

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

**WWS 591e Policy Workshop: Integrating Clean Air and Greenhouse Gas  
Mitigation Strategies in Future Environmental Policy: A Focus on Black Carbon**

Fall Term - 2008

Mondays, 7-10pm, Robertson Hall 014

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**INTRODUCTION, CLIENT, AND ASSIGNMENT**

Climate change is a global environmental issue which will have increasingly undesirable effects around the world in our lifetimes. Air pollution is a local, regional and hemispheric issue that has adverse impacts on public health, agricultural yields and ecosystems. In many cases the emission of air pollutants and greenhouse gases (GHG) come from the same sources and addressing both together could have large co-benefits. However, policies to address the issues are currently separate. Integration of air quality and climate mitigation efforts will likely become a major issue in upcoming domestic legislative and policy debates. The topic is also important internationally as developing countries which face worsening air quality might be engaged in efforts to address climate change if technology and policy options were available that addressed both issues simultaneously.

Black carbon (BC) is an aerosol (particulate) that is emitted in combustion processes. It has a positive radiative forcing and hence contributes to climate warming. Reductions in its emissions would provide a positive benefit to both human health and would help reduce climate warming. This workshop will examine ways in which BC emissions can be reduced domestically and internationally and whether and how such reductions should be placed within domestic or international air quality and/or climate agreements/legislation/ regulations.

Our client is Mr. Robert Brenner, the Director of the Office of Policy Analysis and Review at the U.S Environmental Protection Agency (EPA) and a WWS alum. Brenner played a key role in the development, Congressional passage and implementation of the Clean Air Act Amendments of 1990 and has served for several years as Deputy Assistant Administrator for Air and Radiation, EPA's senior career executive in air pollution control. He, and members of his staff, have been actively involved in deliberations on EPA's role

in controlling GHG. The workshop will advise EPA on potential policy initiatives to jointly address climate change and air quality issues through domestic or international initiatives to reduce BC emissions under the new presidential administration which will take office in January 2008.

The workshop's task is to develop creative yet realistic, well-reasoned and supported policy recommendations for the U.S. Environmental Protection Agency to facilitate domestic and international mitigation of BC emissions under unified air quality and climate initiatives.

## **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 double-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.

Initial background readings, lectures, discussions, an introductory meeting with the EPA 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 of the key aspects of the workshop's assignment during Weeks 1-6. The written paper will be submitted to the workshop. The key findings and recommendations from the papers will be presented orally by each workshop member to the entire group in Week 6, assisted by a concise PowerPoint presentation. Possible background paper topics include, but are not limited to, a list of questions on science issues, engineering/economic issues and policy design issues developed by our EPA clients and the instructor. The list will be posted on Blackboard under Week 2.

Workshop members should select, define, and refine the individual paper topic in consultation with workshop members and the instructor.

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

During the fall recess (October 28 - November 5, 2006), small groups of students may travel to various domestic and foreign destinations, e.g., California, Germany, United Kingdom, France, etc., 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. An interim workshop report outline is due in Week 6, before the fall recess, in order to help structure research during break week. The

outline will be discussed with EPA and rapid turn-around comments requested. Additional speakers and field trips may be arranged as needed during Weeks 7-12

Throughout the semester, workshop members are expected to communicate with each other via Blackboard as well as 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 Monday December 8, 2008 with a **presentation to EPA scheduled for Friday December 12, 2008** in Washington D.C. Revisions to the report responding to EPA comments can be made during reading period and are encouraged. The final report is due to the instructor and EPA by Deans Date (last day of reading period --Tuesday January 13, 2009).

## EVALUATION

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

Workshop participation	20%
Student presentations	20%
Individual paper	20%
Final report	40%

## READINGS

Most reading material for this course will be posted on Blackboard. Other readings are accessible on the Web through links in this syllabus. Books listed in this syllabus are on reserve in the Stokes Library. Articles and chapters of some books are on e-reserves, at: <http://libweb5.princeton.edu/ereserves/logon.asp>. Click on "Login Directly to your Course Reading Page". The user ID is WWS591e and the password is policy.

Workshop members are urged to do as much reading as possible in advance, and recognize that the readings listed by week are also a resource for use throughout the semester. In addition to readings listed by week, this syllabus closes with lists of additional resources on reserve in Stokes Library and helpful web sites.

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

### WEEK 1. September 15, 2008.

#### Climate Science and general introduction/organization.

Introduction to workshop assignment. Basic background information. Discussion of workshop process. 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 and air quality science. Discussion of the current separate policy processes for air pollution and climate mitigation and opportunities for co-benefits in jointly addressing them.

Readings:

This article is an easily accessible and compelling summary of the threats of climate change.

Hansen, Jim. "The Threat to the Planet." New York Review of Books. Vol. 53, No. 12, July 13, 2006, pp. 12-16. <http://www.nybooks.com/articles/19131> (see e-reserves for version with important graphics)

Rosen, Richard A. Ruth f. Weiner, and reply by Jim Hansen. "The Threat to the Planet: An Exchange." New York Review of Books. Vol. 53, No. 14, September 21, 2006, p. 98. <http://www.nybooks.com/articles/19304>

Climate Change 2007 Synthesis Document: Summary for Policymakers, Intergovernmental Panel on Climate Warming. [http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf)

This is the web site where you can find all of the 2007 IPCC reports in .pdf format: <http://www.ipcc.ch/> Depending on your focus you will want to look at relevant sections of the detailed reports on "Science", <http://www.ipcc.ch/ipccreports/ar4-wg1.htm> and "Mitigation", <http://www.ipcc.ch/ipccreports/ar4-wg3.htm>.

NARSTO report: Global Change and Air Quality, chapters 1 and 10, Review draft, 2008.

Black carbon emissions can have a large impact on Arctic warming. The Arctic Climate Impacts Assessment is available here: <http://amap.no/acia/> I have placed the executive summary on Blackboard.

**WEEK 2. Monday September 22 Effects of Black Carbon on health and climate change. Friday September 26, 2008, EPA Client meeting, Washington D.C.**

We will have a brief meeting on Monday September 22, 2008 to finish business from week 1, discuss the effects of black carbon on health and climate, and to prepare for our trip to Washington D.C. on Friday September 26, 2008. EPA has provided a preliminary list of questions on BC organized into science, engineering/economic issues and policy design issues. I have posted the list, with some additions, on Blackboard. These questions could serve as topics for your individual papers as well as possible issues to address in the final report.

Readings:

I have posted on Blackboard under Week 2 the various presentations provided by EPA staff at a meeting a few of us attended over the summer. Also posted is a list of questions on science issues, engineering/economic issues and policy design issues developed by our EPA clients and the instructor for use in developing individual paper topics and developing an outline for the final report.

Also relevant are:

Ramanathan, V., and G. Carmichael (2008), Global and regional climate changes due to black carbon - Review article, *Nature Geoscience*.

Study Fingers Soot as a Major Player in Global Warming, *Nature*, 2008.

Reddy, M. S., and O. Boucher (2007), Climate impact of black carbon emitted from energy consumption in the world's regions, *Geophys. Res. Lett.*, 34, L11802, doi:10.1029/2006GL028904.

Levy, H., II, M. D. Schwarzkopf, L. Horowitz, V. Ramaswamy, and K. L. Findell (2008), Strong sensitivity of late 21<sup>st</sup> century climate to projected changes in short-lived air pollutants, *J. Geophys. Res.*, 113, D06102, doi:10.1029/2007JD009176.

Schwartz, J., B. Coull, F. Laden, and L. Ryan (2008), The Effect of Dose and Timing of Dose on the Association between Airborne Particles and Survival, *Environmental Health Perspectives*, 116.

### **WEEK 3. September 29, 2008**

#### **NGO Perspective.**

**Guest Speaker: Ellen Baum, Clean Air Task Force.**

#### Readings:

William Snape. Fighting global warming effectively in the short-term: giving the Arctic more time immediately by reducing black carbon pollution with existing and viable technologies, 2008. White paper (this has been making the rounds in Washington DC).

Rypdal, K., T. Berntsen, J. Fuglestvedt, K. Aunan, A. Torvanger, F. Stordal, J. M. Pacyna, and L. P. Nygaard (2005), Tropospheric ozone and aerosols in climate agreements: scientific and political challenges, *Environmental Science & Policy*, 8, 29-43.

Black Carbon Emissions and Climate Change: A Technical Workshop held in San Diego in late 2004. This describes some of the opportunities and uncertainties associated with BC.

[http://www.nrel.gov/vehiclesandfuels/nfti/bc\\_technical\\_wkshp.html](http://www.nrel.gov/vehiclesandfuels/nfti/bc_technical_wkshp.html) (workshop site)

[http://www.nrel.gov/vehiclesandfuels/nfti/pdfs/bc\\_recommendations.pdf](http://www.nrel.gov/vehiclesandfuels/nfti/pdfs/bc_recommendations.pdf)

(recommendations)

#### Introduced legislation:

110 Cong., 2<sup>nd</sup> session. HR-6739. Congressman Inslee's climate warming legislation, TITLE V—REDUCTION OF BLACK CARBON EMISSIONS TO PRESERVE THE ARCTIC.

110 Cong., 2<sup>nd</sup> session. Clinton amendment To require emission reductions for emissions of black carbon and tropospheric ozone precursors

**WEEK 4. October 6, 2008**

**Black Carbon sources and mitigation opportunities; Congressional bills.**

**Guest speakers:**

**Prof. Mark Jacobson, Stanford University, by video conference 7-9pm;  
James Bradbury, Congressman Jay Inslee's (D-WA) legislative assistant, former  
AAAS fellow**

Relevant reading:

Congressional testimony for hearing on black carbon and global warming of the House Committee on Government Oversight and Reform chaired by Henry Waxman.

Testimony is available at: <http://oversight.house.gov/story.asp?ID=1550> (bottom of page) for:

- **Dr. Mark Z. Jacobson**, Prof. of Civil and Environmental Engineering, Atmosphere/Energy Program, Stanford University
- **Dr. Tami C. Bond**, Asst. Prof. of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign
- **Dr. V. Ramanathan**, Prof. of Climate and Atmospheric Sciences, Scripps Institute of Oceanography, University of San Diego
- **Dr. Charles Zender**, Assoc. Prof. of Earth System Science, University of California at Irvine.
- **Dr. Joel Schwartz**, Professor of Environmental Epidemiology, Harvard University

Marc Jacobson has also published extensively on air pollution and climate change. Some of his papers address the effects of BC on health and climate and others are relevant to mitigation strategies. After reading his testimony, you may be interested in some of his papers. I have placed a couple on Blackboard (listed below). For others, please refer to his web page: <http://www.stanford.edu/group/efmh/jacobson/>

Jacobson, M. Z., (2008) Review of solutions to global warming, air pollution, and energy security. Submitted.

Jacobson, M. Z., Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming, J. Geophys. Res., 107(D19), 4410, doi:10.1029/2001JD001376, 2002.

The following book, on reserve in entirety and with four chapters highlighted below on e-reserve is very useful for understanding technology transfer approaches that were successful under the Montreal Protocol and that may have aspects that are applicable to BC mitigation for climate change and air quality.

Andersen, Steven O., Sarma, K. Madhava, Taddonio, Kristin N., Technology Transfer for the Ozone Layer: Lessons for Climate Change, chapters 2, Contours of technology transfer, chapter 3: Background of the ozone and climate agreements; chapter 13: Awareness and capacity building; chapter 14: Lessons, Earthscan, London, 2007. (Available on E-reserve).

Be sure to have read Congressman Inslee's climate warming legislation, (listed for last week) to discuss with James Bradbury, Congressman Inslee's LA.

**WEEK 5. October 13, 2008 –**

**Guest Speaker: Prof. Tami Bond, University of Illinois by video conference**  
**Black Carbon sources and policy implications**

Reading:

Bond, T. C., D. G. Streets, K. F. Yarber, S. M. Nelson, J.-H. Woo, and Z. Klimont (2004), A technology-based global inventory of black and organic carbon emissions from combustion, *J. Geophys. Res.*, 109, D14203, doi:10.1029/2003JD003697.

Bond, Tami. Can warming particles enter global climate discussions? *Environ. Res. Lett.* 2 (2007) 045030 (9pp)

Bond, Tami; Sun, Haolin. Can reducing black carbon emissions counteract global warming? *Env. Sci. & Tech.*, 39, 16, 2005. Also supplemental info.

**WEEK 6 October 20 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 26 - November 2: Field Research**

WEEK 7. November 3, 2008

Discussion of findings from field research during fall recess. Finalizing of workshop final report organization and workshop member responsibilities. Feedback from client on initial outline of final report. Short presentation by Joes Schwartz from Harvard School of Public Health on the health effects of aerosols.

WEEK 8. November 10, 2008

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

WEEK 9. November 17, 2008

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

WEEK 10. November 24, 2008

Draft final report completed, circulated within the workshop for comment, and discussed.  
Preparation of PowerPoint presentation.

WEEK 11. December 1, 2008

Revisions to draft final report. Preparation of draft final report. Rehearsal of PowerPoint presentation to client and panel of experts.

WEEK 12. December 8, 2008

**Presentation of draft final report to EPA and panel of experts on Friday December 12, 2008** in Washington D.C. Draft final report due before the presentation to EPA. Revisions in response to comments received from clients will be possible following presentation to EPA.

**Deans Date** (last day of reading period --**Tuesday January 13, 2009**): **Final report due to instructor and EPA clients.**

### **Some Web Sites on Climate Change, Black Carbon, Energy, Mitigation strategies, etc.:**

Intergovernmental Panel on Climate Change. Includes all of the 2007 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.

Convention on Long Range Transboundary Air Pollution (LRTAP). The protocols to the convention set international limits on emissions on many pollutants. Could BC be included in an additional protocol? <http://www.unece.org/env/lrtap/>

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

International Energy Agency. Dealing with Climate Change, Policies and Measures (searchable data base). <http://www.iea.org/textbase/envissu/pamsdb/index.html>

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, 2004. International Energy Annual 2003. <http://www.eia.doe.gov/emeu/iea/contents.html>

European Union. Collection of energy research documents and reports from the European Union on a variety of topics ranging from zero emission coal power plants to various renewable energy technologies. [http://europa.eu.int/comm/research/energy/index\\_en.htm](http://europa.eu.int/comm/research/energy/index_en.htm)



- BP. Statistical Review of World Energy 2006.  
<http://www.bp.com/subsection.do?categoryId=95&contentId=2006480>
- U.S. Department of Energy, Energy Information Agency. International Energy Outlook, 2003. Report # DOE/EIA-0484, 2004. <http://www.eia.doe.gov/oiaf/ieo/index.html>.
- International Energy Agency, 2002. World Energy Outlook 2002. Paris, France: OECD/IEA.  
[http://library.iea.org/dbtw-wpd/Textbase/nppdf/stud/02/weo2002\\_1.pdf](http://library.iea.org/dbtw-wpd/Textbase/nppdf/stud/02/weo2002_1.pdf).
- International Energy Agency, 2003. Key World Energy Statistics. 2003.  
<http://www.iea.org/dbtw-wpd/bookshop/add.aspx?id=144>
- IPCC. Seventh International Conference on Greenhouse Gas Control Technologies, Vancouver, Canada (papers presented), 2004. <http://www.ghgt7.ca>
- Gale, J. and Y. Kaya, eds., 2003. Proceedings of the 6<sup>th</sup> International Conference on Greenhouse Gas Control Technologies, 1-4 October, 2002, Kyoto, Japan. Two volumes. Amsterdam: Pergamon. <http://www.ieagreen.org.uk/ghgt6.htm>
- National Research Council, 2004. The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs. Washington, D.C., National Academy Press.  
<http://www.nap.edu/books/0309091632/html/>
- Union of Concerned Scientists. [http://www.ucsusa.org/global\\_warming/](http://www.ucsusa.org/global_warming/)
- Climate Change Futures: Health, Ecological and Economic Dimensions.  
<http://www.climatechange-futures.org/>
- An Inconvenient Truth movie web site. <http://www.climatecrisis.net/>
- The Energy Foundation. <http://www.ef.org/programs.cfm?program=climate>
- 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. Global Warming Undo It campaign.  
<http://www.undoit.org/home.cfm> and Fight Global Warming campaign.  
<http://fightglobalwarming.com/>
- Natural Resources Defense Council. Solving Global Warming.  
<http://www.nrdc.org/globalwarming/solutions/now.asp>
- Climate Compass. European-based local climate protection initiatives.  
<http://www.climate-compass.net/>
- Real Climate web site (real science from climate scientists). <http://www.realclimate.org/>

IEA Greenhouse Gas R&D Programme. <http://www.ieagreen.org.uk/publications.html>

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

Investor Network on Climate Risk. <http://www.incr.com/>

CERES, Investors and Environmentalists for Sustainable Prosperity.  
<http://www.ceres.org/>

Climate Institute. [http://www.climate.org/climate\\_main.shtml](http://www.climate.org/climate_main.shtml)

Clinton Global Initiative.

[http://www.clintonglobalinitiative.org/home.nsf/pt\\_cmt\\_topic?open&cat=climate](http://www.clintonglobalinitiative.org/home.nsf/pt_cmt_topic?open&cat=climate)

Heinz Center for Science, Economics and the Environment.

<http://heinzctr.org/index.shtml>

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>

### **Additional Material on Reserve in Stokes Library:**

Flannery, Tim. *The Weather Makers: How Man Is Changing the Climate and What It Means for Life on Earth*. New York: Atlantic Monthly Press, 2006. ISBN 10: 0-87113-935-9.

Gore, Al. *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*. Emmaus, PA: Rodale, 2006. ISBN 13:978-1-59486-567-1

Smil, Vaclav, *Energy at the Crossroads: Global Perspectives and Uncertainties*. Cambridge, MA: MIT Press, 2003. Smil's book is an excellent overview of "energy."

Tester, Jefferson W., Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, and William A. Peters. *Sustainable Energy: Choosing Among Options*. MIT Press. 2005. Just out last year, this tome is a comprehensive quantitative introduction to energy technologies, with extensive discussion of non-technical issues

International Energy Agency, *World Energy Outlook 2004*. Paris, France: OECD/IEA. The projections for the world energy system, typically twenty five years into the future, published by the International Energy Agency in its biannual *World Energy Outlook*, are cited by the energy industries and frame their worldview.

Deutch, John and Richard K. Lester, *Making Technology Work: Applications in Energy and the Environment*. Cambridge: Cambridge University Press, 2004. Deutch and

Lester have written a set of case studies dealing with energy and environmental topics. The emphasis is on teaching the techniques of the policy analyst to the undergraduate engineer.

Speth, James Gustav. *Red Sky at Morning: America and the Crisis of the Global Environment*. New Haven: Yale University Press, 2002.