E4S Sample Syllabus—Semester Course using entire book

Course Description:

Energy is figuratively and literally the fuel that drives our society, our economy, and our impact on the environment. During the past thirty years, most of major global recessions have been triggered by energy price increases. The Gulf War in 1991 and the Iraq War make clear the political and geologic realities of our dependence on non-renewable petroleum. Now 2/3 of the U.S. oil consumption is imported, and that proportion continues to increase. Recent crude oil and petroleum-product price increases, the California electricity crisis in 2001, and the east coast blackout of 2003 illustrate our continuing energy problems. Environmental concerns about energy production and consumption, especially the effects of fossil-fuel combustion on air quality and climate change, have further clarified the non-sustainable nature of our current patterns of energy use. Despite global economic recession, rolling blackouts, $100/barrel oil, war, and the threat of major climate change, we have done little to alter our patterns of energy production and consumption in the past 30 years.

We need to establish efficient and environmentally acceptable patterns of energy production and use that are sustainable in a future of limited petroleum and climate change. Conventional sources of energy (coal, oil, natural gas, nuclear power) will be part of our energy mix for decades to come. However, due to geologic, economic, political, and environmental constraints associated with these sources, improving the efficiency of energy use and increasing our reliance on renewable energy systems (solar, biofuels, wind, hydro) provide the best opportunities for sustainable energy.

This course has three basic objectives for students:
1. to learn about the energy situation and relevant economic and environmental issues;
2. to understand the technical nature of energy and apply fundamental design concepts for efficient and renewable systems at both a community and site scale; and
3. to understand and apply some of the basic tools for energy and economic analysis involved in energy system design, planning, evaluation, and policy analysis.

Course Design and Requirements:

The course is divided into five sections: (1) Energy Patterns and Fundamentals; (2) Green Buildings; (3) Sustainable Electricity; (4) Sustainable Transportation and Land Use; and (5) Energy Planning and Policy for Renewables and Efficiency. Emphasis will be on the quantitative aspects of energy design and analysis. These will be explored in six homework assignments. There will also be a midterm and a final exam. In addition, students are given the opportunity to explore a term project either individually or in small groups.

Project:
Students will develop a project during the last half of the semester. Options include a large project that the entire class works on, such as an energy and greenhouse gas inventory for the campus or the community (using ICLEI software), or individual or small group projects, such as an home energy audit (using a blower door), a site wind energy assessment, a critique of local or state energy policy, the design and construction of a solar water heater, etc.]

Evaluation Criteria:

Assignments	50%
Midterm	15%
Final	15%
Term Project & Presentation	15%
Class Participation, attendance	5%
	100%

Course Outline: e.g., twice-a-week 75-minute classes

Date	Topic	Read	Assignment
	Energy Patterns and Fundamentals		
1/15	Introduction		
1/17	Energy Situation: about oil & war & nuclear & global warming	E4S 1,2	
1/22	Energy Futures	E4S 3	
1/24	Energy Situation: Student Group Presentations		1
1/29	Fundamentals of Energy Science	E4S 4	
1/31	Energy and Economic Analysis	E4S 5	
	Green Buildings and Solar Energy Fundamentals		
2/5	Buildings and Energy; Building Envelope - Heat Loss	E4S 6	1 due
2/7	Blacksburg and Virginia Tech Energy & GHG Inventory		2
2/12	Building Energy Systems: HVAC	E4S 7	
2/14	Solar Fundamentals: Sun Angles and Insolation		2 due
2/19	Solar Collection and Domestic Water Heating		3
2/21	Active Space Heating; Passive Solar		Project Topic
2/26	Passive Solar Heating & Cooling		3 due
2/28	MIDTERM		
3/11	Green Buildings; Embodied Energy; Review	E4S 8	
	Electricity		
3/13	Electricity Fundamentals & Centralized Systems	E4S 9	Proj.Update,4
3/18	Electricity: Decentralized Generation	E4S 10	
3/20	Photovoltaics	E4S 11	4 due
3/25	Photovoltaics and Net-Zero-Energy Buildings		5
3/27	Wind Energy	E4S 12	
4/1	Wind Energy		
	Transportation Energy		
4/3	Transportation: Vehicle Efficiency	E4S 13	5 due
4/8	Biofuels	E4S 14	
4/10	Energy, Land Use and Community Design	E4S 15	6
	Energy Planning & Policies for Renewables & Efficiency		
4/15	Government Policies for Renewables & Efficiency	E4S 16	
4/17	Federal, State & Utility Programs for Renewables & Efficiency	E4S 17,18	6 due
4/22	Local Energy Planning: Creating Sustainable Communities	E4S 18	
4/24	Presentation of Student Project		
4/29	Presentation of Student Project		
4/31			Proj. due
5/6	FINAL EXAM		

Readings:

Main text:

Randolph, J., and G.M. Masters. 2008. *Energy for Sustainability: Technology, Planning, Policy*, Island Press

Other references:

California Energy Commission. 2007 Integrated Energy Policy Report. November.

Leckie, J., G.M. Masters, H. Whitehouse, and L. Young. 1981. *More Other Homes and Garbage*. Sierra Club Books. Selections (book is out of print)

Lovins, A. B., et al. *Winning the Oil Endgame: Innovation for Profits, Jobs, and Security. Snowmass,* CO: Rocky Mountain Institute. 2004. download from http://www.oilendgame.com/

Masters, G. M., 2004. *Renewable and Efficient Electric Power Systems.* Wiley-Interscience

Additional references:

Aiken, D., Transitioning to a Renewable Energy Future, White Paper prepared for the ISES, 2003.

Intergovernmental Panel on Climate Change. 2007. Fourth Assessment Report (AR4).

Pacala, S. and R. Socolow. "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies." Science, v. 305. 13 August 2004, p. 968-971.

Science, Special Issue: Toward a Hydrogen Economy. v.305, 13 August 2004, p. 957.
http://www.sciencemag.org/search.dtl (enter vol & 1st page)

U.S. DOE, Efficiency and Renewable Energy Network (EREN),:
Renewable sources primer: surf the site on sources: http://www.eren.doe.gov/
Distributed Energy Basics: http://www.eren.doe.gov/der/basics.html
Buildings: http://www.eren.doe.gov/EE/buildings.html
Photovoltaics: http://www.eren.doe.gov/RE/solar_photovoltaics.html
Transportation: http://www.eren.doe.gov/EE/transportation.html
Biomass: http://www.eren.doe.gov/RE/bio_resources.html, http://www.eren.doe.gov/RE/bio_biopower.html, http://www.eren.doe.gov/RE/bio_fuels.html
Hydrogen: http://www.eren.doe.gov/RE/hydrogen.html
Million Solar Roofs WebSite: http://www.millionsolarroofs.com/

U.S. Energy Information Administration (USEIA),
Annual Energy Review 2006, http://www.eia.doe.gov/emeu/aer/contents.html
Energy Perspectives: Trends and Milestones. http://www.eia.doe.gov/emeu/aer/pdf/perspectives.pdf
Energy in the United States: 1635-2000. http://www.eia.doe.gov/emeu/aer/eh/frame.html.
Annual Energy Outlook 2007, http://www.eia.doe.gov/oiaf/aeo/index.html
International Energy Annual, 2005, http://www.eia.doe.gov/emeu/iea/contents.html

U.S. National Renewable Energy Laboratory, "Clean Energy Basics," http://www.nrel.gov/clean_energy/

U.S. National Renewable Energy Laboratory, "Renewable Energy Data," http://rredc.nrel.gov/

"We're in Trouble" Books:

James Gustave Speth, *Red Sky at Morning: America and the Crisis of the Global Environment*, 2005

Matthew R. Simmons, *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy*, 2005

Kenneth S. Deffeyes, *Beyond Oil : The View from Hubbert's Peak*, 2005

James Howard Kunstler, *The Long Emergency: Surviving the End of the Oil Age, Climate Change, and Other Converging Catastrophes of the Twenty-first Century*, 2004

Richard Heinberg, *The Party's Over : Oil, War and the Fate of Industrial Societies*, 2004

Paul Roberts, *The End of Oil : On the Edge of a Perilous New World*, 2004

Colin Campbell, *The Coming Oil Crisis*, 2004

John Houghton, *Global Warming : The Complete Briefing*, 2004

"We have no Problem" Books:

Peter W. Huber, *The Bottomless Well: The Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy*, 2005

Patrick J. Michaels, *Meltdown : The Predictable Distortion of Global Warming by Scientists, Politicians, and the Media*, 2004

Christopher Essex, *Taken By Storm: The Troubled Science, Policy and Politics of Global Warming*, 2003

Bjorn Lomborg, *Cool It - The Skeptical Environmentalist's Guide to Global Warming*, 2007