

**CEVE / ESCI / ENST 307
ENERGY AND THE ENVIRONMENT
SPRING 2009**

Meeting Times and Location:

T/Th 9:25 – 10:40 a.m., Mech Lab 254

Instructor:

Daniel Cohan, Ph.D.
Assistant Professor of Environmental Engineering
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Office Hours:

Office visits are encouraged and are available by appointment.

Course Description:

Securing sufficient, reliable, and affordable supplies of energy in an environmentally sustainable manner is among the greatest challenges facing society in the 21st century. Appreciating and addressing this complex challenge requires consideration of the various physical, technological, and societal forces that shape energy use and its impact on the environment.

This course will explore the physical principles of energy and how various sectors and fuels impact Earth's environment and climate. We will also examine policies and technologies that could foster more sustainable use of energy resources. The course will include a group project in which students will design and advocate potential policy, research, or business approaches to a particular energy source.

Course Objectives:

This course aims not only to impart heightened knowledge of energy and its impacts on the environment, but also to build skills in research, analysis, and critical thinking that will catalyze a lifetime of engagement with this complex topic. Among the learning objectives for this course, students completing this course will be able to:

- 1) Identify key environmental impacts of various energy sources
- 2) Compute the energy return on investment, overall efficiency, and resource intensity for an energy source
- 3) Obtain objective, credible data and projections for energy availability, consumption, and impacts, and critically evaluate conflicting estimates
- 4) Compare and contrast the challenges posed by regional air pollution and global climate change and their relation to energy use
- 5) Critically assess conflicting evidence regarding energy technologies or policies
- 6) Design and present a persuasive case advocating a policy, scientific study, or business initiative related to an energy source

Prerequisites:

While there are no explicit prerequisites, this course will apply quantitative approaches and scientific principles to examine energy and the environment. Physics and calculus background at least to the level of PHYS 101 and MATH 101 (or AP equivalents) are strongly recommended. Please contact the instructor if you have questions regarding your preparation.

Textbook and Readings:

Richard Wolfson. *Energy Environment and Climate*. W.W. Norton & Company, 2008.
(Available on amazon.com for \$58).

Additional readings from outside sources will be assigned and made available on the OwlSpace website for the course.

Honor System Policy:

All students are expected to adhere to the Rice Honor Code. Exams will be given under the honor system and must be entirely a student's own work, using only resources that are explicitly authorized for that exam. Unless otherwise stated, homework assignments may be discussed with other students but must be written individually in your own words. Any essay assignments must be written in a student's own words with proper citation of any references used; please consult the instructor or www.plagiarism.org if you have questions about what constitutes proper attribution and plagiarism.

Disability Statement:

If you have a documented disability that will impact your work in this class, please contact me to discuss your needs. Additionally, you will need to contact the Disability Support Services Office in the Ley Student Center.

Grading:

Students will be evaluated by their performance on the following:

Written assignments (Problem sets and/or short essays)	30%
Midterm Exam	20%
Group project (Oral presentation and written report)	20%
Final Exam	30%

In addition, attendance and participation are critically important to the success of this course and may be considered in the final determination of grades.

All assignments are expected to be completed on time by 4 p.m. of the due date and may be submitted in class or to Dr. Cohan's mailbox on the first floor of Mech Lab (do not email assignments). Late assignments will incur a penalty of 25 points and will not be accepted after solutions are distributed. Extensions will be granted only by email request describing specific extenuating circumstances.

TENTATIVE SCHEDULE (*subject to change*)

DATE	THEME	TOPIC	TEXTBOOK	OUTSIDE READING*
1/6	Introduction	The Energy Challenge	Ch. 1	Readings from US DOE
1/8	Energy: Physical Principles	Work, energy, and power	Ch. 2, 3	
1/13		Thermodynamics and heat transfer	Ch. 4.1 – 4.5	
1/15		Heat engines, heat pumps, & refrigerators	Ch. 4.6 – 4.9, 8.4	
1/20	Energy: Sectors	Electricity and the Electric Sector	Ch. 3.2, 5.4	Readings from US DOE and Congressional Budget Office
1/22		Transportation Sector		Readings from US DOE, Sci. American, MIT, and Energy Econ
1/27	The Environment	Water & land	Ch. 6.3	Reading from US DOE
1/29		Air	Ch. 6.2, 6.4	Readings from US EPA
2/3		Climate	Ch. 12, 13	Reading from IPCC
2/5		Climate (cont.)	Ch. 14, 15, 16.1, 16.5	
2/10		Emissions control; carbon capture & storage	Ch. 16.2	Readings from Energy Policy and IPCC
2/12	Comparing Energy Options	Metrics for evaluating energy options		Readings TBA
2/17		Evaluation metrics (cont.)		
2/19	Policy Responses	Policy responses: Types of approaches, historical examples	Ch. 5.7	Readings TBA

2/24	EXAM	MIDTERM EXAM		
2/26	Fossil Fuels	Oil	Ch. 5	Readings from GAO (p. 1-39), US DOE, Ann. Rev. Environ. Resources
3/2 – 3/6		SPRING BREAK		
3/10		Natural Gas	Ch. 5 (cont.)	Readings from US DOE, Energy Policy
3/12		Coal	Ch. 5 (cont.)	Readings TBA
3/17	Alternative Fuels	Energy conservation & efficiency	Ch. 16.4	Readings TBA
3/19		Nuclear	Ch. 7	Readings from MIT, Scientific American
3/24		Solar	Ch. 9	Reading from Sci. American
3/26		Biofuels	Ch. 10.3	Readings from Ann. Review of Environ. Res, PNAS
3/31		Wind	Ch. 10.2	Readings TBA
4/2		SPRING RECESS		
4/7		Hydroelectricity, Oceans, & Geothermal	Ch. 8	Readings from Nature, US DOI
4/9		Energy and sustainability at Rice (guest lecture by Richard Johnson)		
4/14		Hydrogen as an energy carrier; futuristic options	Ch. 11	Readings from Sci. American
4/16	Summary	Summing up the Energy Challenge		
		FINAL EXAM		

*Outside reading assignments will be made available via the course OwlSpace website.