Leaks

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CMI 2015
Is gas better for the climate than coal?

More gas use = half the CO$_2$ emissions but additional fugitive methane emissions.

How does one compare emissions of CO$_2$ and CH$_4$?
On the one hand: we have to limit emissions of both methane and CO$_2$ to achieve widely discussed targets.

Figure 1. Surface air temperature response to reductions in emissions of carbon dioxide (CO$_2$), short-lived climate pollutants (SLCPs), or both, relative to a business-as-usual (BAU) reference scenario. CO$_2$ mitigation includes 20% reduction relative to BAU by 2050, and declines steadily thereafter. SLCP mitigation includes deep cuts in black carbon (80%) and methane (40%). CO$_2$ emissions peak in 2080 in BAU case. Figure adapted from Shoemaker et al. 2013.
Methane has \(~100\times\) the radiative efficiency of CO2.

On the other, the benefits of a shift to gas depend on fugitive methane emission rates.

Global Warming Potential of Methane \((Th)\) = \(\frac{\int_0^{Th} \alpha_{CH4} C_{CH4}(t) \, dt}{\int_0^{Th} C_{CO2}(t) \, dt}\)

Methane decays away from the atmosphere faster than CO2.
Emission of 1 kg of CH$_4$ causes more warming than 80 kg of CO$_2$ for ~14 years.

Emission of 1 kg of CH$_4$ causes less than one half the warming of 80 kg of CO$_2$ after ~50 years.
Natural gas technologies typically emit less CO2 than alternatives. This benefit persists through time.

Emissions of methane reduce or reverse the benefits of reduced CO2 emissions, but this reduction itself decreases over time as the methane decays from the atmosphere.

Thus the benefits of natural gas depend critically on both fugitive emissions rates and the time horizon of interest.
To achieve net greenhouse benefit over ALL time horizons, methane leaks must be less than:

1.8% for a CNG vs. gasoline car
1.0% for a CNG vs. heavy diesel truck
3.2% for combined cycle vs. pulverized coal electricity

From Alvarez et al. 2012. PNAS
Conclusion

The literature on fugitive methane emissions is confused and based on too few measurements.

This allows some to claim that gas is worse than coal, and others to claim that methane leaks are not a problem.

We will know if expanded use of natural gas is good for the greenhouse only if we measure fugitive emissions from the entire gas infrastructure.