1-2015

CCS 102.01B: Introduction to Sustainable Energy II

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Missoula College
THE UNIVERSITY OF MONTANA

The University of Montana
Climate Change Studies Program

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Introduction to Energy Systems II

Course Number:	NRGY 102/CCS 102
Credits:	3
Meeting times:	Monday and Wednesday, 4:00 – 5:30/p, HB03
Course Instructor:	Marc Olson marc.olson@umontana.edu
Office Hours:	Tue and Thu 2:00-4/30p, Griz House 8 (Available at other times, email to schedule)
Phone:	406.243.7865
Pre-/Co-requisites:	NRGY 101 Introduction to Energy Systems I or consent of instructor

Course Description

NRGY 102 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;

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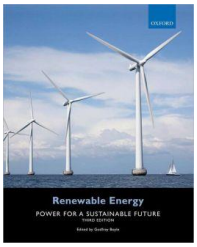
- Identify the technologies, their key elements and basic principles, that we use to capture, convert, store, distribute energy;
- Identify factors that contribute to the economic viability of energy generation from renewable sources, and evaluate the efficacy of conservation and efficiency measures;
- 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;
- Possess improved written communication and problem-solving skills.



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:

Exams (6)	35%
Assignments (5)	30%
Summaries (5)	25%
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 summaries and assignments. It is the **student's responsibility** to check for schedule updates at least semi-weekly. Reading of the text is not regularly assigned but expected prior to the associated lecture. Lecture topics are announced in advance.

Exams consist of six unit/chapter exams. Please consult the Exam Folder in the Course Information module for detailed information on taking exams. Exams typically open after the Wednesday class of the associated week and close before the next Monday class, and must be completed in one sitting with a three hour limit. 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 seek permission to arrange for an alternative time to take the exam. Students must complete exams

independently practicing academic honesty. The final exam is optional and is cumulative and replaces the previous lowest exam grade.

Summaries require your written analysis of an assigned topic. Instructions are explained in the Guidelines and Expectations for NRGY 102 Summaries shown in the introductory portion of Moodle. For those who have taken NRGY 101 or SCN175, please note that while the basic requirements of the 300+ word summaries 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 reference.*

Submit a preliminary draft of your summary to the Forum link for discussion and respond to at least two of your classmates' summaries for class participation credit. Submit your final summary to the Summary Submit link for grading.

Assignments (Problem Sets) involve step-wise problem solving. Consult the Guidelines and Expectations for Problem Sets given in the introductory portion of Moodle. *Show your work and include all units or dimensions, calculations, and conversions for full credit.* Examples are provided. Again you may submit a draft and comment via the Forum to receive participation credit.

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. The bulk of this portion of the grade is determined by the quality of your Discussion Board participation (responses to classmates' summaries). Subject related and professionally termed responses are expected.

Deadlines for the submission of work are communicated when posted. Late work will normally result in grade reduction. It is understood that unusual circumstances can develop; it is the **student's responsibility** to notify the instructor ahead of time for permission to extend a deadline.

Lectures

Lectures are recorded twice per week on Mondays and Wednesdays in Missoula. Lecture topics are announced, the student will enhance learning and participation greatly by reading the material prior to lecture. Students living in town are encouraged to attend. For out-of-town students, and students with commuting challenges, the lectures are also available for viewing via iTunesU. A link to iTunesU is available under OneStop. Instructions for logging into iTunesU are given in the introductory portion of Moodle. If you would like to log in during lecture, you may do so using the "Link for Live Lecture webstreaming" located.

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 (typically 2-8/p weekdays and periodically weekends, will always get back to you). Communicating with the Course Instructor is the Student's responsibility especially with regard to meeting deadlines. Late assignments and exams are strongly discouraged. 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

Very effective help may be obtained via courseware-support@umontana.edu or 243-4999.

Email policy at UM

According to University email policy, an "employee must use *only* UM 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.

Learning Unit One (Weeks 1-4)

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

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 Two (Weeks 5-6)

Bioenergy (Boyle Ch. 4)

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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 Three (Week 7-9)

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

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 Four (Weeks 10 - 12)

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

Wave Energy (Boyle Ch. 8)

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

Learning Unit Five (Week 13)

Geothermal Energy (Boyle Ch. 9)

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

Learning Unit Six (Week 14)

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 (tentative)

(Firm due dates communicated when unit presented)

Week 1	Intro	**Week 9**	Exam 3 Ch. 5 & 6
	Example Assign. (Problem Set)	**Week 10**	Summary 4
Week 2	Assignment 1	**Week 11**	Assignment 4
Week 3	Summary 1	**Week 12**	Exam 4 Ch. 7 & 8
Week 4	Exam 1 Ch. 1-3		Summary 5
	Assignment 2	**Week 13**	Exam 5 Ch. 9
Week 5	Summary 2		Assignment 5
Week 6	Exam 2 Ch. 4	**Week 14**	Exam 6 Ch. 10
Week 7	Summary 3	**Week 15**	Optional Assignment
Week 8	Assignment 3	**Week 16**	Optional Final