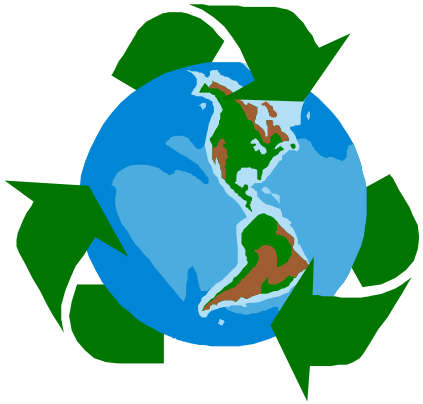

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SUSTAINABLE ENERGY

Fall 2010

Prof. Michael W. Golay
Nuclear Engineering Dept.

SUSTAINABLE ENERGY

3-1-8 U & H
Tuesday and Thursday, 3 – 5 pm

Instructors: R. Field, M. Golay*,
W. Green, Jr., J. Wright

Other faculty and invited speakers

*** Instructor-in-charge and point of contact for questions**

OVERVIEW

Assessment of current and potential future energy systems, covering resources, extraction, conversion, and end-use, with emphasis on meeting regional and global energy needs in the 21st century in a sustainable manner. Different renewable and conventional energy technologies will be presented and their attributes described within a framework that aids in evaluation and analysis of energy technology systems in the context of political, social, economic, and environmental goals. Undergraduate students should enroll in *Introduction to Sustainable Energy* and graduate students should enroll in *Sustainable Energy*.

COURSE MATERIAL

- **Textbook:**
  - ***Sustainable Energy – Choosing Among Options.*** J.W. Tester, E.M. Drake, M.W. Golay, M.J. Driscoll, and W.A. Peters. MIT Press, Cambridge MA, 2005.
- **Other Readings**
  - ***Encyclopedia of Energy Technology and the Environment.*** Bisio and Boots, 1995.
  - ***Renewable Energy Resources,*** Twidell and Weir, 2nd Ed., Taylor and Francis, London, 2006.
  - ***Energy for Sustainability: Technology, Planning, Policy***. Randolph and Masters, 2008.
  - ***Sustainable Energy – Without the Hot Air.*** McKay, 2009. (free PDF from website: http://www.withouthotair.com/download.html)
  - ***The Future of Nuclear Power: An Interdisciplinary MIT Study***, Deutch and Moniz, Chairs (2005). See: http://web.mit.edu/nuclearpower/
  - ***The Future of Geothermal Energy***, Tester, et al. (2006). See http://www1.eere.energy.gov/geothermal/future_geothermal.html
  - ***The Future of Coal: MIT Coal Study,*** Deutch, et al. (2007). See: http://web.mit.edu/coal/The_Future_of_Coal.pdf
  - ***The Intergovernmental Panel on Climate Change(IPCC): Climate Change 2007: – Summary for Policymakers,*** See: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf
  - ***Bali Action Plan:*** See: http://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf#page=3

COURSE MATERIAL, CONT'

- **Web sites:**
  - http://ocw.mit.edu/courses/chemical-engineering/10-391j-sustainable-energy-spring-2005/index.htm

COURSE REQUIREMENTS

- **Lecture/Recitation Format**
  - Two 2-hour lecture sessions per week; periodic replacement with a recitation and problem session. Many guest lecturers are featured in the course, and therefore the schedule is subject to change.
- **Undergraduate Student Requirements**
  - **Homework:**
    - One problem set per 3-class meeting days on average. The first five problem sets focus on analytical skills; later problem sets are more comprehensive and integrating. Eight problem sets total, choose 2 of 4 questions per problem set for the first 5 problem sets, answer each of the questions in the remaining problem sets.
  - **Exams:**
    - There will be two take-home exams and one final exam.
  - **UG Grading:**
    - Homework 40%
    - Exam 1 15%
    - Exam 2 15%
    - Final Exam 30%

COURSE REQUIREMENTS, con't

- **Graduate Student Requirements**
  - **Homework:**
    - One problem set per 3-class meeting days on average. The problem sets focus on analytical skills. Five problem sets total, choose 3 of 4 questions per problem set. The problem sets are the first five problem sets (shared with undergraduate offering).
  - **Term Project:**
    - Graduate students will be required to turn in one written term paper (20-30 pages) with an interim progress report.
  - **Graduate Grading:**
    - Homework 40%
    - Term Project 60%
    - Student-led Discussion 10% (max)
      Extra Credit

COURSE ORGANIZATIONAL STRUCTURE

- **Part I: Energy in Context**
- **Part II: Specific Energy Technologies**
- **Part III: Energy End Use, Option Assessment and Tradeoff Analysis**
- **Toolbox Lectures:**
  1. **Energy Transfer and Conversion Methods**
  2. **Energy Resource Assessment**
  3. **Energy Conversion, Transmission, and Storage**
  4. **Systems Analysis Methodologies**
  5. **Energy Supply, Demand, and Storage Planning Methods**
  6. **Electrical Systems Dynamics**
  7. **Economic Feasibility Assessment Methods**
  8. **Thermodynamics and Efficiency Analysis Methods**
  9. **Risk Assessment Methods**
- **Recitations:**
  1. **Discussion of Sustainability Issues**

  2,3. Carbon Limitation Options 1 and 2

  4,5. Current Energy Policy Options 1 and 2

  6. **Course Summary and Panel Discussion**

COURSE ORGANIZATIONAL STRUCTURE, CONT'

- **Lectures:**
  - ***Part I: Energy in Context***
    1. Introduction
    2. Overview of Energy Use and Related Issues
    3. Global Change Issues and Responses I
    4. Global Change Issues and Responses II
    5. Sustainability, Energy, and Clean Technologies in Context
    7. Electric Power System and Requirements for Success
    8. Historical Factor and Prospects for Change in the Electrical Power Grid
    9. Carbon Limitation Policy Options

COURSE ORGANIZATIONAL STRUCTURE, CONT'

- **Lectures:**
  - ***Part II: Specific Energy Technologies***

6. Wind Power
10. Nuclear Energy I: Current Technologies
11. Nuclear Energy II: Future Technologies and the Fuel Cycle
12. Fossil Energy I: Conversion, Power Cycles, Advanced Tech
13. Fossil Energy II: Types and Characteristics
14. Cape Wind Energy and Offshore Wind Projects
15. Current Energy Policy
16. Fossil Energy III: Fuels, Emissions
17. Nuclear Energy III: Nuclear Proliferation and Waste Disposal
18. Electricity Generation Alternatives
20. Fusion as a Future Energy Source?
21. Carbon Management Options
22. Geothermal Energy
23. Solar Photovoltaic Energy
24. Solar Thermal Energy
25. Biomass Energy
26. Biomass Conversion to Liquid Fuels
27. Hydropower

COURSE ORGANIZATIONAL STRUCTURE, CONT'

- **Lectures:**
  - ***Part III: Energy End Use, Option Assessment, and Tradeoff Analysis***

    19. Transport in Developing Countries
    27. Lifecycle Analysis of Biomass Conversion
    28. Wind, System Dynamics, Barriers to Entry
    29. Transportation
    30. Electrochemical Energy Conversions
    31. Eco-Buildings
    32. Sustainable Buildings in Developing Countries
    33. Corporate and International Efforts to Abate Global Change/ Sustainability and Global Business
    34. Challenges and Options for Electricity Systems in Sub-Saharan Africa

MIT OpenCourseWare
http://ocw.mit.edu

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