Princeton University
Woodrow Wilson School of Public and International Affairs
Graduate Program

**WWS 591c Policy Workshop**
# State Policies on Hydraulic Fracturing

Fall Term - 2014

Mondays, 1:30-4:30 pm, Robertson Hall 005

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## INTRODUCTION, CLIENT, AND ASSIGNMENT

Climate change is a global environmental threat that will have increasingly undesirable effects around the world in our lifetimes. International negotiations to limit the emissions of long-lived greenhouse gases (GHG) have not yet succeeded in placing needed limits on emissions. There is a very real possibility that current emissions of GHG have already committed the world to "dangerous anthropogenic interference with the climate system".

There are, however, domestic initiatives to reduce GHG emissions. Our workshop will examine opportunities to reduce methane emissions from the extraction of natural gas from shale via hydraulic fracturing. Methane is a powerful short-lived (12-year lifetime) greenhouse gas (approximately 20 (50) times as potent as carbon dioxide over 100 (20) years with a lifetime of about 12 years) that also contributes to the formation of surface ozone that harms human health, agriculture and ecosystems. Combustion of methane leads to less carbon dioxide ($CO_2$) emission than combustion of coal, per unit heat obtained, and thus can result in a decrease of CO2 emissions. However, if sufficient methane leaks, the use of natural gas can be worse for climate than burning coal. The United States is now in the midst of a shale gas boom that has dramatically increased natural gas production (and likely leakage), decreased energy domestic energy prices, created jobs, and raised the ire of environmentalists due to its methane leakage and use and contamination of water resources.

**The objective of the workshop is to develop a set of state policy recommendations for governors to consider on how to reduce gaseous emissions and water impacts from shale gas development and distribution.**

## COURSE REQUIREMENTS AND PROCESS

The workshop will prepare a coherent, integrated, collective final report, with a one-page executive summary, findings, recommendations, and supporting rigorous analyses, emphasizing policy recommendations (15-20 single-spaced pages, plus exhibits and supporting individually- or collectively-written appendices). In addition, a concise PowerPoint presentation for briefing the clients and perhaps other relevant audiences will also be prepared and presented to the client early in January in Washington DC.

Initial background readings, lectures, discussions, an introductory meeting with the NGA clients in Washington D.C., and informal briefings by pertinent governmental, scientific, and NGO experts will take place during Weeks 1-6. Additional day trips for meetings with key experts may also be arranged.

Each workshop member will research and write a 10-15 page (double-spaced), well-referenced background paper on one key issue (either technical or policy) relating to fracking during Weeks 1-6. The key findings and recommendations from the papers will be presented orally by each workshop member to the entire group in class on Week 6, assisted by a concise PowerPoint presentation. The written paper will be submitted on BlackBoard to the faculty director and fellow workshop students by the Wednesday before fall break. Possible background paper topics will be distributed in the second week of class. Workshop members should select, define, and refine the individual paper topic in consultation with the clients, workshop members and the professor. Ideally these individual papers will provide background guidance for field research conducted during fall break and will contribute to the final report.

The workshop's final collective report will not simply be a compendium of the individual background papers however, although the content of some background papers, with rewriting, may be included in chapters or appendices of the final report.

An interim workshop report set of priorities is due at the end of Week 6, before the fall recess, in order to help structure research during break week. The outline will be shared with NGA clients and rapid turn-around comments requested.

During the fall recess (October 25 - November 2, 2010), groups of students will travel to various states to conduct interviews and gather information relevant and helpful for the workshop's assignment.

Weeks 7-12 will be devoted to the workshop's collective effort to develop a coherent final report and PowerPoint presentation. Additional speakers and field trips may be arranged as needed during Weeks 7-12.

Throughout the semester, workshop members are expected and encouraged to share information with each other via Blackboard, DropBox, GoogleDocs etc. as well as via e-mail and memos, on research leads, findings, etc. that will contribute to the group's deliberations and collective final report.

A draft of the workshop's final report is due Friday December 12, 2012 with a **presentation to NGA scheduled for early January 2012** in Washington D.C. Revisions to the report responding to NGA comments can be made during reading period and are encouraged. The final report is due to the instructor and clients by the end of the semester.

## EVALUATION

The final course grade and written evaluation of a student's performance in the workshop will be based upon:

| | |
|---|---|
| Workshop participation | 20% |
| Individual paper | 25% |
| Student presentations | 15% |
| Final report | 40% |

## READINGS

**Most initial reading and reference material for this workshop will be available on GoogleDocs at:**
**https://docs.google.com/spreadsheets/d/1OML0ES57EK_df2VKeWYhmF-heM6s6gd2x5iNxWPtOcM/edit#gid=0** and on BlackBoard under "Course Materials". Nathan Ratledge, WWS MPA 2014, has helped compile material. Students are encouraged to add to the Google Docs site with additional material you identify as useful. Other readings are accessible on the Web through links in this syllabus or on BlackBoard. Students are encouraged to share useful documents, papers and websites with each other as they find them.

Workshop members are urged to do as much reading as possible in advance of the weekly workshop meetings.

## WEEKLY SCHEDULE (Readings, Assignments, and Guest Speakers)

**WEEK 1. September 15, 2014.**
**General introduction/organization.**
**Climate Science and the role of Methane; Overview of Hydraulic Fracturing.**

Introduction to workshop assignment. Basic background information. Discussion of workshop process. Travel planning to meet client next Friday (September 26) in Washington DC. Fall recess travel. Organizational matters and logistics for the semester. Selection of student liaisons with Graduate Program Office.

Introduction to current state of understanding of climate change science. Role of methane in climate change and air pollution formation. Overview of hydraulic fracturing technology.

**Readings for the first few weeks:**

**These readings attempt to give you a basic understanding of climate change, reasons to be concerned about methane leakage, hydraulic fracturing technology and prospects, and various relevant federal and state level policies that are developing now.**

Climate Change 2013 Science Assessment: Summary for Policymakers, Intergovernmental Panel on Climate Change (IPCC). This gives an overview of the current understanding of climate change science.

http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf

Climate Change 2013 Mitigation Assessment: Summary for Policymakers, Intergovernmental Panel on Climate Change. This gives an overview of mitigation options. See pp. 21-22 on Energy Supply, and p. 27 for Mitigation policy and institutions.

http://report.mitigation2014.org/spm/ipcc_wg3_ar5_summary-for-policymakers_approved.pdf

If interested, you can access all the full IPCC Assessment Reports 5 (AR5) for 2013 here: http://www.ipcc.ch/report/ar5/

DL Mauzerall, Methane mitigation – Benefits for air quality, health, crop yields and climate, IGAC Newsletter, pp. 17-18, October 2011. http://www.princeton.edu/~mauzeral/papers/Mauzerall_CH4_IGAC_Newsletter_Oct11.pdf

Brandt et al., Methane Leaks from North American Natural Gas Systems, *Science*, 343 (6172): 733-735, 2014.

http://www.sciencemag.org/content/343/6172/733.summary

Climate Action Plan Strategy to Reduce Methane Emissions: http://www.whitehouse.gov/sites/default/files/strategy_to_reduce_methane_emissions_2014-03-28_final.pdf

*Optional*: Shindell et al (2012) Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security. Science 335, 183-189. This is a synthesis of the UNEP report. http://www.sciencemag.org/content/335/6065/183.full.pdf?sid=d88ec356-e93f-4af8-a1c6-cd50f32ea51e

*Optional*: The full report goes into detail on specific mitigation options for methane. UNEP. Near-term climate protection and clean air benefits: Actions for controlling short-lived climate forcers. http://www.unep.org/publications/ebooks/SLCF/

*Optional*: Reay, D. P. Smith, and A. van Amstel (Eds.). 2010. Chapter 1, Methane Sources and Budget and chapter 3 Options for Methane Control in: Methane and Climate Change. Washington, DC: Earthscan. These chapters are available on Blackboard. The full book is on reserve in Stokes.

**Information on Hydraulic Fracturing (on BlackBoard if not available from links below)**

General description of fracking in pictures: http://www.cnbc.com/id/47834540?slide=1

Hydraulic Fracturing: Unlocking America's Natural Gas Resources. American Petroleum Institute, July 2014. http://www.api.org/policy-and-issues/policy-items/hf/~/media/Files/Oil-and-Natural-Gas/Hydraulic-Fracturing-primer/Hydraulic-Fracturing-Primer-2014-highres.pdf

The report above gives the oil and gas industry perspective on fracking. It provides a useful summary of some facts and paints a rosy picture of the process.

Flaring Up: Natural Gas Flaring in North Dakota more than doubles in two years http://www.ceres.org/resources/reports/flaring-up-north-dakota-natural-gas-flaring-more-than-doubles-in-two-years

Describes how production is outpacing infra-structure ability to transport the gas with resulting negative impacts on climate, air quality and economics.

US Energy Information Agency cuts recoverable Montery Shale oil by 96 percent:

http://www.reuters.com/article/2014/05/21/eia-monterey-shale-

idUSL1N0O713N20140521

Shows how estimates of future reserves are uncertain.

Colorado first state to clamp down on fracking methane pollution:

http://www.bloomberg.com/news/2014-02-24/colorado-first-state-to-clamp-down-on-fracking-methane-pollution.html

Shows government-industry partnership.

Green Fracking: Five Technologies for Cleaner Shale Energy. National Geographic, March 2014. http://news.nationalgeographic.com/news/energy/2014/03/140319-5-technologies-for-greener-fracking/

"Should fracking stop? Point and Counterpoint", *Nature*, Vol 477, 15 September 2011.

This paper got a lot of attention:
Howarth, RW, Santoro, R, Ingraffea, A. Methane and the greenhouse-gas footprint of natural gas from shale formations, *Climatic Change* 106:679-690, (2011)
http://www.springerlink.com/content/e384226wr4160653/fulltext.pdf?MUD=MP

And was contested by:

Cathles III, LM, Brown L, Taam, M., Hunger A. A commentary on "The greenhouse-gas footprint of natural gas in shale formations" by Howarth et al., *Climatic Change* 113:525-535 (2012).

Kargbo, DM, Wilhelm, RG, Campbell, DJ, Natural gasplays in the Marcellus Shale: Challenges and Potential Opportunities, *Environmental Science and Technology*, 44, 5679-5684, 2010.

Wigley, Tom, Coal to gas: the influence of methane leakage, *Climate Change*, 108:601-608, 2011.

Tollefson, Jeff. Air sampling reveals high emissions from gas field. Methane leaks during production may offset climate benefits of natural gas. *Nature / News*. February 2012.

Freeman, Jody. The Wise Way to Regulate Gas Drilling. *New York Times,* OpEd, July 5, 2012.

## Some Proposed and Promulgated Hydraulic Fracturing Regulations:

EPA:
Targeting emissions of VOCs (with methane included as one of the captured gases):
http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/c742df7944b37c50852579e400594f8f!OpenDocument

New York State Department of Environmental Conservation:
http://www.dec.ny.gov/regulations/77353.html

Department of Interior:
http://www.doi.gov/news/pressreleases/Interior-Releases-Draft-Rule-Requiring-Public-Disclosure-of-Chemicals-Used-in-Hydraulic-Fracturing-on-Public-and-Indian-Lands.cfm

Targeting safe drinking water:
http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_hydroreg.cfm

**WEEK 2. Monday September 22. Continue coverage of background information from week 1.**

As we will be spending all day on Friday travelling to and from Washington DC, the Monday class meeting will end at 3:00.

**Trip to Washington DC to meet with clients on Friday September 26, 2014.**

**Please read over the material provided by the client on BlackBoard in folder labeled "Information from client"**

We will finish business from week 1, continue discussing hydraulic fracturing technologies and policies for reducing methane leakage and water contamination, and will prepare for our trip to Washington D.C. on Friday.

**Friday September 26, 2014: meeting with clients and possibly other relevant organizations in Washington D.C.**

**WEEK 3. September 29, 2014**
**Guest Speaker: John Quigley.**

**Mr. Quigley writes extensively on fracking issues on his blog.**

John Quigley
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http://johnhquigley.blogspot.com/
http://www.onearth.org/author/john-quigley
John Quigley Speaking:
https://www.youtube.com/playlist?list=PLgdZX6WDi0HlfiOrP6xRr-LhdarTeSR2n

Please look over some of the material provided on his blog and in the Google Docs as well as the reading listed in the first part of this syllabus. Mr. Quigley will present, answer questions, and help us formulate a research strategy and priorities. Let me know if you'd like to join us for dinner at 5:30PM on Monday.

**WEEK 4. October 6, 2014 – Research planning**

We will strategize on how to best divide the research components of the report among workshop students and will identify mid-term paper topics.

We will also decide on where to travel over fall break and identify who will go where.

**TRAVEL PROPOSALS DUE FRIDAY OCTOBER ?, 2014.**

**WEEK 5. October 13, 2014**
Guest speaker: TBD

**WEEK 6**. October 20, 2014. **Student Presentations and Discussions**

Assignments: First papers due. Ten minute oral presentations of individual papers. Workshop initial outline of final report due for discussion and submission to client for comments. Discussion of proposed field research during recess.

**FALL RECESS, October 27 - November 2, 2014: Field Research**

WEEK 7. November 3, 2014

Presentation and discussion of findings from field research during fall break. Finalizing of workshop final report organization and workshop member responsibilities. Feedback from client on initial outline of final report.

WEEK 8. November 10, 2014

Discussions and decisions on joint recommendations. Planning the workshop's final report. Assignments of remaining work.

WEEK 9. November 17, 2014

Discussions and decisions on joint recommendations. Planning the workshop's final report. Assignments of remaining work.

WEEK 10. November 24, 2014

Draft final report completed, circulated within the workshop for comment, and discussed.

WEEK 11. December 1, 2014

Revisions to draft final report. Provide draft report to clients for comment.

WEEK 12. December 8, 2014

Rehearsal of PowerPoint presentation to client and panel of experts.

Work on revisions in response to comments received from clients.

Reading period in January (week of January 5): Presentation of draft final report to NGA and panel of experts. Date TBD but likely January 7, 2015.

**Final report due to instructor and EPA clients by end of semester.**

## GENERAL BACKGROUND

### Web Sites on Climate Change, Energy, Sustainability:

Intergovernmental Panel on Climate Change. Includes all of the 2013 reports on Science, Adaptation and Mitigation as well as a variety of special reports http://www.ipcc.ch/ . These reports come from the flagship international assessment effort of climate change which shared the Nobel Peace Prize with Al Gore in 2007.

Tyndall Center for Climate Change Research. http://www.tyndall.ac.uk/index.shtml

International Energy Agency. www.iea.org

U.S. Environmental Protection Agency, Global Warming. http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html

U.S. Department of Energy, Energy Information Administration, Independent statistics and analysis http://www.eia.doe.gov/emeu/iea/contents.html

BP. Statistical Review of World Energy 2010. http://www.bp.com/productlanding.do?categoryId=6929&contentId=7044622

U.S. Department of Energy, Energy Information Agency. International Energy Outlook, 2013. http://www.eia.doe.gov/oiaf/ieo/index.html

Pew Center for Global Change. http://www.pewclimate.org/

CERES, Investors and Environmentalists for Sustainable Prosperity (coalition of investors, environmental and public interest organizations addressing climate change). http://www.ceres.org/

Environmental Defense. www.edf.org

Real Climate web site (real science from climate scientists). http://www.realclimate.org/

National Oceanic & Atmospheric Administration. http://www.noaa.gov/

Subscribe to CLIMATE-L list serve (moderated, world-wide submissions on climate change issues, about 2-3 per day on average): http://www.iisd.ca/email/subscribe.htm

Another useful list serve to consider is Climate Change Information Service, for various daily news clippings. Register at: http://www.climatewire.org/login.cfm