To: Janice Whitney/R2/USEPA/US@EPA, Edward Hanlon/DC/USEPA/US@EPA
Date: 04/08/2010 06:07 PM
Subject: EPA Science Advisory Board - public comment on hydraulic fracturing study

Dear Ms. Whitney and Mr. Hanlon,

On Monday of this week (April 5), I wrote to ask that Tompkins County in New York's Southern Tier be on your list of stakeholders for the EPA study of hydrofracking. I hope that there will be notes from the scoping meetings you held yesterday and today, and that those notes will be distributed to all stakeholders.

I also mentioned in my earlier email that I was planning to submit a statement commenting on the draft scope for the study, on the critical issue of the full life-cycle emissions of shale gas. I now submit that statement, attached, with the signature of six additional legislators from our county. The second attachment is from Dr. Robert Howarth of Cornell University, as information that provides supportive detail; these two should be read and considered together.

We deeply appreciate consideration of these papers by the Science Advisory Board.
Please do not hesitate to contact me if there are any questions.
I look forward to hearing back from you.

Sincerely,
Martha Robertson

Martha Robertson
Chair, Tompkins County Legislature
320 N. Tioga St.
Ithaca, NY 14850
607-274-5434
607-592-3119 (cell)
www.tompkins-co.org

Tompkins County Legislature
320 North Tioga Street, Ithaca, N.Y. 14850
Telephone (607) 274-5434 Fax: (607) 274-5430
www.tompkins-co.org/legislature

Hydraulic Fracturing Research Plan:

Comments for EPA Science Advisory Board Meeting

April 8, 2010

The EPA's document, "Scoping Materials for Initial Design of EPA Research Study on Potential Relationships Between Hydraulic Fracturing and Drinking Water Resources" (March 2010), includes a broad range of questions related to the impacts on water resources from the practice of high volume hydrofracking (HVHF). We share deep concerns about water withdrawals, potential contamination of wells and aquifers, use of chemicals that are toxic and known or suspected carcinogens, mutagens, and endocrine disruptors, and the lack of adequate means of treating the flowback or produced water.

However, we are limiting our comments here to a single topic: the overall carbon footprint of HVHF and the undocumented assertion that gas is "cleaner" than other fossil fuels. We are concerned that this assumption leads many to conclude that we must accept the risks of HVHF in order to combat global warming. Unfortunately, this could be a tragic error. When the total life-cycle emissions of greenhouse gases (GHG) are considered, fossil gas extracted through HVHF may in fact be *worse* in terms of consequences on global warming than other fuels, even coal. Moreover, if massive new supplies of gas become available, the price will drop even below current low costs. This will make conservation and transition to renewable fuels less economically attractive and will further delay any transition to a more sustainable future for our nation.

We believe that, even if environmental protections from the risks of HVHF were as stringent as possible, the GHG impact of fossil gas cannot be mitigated. A full consideration of these issues should include **the effect of this type of drilling on the acceleration of climate change, which will itself have a resulting profound impact on our nation's water resources.**

Climate change is already causing disturbances in our nation's water resources. As noted in the EPA's document cited above, the charge to the agency from Congress states: *"The conferees urge the Agency to carry out a study on the relationship between hydraulic fracturing and drinking water..."* (p. 2). If HVHF increases our net carbon footprint and therefore accelerates the pace of global warming, the impacts will be extremely dangerous -- exacerbating the problem of water scarcity in our western states, and creating stress on the now-abundant water resources in our eastern states.

Therefore **it is critical to know the true cost, in greenhouse gas emissions that cause global warming, of fossil gas produced by HVHF.** As stated by Robert W. Howarth, David R. Atkinson Professor of Ecology & Environmental Biology, Cornell University (17 March 2010, statement attached to this document): "I am aware of no such analysis that is publicly available. Some information suggests that one or more assessments may have been conducted by industry groups, but if so these are available only to industry on a confidential basis. If such assessments exist, they have not been subjected to external, unbiased scientific review."

We therefore respectfully urge that the EPA's study include a full life-cycle analysis of the carbon footprint of HVHF.

Preliminary analyses suggest that HVHF may actually *increase* our nation's carbon footprint, *not* reduce it.

Natural gas is widely touted as a "green" source of energy because it releases fewer greenhouse gases (GHG) than does coal *when it is burned*. However, no less a figure than New York State's Deputy Commissioner of the Department of Environmental Conservation Val Washington has said that there has not been any study of the full life-cycle emissions of this unconventional drilling (presentation at New York State Association of Counties conference, Albany, NY, February 9, 2010). The Draft SGEIS on drilling the Marcellus Shale by NYS DEC contains some estimates of greenhouse gas emissions for Marcellus Shale production (see Chapter 6), but fails to use the estimates to make any recommendations.

However, the Tompkins County (NY) Planning Department did decide to use the figures in the draft SGEIS to estimate GHG emissions, based on the number of wells that would be allowed just in our county. Our staff's calculations indicate that a reasonable level of drilling would generate the equivalent of *516 years of emissions*, at current levels, from *all* other locally-generated sources.[1]

What are the sources of GHG from Unconventional Drilling?[2]

Obtaining natural gas through conventional drilling causes the emission of significant amounts of heat-trapping GHG during exploration, extraction, processing, and transmission. By comparison, even more GHG are emitted when gas is obtained by intense HVHF. Initial analyses by the National Research Council and the EPA indicate that the ecological costs of unconventional drilling will be higher than they are for conventional gas drilling.[3]

1. **Upstream Combustion of Fossil Fuels** (emits various GHGs, including CO_2, SOx and NOx):
    - **Transportation** uses large amounts of fuel to move equipment, to bring workers to the area and then to work sites, and especially to truck millions of gallons of water to and from each well, every time the well is fracked (NYS DEC estimates an average of 5 million gallons of water per fracking event).
    - **Operating drilling, processing and transmission equipment** (especially diesel-powered compressors, drills, pumps, separators, and dehydrators) is fuel-intensive.
    - **Storage and/or treatment of produced water** can only be done at specialized (and thus usually distant) locations. The only thorough method of removing certain toxic chemicals from used frack water is distillation (AKA crystallization of the chemicals), which uses very large amounts of energy.

2. **Releases of Unburned Methane (which traps 72 times as much heat as does CO_2[4])**
    - **Leaks** can begin during exploration if methane is released from overlying formations; leaks can also result from improper casings, or from migration of produced gas during fracking. Infrared camera video footage showing hydrocarbon leaks from many different parts of natural gas production can be seen at http://un-naturalgas.org/weblog/2009/09/782/.
    - **Flaring of methane** (intentional burning of produced gas) is carried out until a well is capped.
    - **Fugitive GHG emissions** are released during capping, processing, compression, transmission, and venting and volatilize from the flowback and produced water. With 2% fugitive emissions (a low-end estimate), peak emissions from *conventional* gas *equal those from coal* over 20 years.[5,6]

3. **Destruction of Carbon Sinks**[7]
   - **Trees and fields are cleared** from thousands of acres for drill pads, holding ponds, gathering lines, treatment and compressor stations, and transmission lines, plus access roads to all of the above.
   - **Air pollution, especially ozone,** from compressors and truck traffic slows growth of plants.
   - **Soil compacted** by heavy equipment retains less carbon due to the death of plant roots and microorganisms.
   - **Water contaminated** by spills of fuel, chemicals, drilling mud, and/or produced water no longer supports plant life.

We have experience already with the results of HVHF; we do not need to rely on modeling to investigate this problem. Ozone levels (ground-level smog) have gotten so high in the Pinedale, Wyoming area (home of the Pinedale Anticline gas field), that in recent winters they have rivaled the worst bad-ozone days in major cities such as Los Angeles.[8]

One notable recent report on global warming emissions from gas production is *Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements (*Al Armendariz, Ph.D., Southern Methodist University, 2009). In the Barnett Shale in Texas, where high-volume hydrofracking and horizontal drilling are already in use, emissions of carbon dioxide and methane are roughly equal, every day, to the greenhouse gas emissions from two 750 MW coal-fired power plants.

As summarized by Howarth, attached, "When the total emissions of greenhouse gases are considered, HVSWHF-obtained natural gas and coal from mountain-top removal probably have similar releases, and in fact the natural gas may be worse in terms of consequences on global warming." Given the disastrous effects of climate change on the nation's water resources, the EPA study will be incomplete if the relationship between HVHF and global warming is not studied thoroughly.

Finally, regarding stakeholder involvement, we appreciate the opportunity to request stakeholder status and look forward to meaningful involvement as this important research continues. Understanding that it is labor-intensive to involve the public, we believe it is essential to "cast a wide net" and strongly encourage the EPA to make it as easy as possible for stakeholders and the general public to follow your work and be engaged. In particular, we urge that EPA conduct public meetings where these issues are most pressing, such as New York, Pennsylvania, Texas, Colorado, and Wyoming.

Respectfully submitted,

Martha Oschrin Robertson, Chair, Tompkins County Legislature
Carol Chock, District No. 3 Legislator, City and Town of Ithaca
Nathan Shinagawa, MHA, District No. 4 Legislator, City of Ithaca
Kathy Luz Herrera, District No. 5 Legislator, City and Town of Ithaca
Pat Pryor, District No. 6 Legislator, Town of Lansing
Dooley Kiefer, District No. 10 Legislator, Villages of Lansing and Cayuga Heights
Will Burbank, District No. 12 Legislator, Town of Ithaca

References and More Information:

1. Tompkins County Planning Department comments to NYSDEC, Dec. 2009 accessed on 1/20/2010 at http://www.tompkins-co.org/planning/energyclimate/documents/PlanningDeptcommentsfinal12_30.pdf

2. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2007*, U.S. EPA, April 15, 2009.

   "Over the last two hundred and fifty years, the concentration of CH_4 in the atmosphere increased by 148 percent (IPCC 2007)." p. 20, Executive Summary.
   See also Key Categories [of GHG Emissions] Figure ES-16, p. 20, Executive Summary.

3. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use*, National Research Council, The National Academies Press, October 2009.

   "[Unconventional] processes have a considerably greater potential for causing air-quality degradation than do conventional recovery technologies. . . ." p. 84

   "Beyond emissions from engines, there are also significant GHG emissions of methane . . . from fugitive emissions. . . ." p.86.

   "The prospect of this [Marcellus Shale] gas, however, is balanced against the deeper drilling and more complicated extraction, which would increase the life-cycle energy use and associated emissions of using this resource." p.91

4. According to the latest report from the Intergovernmental Panel on Climate Change (2007, Table 2.14 of the 4th Assessment), methane's effect on global warming is 72 times greater than that of CO_2 (the difference in absorption of infrared radiation in the atmosphere).

5. EPA estimates of the amount of methane leaked in US production is reported by Revkin, A. and Krauss, C. October 14, 2009. "Curbing Emissions by Sealing Gas Leaks." *New York Times*, http://www.nytimes.com/2009/10/15/business/energy-environment/15degrees.html

6. Lovelock, J. 2007. *Revenge of Gaia*. Basic Books. See pp. 74–76 for the discussion of effective warming from methane.

7. See, for example "Land Use and Habitat Fragmentation of Oil Sands Production: A Life cycle Perspective," Jordaan, S., et al. University of Calgary/Institute for Sustainable Energy Environment and Economy, September 2009.

   "Methods for the inclusion of landscape fragmentation in life cycle assessment are not well established. . . . The results suggest that land disturbance due to natural gas production can be relatively large per unit energy." (from abstract)

8. Hargreaves, Steve, Small Town, Big Changes, CNNMoney.com, October 20, 2008.

****

Cornell University

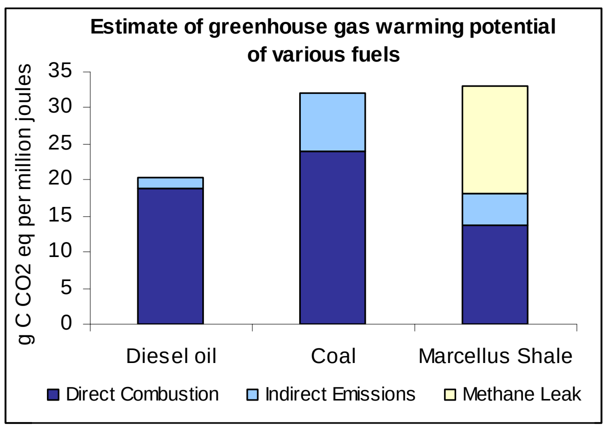
Department of Ecology and Evolutionary Biology

Preliminary Assessment of the Greenhouse Gas Emissions from Natural Gas obtained by Hydraulic Fracturing

Robert W. Howarth
David R. Atkinson Professor of Ecology & Environmental Biology, Cornell University
(*17 March 2010 Draft*)

Natural gas is being widely advertised and promoted as a clean burning fuel that produces less greenhouse gas emissions than coal when burned. While it is true that less carbon dioxide is emitted from burning natural gas than from burning coal per unit of energy generated, the combustion emissions are only part of story and the comparison is quite misleading. **A complete consideration of all emissions from using natural gas seems likely to make natural gas far less attractive than other fossil fuels in terms of the consequences for global warming.**

There is an urgent need for a comprehensive assessment of the full range of emission of greenhouse gases from using natural gas obtained by high-volume, slick water hydraulic fracturing (HVSWHF, or "hydrofracking"). I am aware of no such analysis that is publicly available. Some information suggests that one or more assessments may have been conducted by industry groups, but if so these are available only to industry on a confidential basis. If such assessments exist, they have not been subjected to external, unbiased scientific review.



A first attempt at comparing the total emissions of greenhouse gas emissions from HVWWHF-obtained natural gas suggests that they are 2.4-fold greater than are the emissions just from the combustion of the natural gas. This estimate is highly uncertain, but is likely conservative, with true emissions being even greater. **When the total emissions of greenhouse gases are considered, HVSWHF-obtained natural gas and coal from mountain-top removal probably have similar releases, and in fact the natural gas may be worse in terms of consequences on global warming.** Greenhouse gas emissions from HVSWHF-obtained natural gas are estimated to be 60% more than for diesel fuel and gasoline. These numbers should be treated with caution. Nonetheless, until better estimates are generated and rigorously reviewed, society should be wary of claims that natural gas is a desirable fuel in terms of the consequences on global warming. **Far better would be to rapidly move towards an economy based on renewable fuels. Recent studies indicate the U.S. and the world could rely 100% on such green energy sources within 20 years if we dedicate ourselves to that course.** See Jacobson & Delucchi (2009) A Path to Sustainable Energy by 2030, *Scientific American* 301: 58-65.

Presentation of assumptions and uncertainties behind estimates:

Considering the release during combustion alone, greenhouse gas emissions from burning natural gas average 13.7 g C of CO_2 per million joules of energy compared to 18.6 for gasoline, 18.9 for diesel fuel, and 24.0 for bituminous coal (U. S. Department of Energy: http://www.eia.doe.gov/oiaf/1605/coefficients.html). Additional emissions of greenhouse gas occur during the development, processing, and transport of natural gas (due to the use of fossil fuels to build pipelines, truck water, drill wells, make the compounds used in drilling and fracturing, and treat wastes, and the loss of carbon-trapping forests). I am aware of no rigorous estimate for these additional greenhouse gas emissions, but they appear likely to equal at least one third of those released during combustion (4.5 g C of CO_2 per million joules of energy). For comparison, the greenhouse gas emissions from obtaining, processing, and transporting diesel fuel and gasoline are in the range of 8% (Howarth et al. 2009: http://cip.cornell.edu/biofuels/), or perhaps 1.5 g C of CO_2 per million joules of energy. Note that as fossil fuel energy resources become more diffuse and difficult to obtain (as is gas in the Marcellus Shale), the energy needed to extract them and the greenhouse gas emissions associated with this effort go up substantially.

The leakage of methane gas during production, transport, processing, and use of natural gas is probably a far more important consideration. Methane is by the far the major component of natural gas, and it is a powerful greenhouse gas: 72-times more powerful than is CO_2 per molecule in the atmosphere (Table 2.14 in the Intergovernmental Panel on Climate Change Fourth Assessment Report (AR4), Climate Change 2007: The Physical Science Basis. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm). Note that this comparison of the global warming potential of methane with CO_2 is based on a 20-year assessment time; the factor decreases to 25-fold for for an 100-year assessment time. The shorter time with the higher relative global warming potential is the appropriate one, if one is concerned about the effects of methane during the time a natural gas field is developed, and for the few decades after production in the field ends. Since methane is such a powerful greenhouse gas, even small leakages of natural gas to the atmosphere have very large consequences on global warming. The most recent data I could find for the US (from 2006) suggest a leakage rate from the oil and gas industry of an amount of methane equal to 1.5% of the natural gas consumed (based on leakage data reported in EPA (2008) Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2006 and consumption data from the U.S. Department of Energy: http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/natural_gas_monthly/current/pdf/table_02.pdf). This leakage rate is roughly equal to that estimated by the EPA in 1997 (http://p2pays.net/ref/07/06348.pdf). However, as noted by Andrew Revkin in the New York Times in October 2009, the actual leakage is not well known, as monitoring is quite limited, and "government scientists and some industry officials caution that the real figure is actually higher" (http://www.nytimes.com/2009/10/15/business/energy-environment/15degrees.html?_r=2&scp=1&sq=natural%20gas%20leaks%20tanks&st=cse).

If we assume a 1.5% leakage rate, this would have a greenhouse gas warming potential equal to 14.8 g C of CO_2 per million joules of energy. This would be additive to the emissions during combustion (13.7 g C of CO_2 per million joules of energy) and to the emissions associated with obtaining and transporting the natural gas (very roughly estimated above as 4.5 g C of CO_2 per million joules of energy). Total greenhouse gas emissions from natural gas from hydraulic fracturing may, therefore, be equivalent to 33 g C of CO_2 per million joules of energy. For diesel fuel or gasoline, the total greenhouse gas emissions are equivalent to approximately 20.3 g C of CO_2 per million joules of energy.

The comparison with coal is difficult, as the energy needs and greenhouse gas emissions from mining and transporting the coal are not well known. As a first cut, it may make sense to assume that these are roughly equal to one third of the emissions from direct combustion, as we have done with natural gas. If so, total emissions from coal would be equivalent to 31.9 g C of CO_2 per million joules of energy, or very slightly less than the estimate for the natural gas.