

Syllabus of EAS 401/501; Energy and its Impacts: Technology, Ecology, Economics, Sustainability.

Instructor: Professor Noam Lior

Fall term 2017
Tu Th 6-7:20 pm
216 Moore

Course Objective

The objective is to introduce students to one of the most dominating and compelling areas of human existence and endeavor: energy, with its foundations in technology, from a quantitative sustainability viewpoint with its association to economics and impacts on environment and society. This introduction is intended both for general education and awareness and for preparation for careers related to this field, with emphasis on explaining the technological foundation. The course spans from basic principles to applications. A review of energy consumption, use, and resources; environmental impacts, sustainability and design of sustainable energy systems; introductory aspects of energy economics and carbon trading; methods of energy analysis; energy storage; electricity generation and distribution systems (steam and gas turbine based power plants, fuel cells); energy use in buildings; energy for transportation (cars, aircraft, and ships); nuclear energy and wastes; very brief introduction to renewable energy (solar, wind, hydroelectric, geothermal, biomass); prospects for future energy systems: fusion power, power generation in space.

Students interested in specializing in one or two energy topics can do so by choosing them as their course project assignments.

Instructor

Professor Noam Lior (web page: <http://www.seas.upenn.edu/~lior/>), has decades of experience in energy research and education, is editor of major international scientific energy journals, a frequent invited keynote speaker on energy at international conferences, and faculty member of the Wharton IGEL Advisory Committee, the Lauder Institute graduate group, and of the Institute of Environmental Science.

No prerequisites

Regardless of prior courses taken, any Penn graduate student, and any Penn undergraduate student of Junior or Senior standing, who are interested in energy and its impacts may take this course. Students taking the course as EAS 501 will have assignments commensurate with graduate standing.

Relation to the course EAS 402/502: Renewable energy and its impacts: technology, ecology, economics, sustainability.

The courses differ in that EAS 401/501 covers all energy aspects while EAS 402/502 focuses specifically on renewable energy in much more depth. Both courses can thus be taken.

Note: This is also an approved "Technology in Business and Society" course. Students interested in the relationships among technology, business, and society may choose to substitute up to two of the required social science and humanities courses with selections from the Technology in Business and Society category.

Course conduct

Homework (30% of grade), term projects (Project 1: 20%, Project 2: 25%), final exam (25%).

Students taking the course as EAS 401 will have somewhat easier assignments and final exam, commensurate with undergraduate standing.

Credit Units

1 credit unit course.

Syllabus (approximate number of weeks)

1. An overview of global energy: sustainability (environment, economics, social), resources, uses, consumption, and R&D (2)
2. A very brief review of basic nature laws of energy (thermodynamics) heat transfer, and chemical reactions (1.5)
3. A very brief intro to scientific sustainability (1)
4. A Note on Energy Conservation, Embodied Energy, and Recycling (0.5)
5. A (very) brief introduction to practical energy economics (0.5)
6. Electrical energy, and mechanical power generation (1.5)
7. Electrochemical energy storage/conversion: batteries and fuel cells (0.5)
8. Electricity distribution and regulation (0.25)
9. Energy storage (0.5)
10. Energy and Buildings (0.75)
11. The global energy balance (0.25)
12. Comments on CO₂ emissions and their control (0.25)

13. Fossil Fuels

13.1 Oil (including tar sands, oil shales) (0.5)

13.2 Gas (including gas shales) (0.5)

13.3 Coal (0.25)

14. Nuclear Power

14.1 Nuclear fission: basic equations and fuels (1.0)

14.2 Fission nuclear power, wastes, and safety (0.75)

15. Sustainable power for earth by generation in space (0.25)

16. Energy: Some possible sustainable paths to the future (0.25)

Reference Texts

Limited selections from some of the below-listed books (no required textbook) are available on Canvas for reading and downloading.

Most highly recommended:

J.W. Tester, E.M. Drake, M.J. Driscoll, M.W. Golay, W.A. Peters, "Sustainable energy", 2d edition, MIT Press 2012. Others Recommended:

J. Randolph and G.M. Masters: Energy for sustainability, Island Press, 2008.

V. Smil : Energy at the Crossroads

F. Kreith and J. Kreider, "Principles of Sustainable Energy, CRC Press, 2011.

The Canvas Course Web site: Use and Support

Information, lectures, assignments, materials and just about everything else related to the course are done via Canvas.