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NRGY 102.01: Introduction to Sustainable Energy Systems II

Bradley E. Layton
University of Montana - Missoula, bradley.layton@umontana.edu

Missoula College
THE UNIVERSITY OF MONTANA
The University of Montana
Climate Change Studies Program
Bradley Layton
bradley.layton@umontana.edu

Introduction to Energy Systems II

Course Number:	NRGY 102/CCS 102
Credits:	3
Meeting times:	TR 2:10 – 3:30 HB17
Course Instructor:	**Bradley Layton** bradley.layton@umontana.edu 406.243.7865
Office Hours:	9:30 am – 11:00 am TR or by appt
Pre-/Co-requisites:	NRG101 Introduction to Energy Systems I or consent of instructor

Course Description

NRG102 Introduction to Energy Systems II is a survey of renewable energy systems and technologies. The course addresses the physical and technical aspects of wind, solar, geothermal, hydro, tidal, biological, and wave energy systems. Consideration is also given to the engineering, economic, social, environmental, and political factors that determine implementation and sustainability.

Course Overview

Introduction to Energy Systems II is the second of a two-part course. It provides students with a comprehensive look at the history and nature of sustainable energy systems. Consideration is given to the primary sources of the earth's energy supplies and their ability to meet and sustain the increasing rate of consumption with current and emerging technologies.

Problems and opportunities associated with integration of these energy systems into existing energy infrastructure are also discussed.

Introduction to Energy Systems II provides students with a working knowledge of the fundamental principles of inexhaustible and renewable energy as well as practical examples of technologies designed to harness them. It provides the student with tools for assessing the current global, state and local human consumption rates and habits as well as opportunities and constraints for future applications.

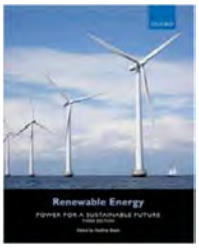
Course Objectives

Upon completion of this course, the student will be able to:

- Quantify the rate of global and regional human metabolic and technological energy consumption;
- Put the current rate of consumption into context with historical and prehistoric consumption rates;
- Evaluate the physical and technical aspects of renewable energy and energy supply/demand systems;
- Identify the technologies, their key elements and basic principles, that we use to capture, convert, store, distribute energy;

Bradley Layton bradley.layton@umontana.edu

- Identify factors that contribute to the economic viability of energy generation from renewable sources, and evaluate the efficacy of conservation and efficiency measures;
- Discuss the problem of sustainability in the context of renewable energy and identify technical and social barriers and solutions to the use of renewable energy sources;
- Assess the costs and benefits associated with different renewable energy sources and technologies;
- Perform fundamental energy-related calculations such as those involving the laws of thermodynamics and energy conversion efficiencies;
- Undertake elementary economic analyses of a renewable energy project, taking into account the effect of such factors as discount rates and project lifetimes;
- Develop a practical and theoretical knowledge of the full suite of renewable energy systems and apply that knowledge to real world situations.



Required Texts

Boyle, Godfrey, ed. *Renewable Energy: Power for a Sustainable Future 3rd Ed.* Oxford University Press in association with The Open University, 2012. ISBN: 0199261784.

Assessment/Grading Policies

Grades are based upon successful completion of the following:

Essays	15%
Exams (6)	60% Final Exam @ 10% replaces previous lowest
Summaries (5)	15%
Summary responses/participation	10%

Grading scale

A = 90-100
B = 80-89
C = 70-79
D = 60-69
F < 60

Homework/Exams/Summaries/Participation

Homework consists of several essays and summaries. Due dates are listed at the bottom of the syllabus. It is the student's responsibility to check for schedule updates at least semi-weekly.

Exams consist of six unit/chapter exams. Please consult the Exam folder in the Course Information module for detailed information on taking exams. There are no make-up exams without prior approval. If you foresee missing an exam because of a scheduling conflict or due to illness, you must notify the instructor in advance to arrange for an alternative time to take the exam PRIOR to its regularly scheduled date. The final exam is cumulative and replaces the previous lowest exam grade.

Summaries Instructions for completing this exercise can be found in Learning Unit 1. For those who have taken NRG101 or SCN175, please note that while the basic requirements of the 300+ word assignments remain the same, the expectations are higher for the quality of work and the complexity of articles. The student must still meet the basic requirements (formatting, spelling, grammar, citation, etc.), but the summaries must indicate an increased ability to read more technically complex articles and to summarize them critically with greater detail and quantitative analysis. Your responses should also

reflect an increased ability to think analytically and raise additional discussion points about issues, and to relate the issues to course material. *For each summary, you must include at least one equation, cite the reading required, and cite an additional relevant peer-reviewed non-web reference.*

Essays are similar to summaries, but involve individual research rather than reading a prescribed article. Participation and Attendance Traditional 3-credit courses meet for 3 hours per week. For every in-class hour, the student is expected to spend 3-4 hours outside of class reading, preparing, and doing homework. Thus, the student ideally spends 12-15 hours per week on this course, depending upon time management and study skills. The time commitment is the same for an online course.

Participation is based upon timely completion of assignments, exams and discussion board submissions. This also means submitting assignments as instructed. The bulk of this portion of the grade is determined by the quality of your Discussion Board participation (responses to classmates' summaries).

Drop/Add Policy

The Drop/Add Policy may be found at the in the Provost's website.

Academic Honesty Policy

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University.
All students must be familiar with the Student Conduct Code.

Accommodations

To request an accommodation, please contact the Course Instructor. For more information, visit accommodation website or call 406.243.2243 (Voice/Text).

Communication

Communication is vital to your success in this course. Contact information is provided in this Syllabus. As the Course Instructor, I try to answer all calls and e-mails promptly. Communicating with the Course Instructor is the Student's responsibility especially with regard to meeting deadlines. In general, late assignments are not accepted and exams cannot be made up. If an unforeseen event happens, please contact the Course Instructor immediately, and PRIOR to a deadline, to make alternative arrangements for meeting your class responsibilities.

Online support

may be obtained via courseware-support@umontana.edu or x4999

Email policy at UM

According to University email policy, an "employee must use *only* UMM assigned student email accounts for all email exchanges with students, since such communication typically involves private student information." For more information on setting up and using your GrizMail account, visit the UMontana Information Technology Website.

Bradley Layton bradley.layton@umontana.edu

Outline

Learning Unit One (Week 1)

Introducing Renewable Energy (Boyle Ch 1)

Review: force, energy, power; energy conservation (1st law of TD); forms of energy; conversion and efficiency; present-day energy use; fossil fuels and climate change; renewable energy sources; renewable energy and sustainability

Learning Unit Two (Weeks 2-4)

Solar Thermal Energy (Boyle Ch 2)

Nature and availability of solar radiation; rooftop solar water heaters; glass; low-temp solar applications; active solar heating; passive solar heating; daylighting; solar thermal engines and electricity generation; economics, future potential, and environmental impacts

Solar Photovoltaics (Boyle Ch 3)

History of PV; PV in silicon: basic principles; Crystalline PV: reducing costs, raising efficiency; thin-film PV; innovations in PV; electrical characteristics of silicon PV cells and modules; PV systems for remote power; grid-tie PV systems; costing energy from PV; environmental impacts; safety; integration and future prospects

Learning Unit Three (Weeks 5-6)

Bioenergy (Boyle Ch 4)

Past and present uses; biomass as fuel; bioenergy sources: energy crops and wastes; combustion of solid biomass; production of gaseous fuels from biomass; production of liquid fuels from biomass; environmental concerns; economics

Learning Unit Four (Week 7)

Hydroelectricity (Boyle Ch 5)

Hydro schemes around the world; the resource; stored energy and available power; history of water power; types of hydroelectric plants; Francis turbines; propellers; impulse turbines; applications; scale: large, medium, small, micro; environmental impacts; integration; economics; future prospects

Learning Unit Five (Week 8 & 9)

Tidal Power (Boyle Ch 6)

Nature of the resource; technical; environmental, economic factors; integration; future prospects; types of systems: tidal barrages, tidal streams, tidal currents; assessment of potential

Learning Unit Six (Week 10 & 11)

Wind Energy (Boyle Ch 7)

Nature of the resource; wind turbines; aerodynamics; power and energy from turbines; environmental impacts; economic assessment; commercial development and potential; offshore sources

Learning Unit Seven (Week 12)

Wave Energy (Boyle Ch 8)

Nature of the resource; sample applications; wave energy technologies; economics; environmental impacts; integration; future prospects

Learning Unit Eight (Week 13)

Geothermal Energy (Boyle Ch 9)

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Overview of the resource; nature of the resource; historical uses; technologies for exploitation; environmental impacts; sustainability; economics; future prospects

Learning Unit Nine (Weeks 14 & 15)

Integration (Boyle Ch 10)

Analysis of existing energy infrastructure; location and availability of RE supplies; sustainability and harvest rates; system solutions for integration of RE; hydrogen economy; economics; case study: Danish system; global considerations

Schedule of Due Dates

Week 1 nothing due
Week 2 Biosketch
Week 3 Summary 1
Week 4 Exam 1 Ch 1-3
Week 5 Summary 2
Week 6 Exam 2 Ch 4
Week 7 Summary 3
Week 8 Essay I
Week 9 Exam 3 Ch 5 & 6
Week 10 Summary 4
Week 11 Exam 4 Ch 7 & 8
Week 12 Summary 5
Week 13 Essay II
Week 14 Exam 5 Ch 9
Week 15 Essay III
Week 16 Exam 6 10