Energy

KHC PY101

Spring 2012
Tuesdays/Thursdays
2:00PM - 3:30 PM
Room: KHC 107

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Course Introduction

Enrollment in this class is limited to at most 12 freshmen, all of whom must be registered in the University Honors College. PY-101 is a seminar course, meaning that it brings together a small and select group of students for recurring classroom meetings. Each meeting focuses on an energy related issue, and everyone present is expected to prepare beforehand so as to be able to participate actively in our discussions. Although the content of this course is primarily scientific, the subject of energy is truly interdisciplinary, with ramifications in Economics, Social Science, Risk Analysis, International Relations, Political Science, etc.

Course Content

Ours is an energy intensive society. American energy consumption per capita is now over ten times what it was when our nation was founded, and the rest of the world is rapidly following our example. This is leading to increasingly severe worldwide problems such as the growing competition for scarce resources.

These include fossil fuels (today's principal sources of energy by far) but also fresh water, agricultural land and mineral resources. Many countries face ever more severe problems of pollution, congestion, desertification, flooding, drought and, most likely and threateningly, the incipient and growing effects of global climate change. Many governments and industries are aware of these issues and numerous attempts at remediation (some sensible and some not) have been considered, proposed, adopted, deferred or rejected. The goals of this seminar are (i.) to examine the physical principles underlying the production, distribution and consumption of energy and (ii.) to use this knowledge to explore and discuss such issues as energy conservation, public transport, the so-called hydrogen economy, electric and hybrid vehicles, nuclear power (both fission and fusion) and carbon sequestration, as well as to evaluate the feasibility of various alternative sources of energy, e.g. wind, solar, fusion, geothermal, tidal, agricultural and aquacultural.

Course Description

Because the subject material of the course is technical, the first lectures will offer a review of relevant material: Pure vs. applied math, the units and dimensions of physical quantities such as power, pressure, momentum and energy; the many forms energy may assume; the nature of heat; the laws of mechanics and thermodynamics, elementary nuclear physics, functions and their derivatives, &c. Thereafter, we turn to societal issues relating to the fact that about 85% of energy usage (either Worldwide or American) comes from burning fossil fuels, that this process is responsible for the rising concentration of carbon dioxide in the atmosphere, which is likely to lead to ever more significant effects upon the global climate. During the Seminar, we anticipate freewheeling conversations relating to various energy-related issues, such as but not limited to: Are we running out of oil? What is the evidence for anthropically caused Global Warming? What can be done to prevent (or prepare for) it? Can part or all of the problem be solved by nuclear (or solar, wind, geothermal, &c) power? Is it feasible to capture and sequester the CO2 produced by fossil power plants? How important is it to conserve energy (e.g., by insulating homes better)? ...increase efficiency (e.g., by banning incandescent light bulbs)? ...travel smarter (e.g., with electric cars or high-speed rail service)?

Required Texts

1. Sustainable Energy, by David McKay. You need not purchase this book. It may be accessed on the web for no charge: www.withouthotair.com
2. Beyond Smoke and Mirrors, by Burt Richter (Cambridge University Press, 2010).

Recommended Readings: Various other relevant books will be placed on reserve in the Science Library, some of which are listed below: Storms of My Grandchildren J.C. Hansen

Energy Myths and Realities... the Energy Policy Debate, Vaclav Smil (American Enterprise Institute, 2010)
Why we disagree about climate change, Mike Hulme (Cambridge, 2009)
Climate Change, David Downie et al., (ABC-Clio, 2009)
Global Fever, Wm. Calvin (U. of Chicago, 2008)
Wind Energy, S. Mathew (Springer 2005)
Biofuels, solar and wind...D. Pimentel, ed. (Springer 2009)
The Crash Course — The Unsustainable Future...C. Martenson
Energy, Environment & Climate, R. Wolfson

Recommended Readings, Continued

The End of Energy, J. Graetz Challenged by Carbon B. Lovell
Physics & Technology for Future Presidents, R. Muller
Out of Gas, David Goodstein
Post-Carbon Reader, R. Heinberg

A Great Aridness, Wm. de Buys (Oxford)
Bird on Fire, A. Ross (Oxford)
Changing Planet, Changing Health, P.R. Epstein & D. Ferber

Students are also encouraged to consult web sites such as the Wikipedia to obtain further information on various technical subjects: alternative energy sources, climate change, geothermal power, global warming, nuclear power, photovoltaics, solar-thermal power, wind power, &c. They are also strongly encouraged to identify (in the NY Times, the Economist, &c) such currently relevant issues as are appropriate to discuss in class.

Attendance

It is strongly recommended that students attend all meetings of the class. Attendance records will not be kept, but one or more unannounced 'spot quizzes' will take place in class. Furthermore, individual students will be called upon to prepare oral presentations to the class so as to initiate our further discussions.

Academic Conduct

All students are expected to maintain high standards of academic honesty and integrity. It is the responsibility of all students in the Kilachand Honors College to be aware of the Academic Conduct Codes of their respective Colleges and to abide by their provisions. Cases of suspected misconduct will be reported to the appropriate authority.
http://www.bu.edu/academics/resources/academic-conduct-code/

Assignments

It is strongly recommended that students attend all meetings of the class. Attendance records will not be kept, but one or more unannounced 'spot quizzes' will take place in class. Furthermore, individual students will be called upon to prepare oral presentations to the class so as to initiate our further discussions.

Grading

This class is small enough for the instructor to obtain a clear understanding of the ability, performance and development of each student. There will be no formal final examination. Final grades will be determined more-or-less as follows:

- Class Performance: 50%
- Quizzes: 10%
- Problem Sets: 15%
- Essays: 25%

Lecture Schedule

The first few lectures offer a review of elementary principles of science and mathematics that are needed for our future discussions concerning the science of energy and its relevance to

society. Thereafter the course becomes less prescriptive. For this reason, I can offer only a tentative week-by-week description of the course material. I anticipate that we shall enjoy informed but free-wheeling discussions of numerous energy-related is- sues, such as, but in no way limited to: climate change, oil independence, nuclear power, the hydrogen economy, or the demise of incandescent bulbs and the decline of internal combustion engines. Considerable class time will be devoted to debate and discussion of many relevant issues, both technical and societal, with the instructor acting as moderator.

Tentative Course Schedule

This schedule is not written in stone. Our discussions will be free-flowing and will depend on the interests of the group and upon relevant political, scientific, technological or climatic events or developments. Relevant readings from the three required texts or other sources will be assigned on a weekly basis.

Week 1. 17–19 JAN Pure & Applied Mathematics, Units, Dimensions

Week 2. 24–26 Review of Basic Physics & Chemistry

Week 3. 31–02 FEB Energy Production and Consumption, US & World

Week 4. 07–09 CO2, Climate Change, Energy Security

Week 5. 14–16 A Society that Relies on Fossil Fuels

— NO CLASS ON TUESDAY 21 FEBRUARY—

Week 6. 23–28 MAR Cap & Trade, Capture & Sequestration &c. Week 7. 01–06 Nuclear

Power: Fission Now and Fusion Later? Week 8. 08 Thorium for the Future?

— SPRING BREAK —

Week 10. 20-22 Can we grow our fuel?

Week 11. 27–29 Power from the Sun, Wind and Water? Week 12. 03–05 APR Tidal or

Geothermal Solutions? Week 13. 10–12 Clean Electricity foe Electric Cars? Week 14. 17–19

Doubters and Deniers

Week 15. 24–26 Scientifically Informed Public Policy?

Week 16. 01 MAY Realistic Prospects