ES297
ENERGY AND SUSTAINABILITY
MON, WED AND FRI; 10:00 – 10:50, Olin 234

INSTRUCTOR: TERESA SABOL SPEZIO
Office Hours (DIAMOND 202): W 11:00 – Noon and TH 1:30 – 3:00

Closely related issues involving energy, the environment, and the economy greatly affect our world. We face far-reaching choices on these issues, which will shape our future, including the type of energy we use, the quality of the environment in which we live, and the global economy in which we work. This course examines these choices and their long-term implications. It provides tools to analyze the current and emerging global energy industry and analyze the challenges to the creation of a sustainable energy future.

The course will introduce you to issues of importance to the future of energy, including energy consumption patterns, current and emerging energy sources, conservation, and climate change. We will use many different types of media. The assigned readings encompass the types of materials needed to learn and understand public policy issues. At the end of the course, students will have the tools to perform the following:

- Learn the history of energy production and use
- Understand emerging energy sources
- Integrate energy's role with global economic, social and political issues
- Analyze patterns of energy consumption
- Analyze connections between energy use and environmental issues, including climate change
- Develop and communicate strategies to create a sustainable energy future

To be fair to everyone, I will not accept late papers. ALL papers and assignments are due at the time specified in the syllabus. Late papers are allowed only with a doctor's note or with the prior approval of the instructors. We will return papers within one week.

REQUIREMENTS FOR THE CLASS:
READ THE ASSIGNMENTS BEFORE THE CLASS FOR WHICH THEY ARE LISTED ON THE SYLLABUS. ATTEND CLASS REGULARLY AND COME PREPARED TO PARTICIPATE IN DISCUSSIONS OF THE COURSE MATERIALS. SUBMIT THE ASSIGNMENTS ON TIME.

Required Reading (Available on the course's Moodle site).

ASSIGNMENTS (TOTAL NUMBER OF POINTS: 1000):
QUIZZES (75 POINTS EACH): We will have one chemistry quiz to evaluate if you understand the language of chemistry and one sustainability quiz to evaluate if you understand the language of sustainability. Chemistry Quiz will be on September 16 and the sustainability quiz will be on September 25.
PARTICIPATION INCLUDING ATTENDANCE (150 POINTS): Come to class prepared. Ask questions as needed and take part in discussions.
ESSAYS (100 POINTS EACH): These four papers will require you to analyze and reflect on the main topics covered in each section. The essays will be analytical in nature. Additional information will be distributed. They are expected to be between 3 and 4 pages long. See below for essay due dates.
CLASS PRESENTATION (100 POINTS): When we begin to review each fuel source in the second half of the term, we will form teams of two students. Each group will prepare a presentation on the assigned fuel source.
RELEVANT ARTICLE ASSIGNMENT (200 POINTS): The course meets thirty-eight times. Review current newspapers, magazines and journals (The Economist, Wall Street Journal, and New York Times etc.) for articles about the topic covered. Each student must submit the citation and link to the course's web site before midnight on the day after class for twenty classes. Each class' best link will receive 10 extra credit points you can earn extra credit three times during the semester.

Introduction and Energy and Sustainability

Wednesday September 4 – Introduction and Knowledge Quiz

Friday September 6 - Defining & Measuring Energy & Power

Monday September 9 - Forms of Energy

Wednesday September 11 – Conversion of Energy

Friday September 13 – Second Law of Thermodynamics

Monday September 16 – **QUIZ** and Introduction to Sustainability

Wednesday September 18 – Sustainability
Read: Selections from *World Conservation Strategy* and *Our Common Future*
Enter the Triple Bottom Line

Friday September 20 –Sustainability Measures
Read: Bohringer, C and PEP Jochem. "Measuring the immeasurable – a survey of sustainability indices*"*
Ecological Economics 63 (2007) 1-8.

Monday September 23 – Sustainability Measures
Read: http://ecoopportunity.net/2013/07/responsible-corporations-vs-corporate-responsibility/
Read Exxon Mobil or Royal Dutch Shell Sustainability Report
Seven Sins of Greenwashing

Wednesday September 25 – **QUIZ** and watch first part of *Switch*
Read: TBD

Friday September 27 – History of Coal and Oil
Read: Jones, CF. "A Landscape of Energy Abundance: Anthracite Coal Canals and the Roots of American Fossil Fuel Dependence, 1820-1860" *Environmental History* 15 (July 2010); 449-484.
Painter, DS. "Oil and the American Century" *Journal of American History* 99 (June 2012) 24-39.

Monday September 30 – History of Coal and Oil
First Assignment Due – Analysis and Critique of the Main Question of the Movie
Read: Energy Information Administration. *Annual Energy Review 2011*.

Wednesday October 2 – Coal Technology
Read: Power Plant Primer
Bituminous and Subbituminous Coal Combustion chapter from AP-42, Fifth Edition *Compilation of air Pollutant Emission Standards*

Friday October 4 – Oil Technology
Read: Petroleum Refining chapter from AP-42.

Monday October 7 – Hydropower
Read: Deudney, D. "Hydropower: An Old Technology for a New Era" *Environment* 23 (Sept. 1981)
International Hydropower Association. *Hydropower Sustainability Assessment*, November 2010.

Wednesday October 9 – Pollution and Environmental Effects
Read: Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Stations

Friday October 11 – The History of the Grid **(Paper Due)**

Read: Listen to NPR Series *Power Hungry*. http://www.npr.org/series/103281114/power-hungry-reinventing-the-u-s-electric-grid
North American Electric Reliability Corporation. *Understanding the Grid* December 2012.

Wednesday October 16 – Watch second part of *Switch*

Friday October 18 – Switch – Let's Discuss

Monday October 21 – Primacy of Price (Economic/Price)
Read: Pratt, JA. "The Business of Energy Transitions" unpublished.

Wednesday October 23 – Primacy of Carbon and Carbon Sequestration (Environment/Pollution)
Read: IPCC Climate Change 2013 for Policymakers

Friday October 25 – Primacy of Society (Social/People)
Read: Freemark, Y. Cars, Highways and the Poor" *Dissent* (Winter 2010) 10-13.
Sandbrook, C. "On the role of Cynicism in Conservation" *Thinking like a human* Feb 2013.

Monday October 28 – Conservation/Efficiency
Read: Colby's Green Purchasing and Living Guide
USEPA. *Energy-Efficient Product Procurement*. (2011)

Wednesday October 30 – Biofuels
Read: Selections from USEPA. *Biofuels and the Environment: First Triennial Report to Congress* Dec. 2011
Walker, R. "The Impact of Brazilian Biofuel Production in Amazonia" *Annals of the Association of American Geographers* 10 (4) 2011.

Friday November 1 – Conventional Natural Gas
Read: Economides, MJ and DA Wood. "The State of Natural Gas." *Journal of Natural Gas Science and Engineering* 1 (2009) 1 -13.

Monday November 4 – Non-Conventional Natural Gas
Read: King, GE. *Hydraulic Fracturing 101* SPE152596.
Fontenot, BE et. al. "An Evaluation of Water Quality in Private Drinking Water Wells Near Natural Gas Extraction Sites in the Barnett Shale Formation." *Environmental Science & Technology* 47 (2013) 10032- 40.

Wednesday November 6 – Oil Sands
Read: Selections from *Responsible Actions: A Plan for Alberta's Oil Sands*
Kelly, EN et. al. "Oil Sands Development Contributes Polycyclic Aromatic Compounds to the Athabasca River and Its Tributaries" *PNAS* 106 (Dec 2009) 22346-51.
Selections from Economic Impact of Alberta's Oil Sands

Friday November 8 – Geothermal
Read: Selections from *Geothermal Energy: An Alternative Resources for the 21st Century*
Lund, JW et. al. "Direct utilization of geothermal energy 2010 worldwide review" *Geothermics* 40 (2011) 159-180.

Monday November 11 – **Paper Due**
Read: TBD

Wednesday November 13 – Nuclear Energy
Read: Lanouette, W. "Atomic Energy, 1945 – 1985" *The Wilson Quarterly* 9 (Winter 1984) 90 – 131.
Davis, LW. "Prospects for Nuclear Power" *The Journal of Economic Perspectives* 26 (Winter 2012) 49-66

Friday November 15 – Wind Power
Read: Brannstrom C et.al. "Social Perspectives on Wind Power Development in West Texas" *Annals of the Association of American Geographers* 101 (May 2011) 839-851.
Hansen JD et.al. "The Establishment of the Danish Windmill Industry – Was It worthwhile?" *Review of World Economics* 139 (2003) 324-347

Monday November 18 – Solar Power
Read: Peter, LM "Towards sustainable photovoltaics: the search for new materials" *Phil. Trans. R. Soc. A* 369 (2011) 1940 – 1856.
Ball, P. "How sunlight became a commodity in Germany" *MRS Bulletin* 35 (Sept. 2010)
-. "How Electricity Became a Luxury Good" *Der Spiegel*

Wednesday November 20 – Tidal Power
Read: Smith, L. "Tidal Power in Maine" *Land Economics* 24 (Aug 1948) 239-252.

Friday November 22 – Fuel Cells
Read: Department of Energy Fuel Technologies Program Fact Sheet
Mekhilel, S, et.al. Comparative Study of Different Fuel Cell Technologies *Renewable and Sustainable Energy Reviews* 16 (2012) 981-989.

Monday November 25 – Transportation
Read: Pearre, Nathaniel S, et.al. Electric vehicles: How Much Range is Required for a Day's Driving. *Transportation Research Part C.* 19(2011) 1171-1184.
MacLean, Heather L. et.al. Life Cycle Assessment of Automobile/Fuel Options. *Environmental Science and Technology*. 37 (2003) 5445-5452.

Monday December 2 – Buildings
Read: LEED Standards for New Buildings

Wednesday December 4 – Solutions

Friday December 6 – Discussion