NSW Trade & Investment

Information on CSG migratory emissions for review

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Dear Rebecca

Thanks for the opportunity to send through some information on CSG fugitive emissions.

The key issue is that NGERS fugitive emissions factors are based on assumptions that come largely from the American Petroleum Institute Compendium, which is based on research done by the US EPA and Gas Research Institute (GRI) in the 1990s, recently updated in 2011.

These look at a range of parts of the process that leakage is known to take place, including well completions, work overs, venting etc.

The problem is that these are all at the wellhead (and some other parts of the process), and it doesn't measure methane escaping through other pathways.

Coal seams are "dewatered" in the CSG extraction process in order to eliminate the pressure that holds the gas in the seams. This allows the gas to migrate up the wells as intended.

However, the reduction in pressure as a result of dewatering also allows gas to migrate up other pathways including geological fissures and old bore holes. Fracking also has a reach of several hundred meters, so this can increase the number of pathways.

Clearly this methane has been trapped for geological ages, and does not just leak without the dewatering reducing the pressure.

The NGER/ API/ EPA measurements do not measure these "migratory emissions", because they look only at the wellhead and some other parts of the process.

When atmospheric measuring has been done at unconventional (Shale and CBM) fields in the US, concentrations of methane, and volumes extrapolated from modelling based on these concentrations have been very high. For example;

Tollefson, Jeff. "Methane Leaks Erode Green Credentials of Natural Gas." *Nature* 493, no. 7430 (January 2, 2013): 12–12. doi:10.1038/493012a.

This Nature 'news article' suggest losses of up to 9% in some cases, but importantly also references several other Journal articles including (and attached):

Pétron, Gabrielle, Gregory Frost, Benjamin R. Miller, Adam I. Hirsch, Stephen A. Montzka, Anna Karion, Michael Trainer, et al. "Hydrocarbon Emissions Characterization in the Colorado Front Range: A Pilot Study." *Journal of Geophysical Research* 117, no. D4 (February 21, 2012). doi:10.1029/2011JD016360.

Which suggests that up to 4% of the methane produced at a field near Denver was escaping into the atmosphere.

There is also the CBM Separator study carried out by the US DoE that found 15% of well yield at CBM fields in Wyoming USA being lost to the atmosphere (attached also)
Of course the most famous (and perhaps earliest) analysis is the Howarth paper (attached):

Howarth, Robert W., Renee Santoro, and Anthony Ingraffea. "Methane and the Greenhouse-gas Footprint of Natural Gas from Shale Formations." *Climatic Change* 106, no. 4 (April 12, 2011): 679–690. doi:10.1007/s10584-011-0061-5.

This is in the abstract:

"We evaluate the greenhouse gas footprint of natural gas obtained by high-volume hydraulic fracturing from shale formations, focusing on methane emissions. Natural gas is composed largely of methane, and 3.6% to 7.9% of the methane from shale-gas production escapes to the atmosphere in venting and leaks over the life-time of a well. These methane emissions are at least 30% more than and perhaps more than twice as great as those from conventional gas....."

If you want further information, there a references in the Tollefson and Howarth paper that might be worth following up. There is also a more Australian centric study I can dig up if you are interested - they considered a range of scenarios, including one with a 4.38% fugitive emissions rate (it should be noted that this rate is also based on the Petron et al work, so perhaps that is a duplication).

(as an aside, considering this 4.38% scenario, the overall emissions intensity for gas produced electricity is most definitely greater than coal).

The GLNG project was approved assuming only 0.1% fugitives, i.e. one 90th of the the measurements found by the NOAA.

The recent SCU study measuring concentrations of methane around Tara in QLD was vert preliminary found very high concentrations of up to 6.9 ppm.

Every time atmospheric methane is actually measured, rather than using assumptions that only look at wells (and some other parts of the process), the the leakage rates are found to be far higher. There is a least a very real danger that methane concentrations are very seriously underestimated because the atmospheric testing is not being done and migratory emissions are being ignored.

It is also extremely important that <u>independent</u> (not gas companies) baseline studies of methane concentrations are undertaken at all proposed gas fields.

I hope this is useful for your review.

Best Regards,

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(See attached file: Tollefson - 2013 - Methane leaks erode green credentials of natural g.pdf)(See attached file: Pétron et al. - 2012 - Hydrocarbon emissions characterization in the Colo.pdf)(See attached file: Howarth et al. - 2011 - Methane and the greenhouse-gas footprint of natura.pdf)(See attached file: CBM_Separator.pdf)

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4 attachments

CBM_Separator.pdf
1976K

Howarth et al. - 2011 - Methane and the greenhouse-gas footprint of natura .pdf
489K

Tollefson - 2013 - Methane leaks erode green credentials of natural g.pdf
364K

Pétron et al. - 2012 - Hydrocarbon emissions characterization in the Colo.pdf
1574K