Course Outline ENG EK 546 Assessment of Sustainable Energy Technologies: Fall 2011 (M/W 11-12:30)

Professor Michael Gevelber, Mechanical Engineering Questions? Make an appointment to discuss (gevelber@bu.edu), and do bring your questions to class.

Critical to launching new energy ventures and implementing new energy policies is developing an understanding of how technically feasible the proposed project/technology is in meeting economic, environmental, and end-use requirements. This course will provide students with the background needed to asses the potential for energy efficiency and effectiveness of different technologies, the related economics, as well as identify the key technical risks in emerging technologies. Examples will be drawn from a variety of emerging technologies such as solar photovoltaics, fuel cells , advanced transportation technology, as well as conservation options such as motors, cogeneration, building automation and HVAC. This course will also address evaluating the life cycle implications of emerging technologies, including manufacturing issues, end-of life, as well as estimating performance.

Prerequisites: Phys 105 or Chem 101 or ES 105 or equiv, Calculus (MA 121 or equiv). Students are expected to review related material and analysis techniques, as well as learn new concepts based on these fundamentals.

Textbook: Sustainabile Energy, MIT Press, 2005, J.W. Tester et. al.

And "Without the hot air": http://www.withouthotair.com/download.html

Goal: Students will be able to evauluate alternative energy technology options in terms of a variety of different dimensions that affect the technologies commercial viability and life-cycle performance/effectiveness. This course seeks to integrate a broad set of engineering, energy, economic, and environmental issues. A major objective of the course is to develop the students ability to develop appropriate analysis and estimates for a variety of energy issues. These analysis and estimates are typically based on incomplete data sets, utilizing upper and lower bounds, and many times are based on information beyond the analysts previous knowledge base.

Topics:

- Energy analysis basics: 1st & 2nd law, efficiency, combustion, fuel cells, wind turbines examples.

- Efficiency & Conservation: Lovins Negawatt concept and proposals. Building energy use.

- Energy Economics & Cost Analysis: efficiency, BAU, supply

- Business issues: Christensen's analysis of the "Innovator's Delemma", Agency issue, various business cases from HBS such as A123, capital requirements for large projects, etc.

- Life Cycle Analysis: use of CMU's EIO/LCA tool and examples for electricity transmission, plastic vs steel gas tank.

-Electricity: demand curves, transmission losses, smart grid, demand management (Enernoc).

- Solar cells: options for manufacture of silicon, different concepts, and energy payback analysis.

- Energy storage, systems costing, requirements, and options.

-Advanced turbine power cycles

-Analysis of manufacturing options/issues; ex of silicon mfg.

Requirements:

Students will pursue a semester long project and willpresent an oral and written report on a specific energy technology, analyzing the above issues. Project teams will be comprised a mix of ENG, SMG and CAS students. In addition, there will be a mid term exam that covers energy technology fundamentals and application requirements. Mid term will include both an inclass exam (tentatively 11/2) and take home (tentatively due 11/9).

Approximately 6 to 8 homework assignments related to the key lecture topics will be assigned throughout the course. While students make discuss these assigments with others, their handed in work should be their own write up and analysis.

Project:

Students will select a project to conduct, that addresses the technology issues, economics, and R&D development issues in an area related to emerging energy supply, use, and efficiency technology. All projects will include a final written report as well as an oral presentaion. Where applicable, these projects will be team based. Examples from previous years include: energy in developing countries, off shore power: wave and wind, hybrid-pev vehicless, building energy use: resididential & commercial, industrial waste heat recovery, smart grid.

All groups should be addressing the following issues:
- technology [how it works as well as key tech development issues]
- application & requirements - economics
- business issues: market, demand, agent issues - risks - sustainability analysis

Mid project presentation: Oct 17 & 19. Final Presentations: expected Dec: 5, 7, and 12. Students are expected to attend all final presentations.

Grading: 24% homework, 44% midterms (14% inclass), 32% project (team and individual grades, mid project presentation 6% out of the 32%, so make sure your team is working with me before hand.)