

MATSC101: ENERGY AND THE ENVIRONMENT

FALL 2002 ~43 classes

Course Summary

Conventional and alternative energy resources, uses, and technologies; socio-environmental considerations

Instructor: Dr. Tony Foyle
Class Time and Location: MWF 4:00 – 4:50 in 101-Science
Contact Information: H24 (under Computer Center); Ph 898-6277; E-mail amf11@psu.edu
Office Hours: H24 (under computer center): MWF 3:00 – 3:50, & by appointment
Website: Pending!

COURSE GRADING SCHEME

• 3 three-page essays @ 5% each	15%	150 pts
• 1 Library assignment	04%	40 pts
• Homework assignments & Switch-Reports	16%	160 pts
• 2 in-term examinations @ 15% each	30%	300 pts
• 1 final comprehensive examination	18%	180 pts
• 1 End-of-Semester Country Project + Pres	08%	80 pts
• Quizzes, RATs	09%	90 pts
• TOTAL	100%	1000 pts
• Extra-credit opportunities:		
Newspaper, magazine, or date-stamped web page clips on current energy issues; Sample seasonal energy bills; Energy video; +/- GE or WM fieldtrip	03%	30 pts
Note Card surveys, MSEs	02%	20 pts

Letter grade scores for the course will be based on the following scale. I may lower (but not raise) the scale: **A** =93-100%, **A-** =90-92, **B+** =87-89, **B** =83-86, **B-** =80-82, **C+** = 77-79, **C** =70-76, **D** =60-69, **F** =0-59.

COURSE DESCRIPTION & LEARNING OUTCOMES

This Natural Sciences Gen Ed course is designed for students majoring in fields outside of science and engineering who have an interest in Society's use (and misuse?) of energy resources. We'll cover energy concepts, resources, applications, and problems of current interest. Completion of the course will enhance your scientific literacy and numeracy skills, particularly as they relate to energy issues, and you will also benefit by becoming a better-informed energy consumer. A basic knowledge of algebra is assumed.

You will become an expert in everyday energy issues by playing an **active role** in:

- (1) Examining the technical, economic, and societal aspects of energy availability, extraction, and use.
- (2) Seeking out and critically evaluating current energy information.
- (3) Synthesizing information and forming educated opinions on energy issues.
- (4) Using real-world scientific, engineering, and economic data to understand how common energy systems work and impact our daily lives.
- (5) Demonstrating your ability to learn, retain, and apply energy-related knowledge and concepts to the solution of specific problems/issues.

There are four major recurring *THEMES* that run through this course that we will return to on a regular basis:

- (1) **FUNDAMENTAL PHYSICAL LAWS:** simple equations that govern energy, energy conversion, and energy use. We need to understand these in order to develop educated opinion on energy issues.
- (2) **ENERGY SUPPLY:** energy types, how much there is, where it is, why it's there, how (fast) we use it, what the future holds.
- (3) **ENERGY DEMAND:** energy realities that we live by every day, why we use so much, the \$ consequences, and our energy-saving options.
- (4) **THE FUTURE:** how today's energy balance will influence our energy options over the next several decades to centuries.

ACADEMIC INTEGRITY

Academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. It is one of the guiding principles for all academic activity at Penn State and is one of the four Penn State Principles to which all students must abide. Any violation of academic integrity will receive academic and possibly disciplinary sanctions, including the possible awarding of an XF grade (which is recorded on your transcript and states that failure of the course was due to academic dishonesty). All acts of academic dishonesty will be recorded so that repeat offences can be sanctioned accordingly. For more information, see:

<http://www.pserie.psu.edu/faculty/academics/integrity.htm>

PRELIMINARY SCHEDULE

TOPIC

PRE-CLASS RK READING ASSIGNMENT

(1) COURSE PREVIEW (2 classes):

8/28-8/30 WEEK 1

Syllabus; Textbook and Reserve/Online Text
Pre-Course Assessment
Course introduction: Importance of Energy

(2) ENERGY FUNDAMENTALS (11 classes):

9/2-9/27 WEEKS 2-5

Introduction		1-6
Renewable and Non-Renewable Energy (The major types of energy we have)		25-27
Energy ~ Work: Definitions and Units (What energy is, how we use and measure it)		6-9
Forms of Energy (<i>C – H/T – M/N – EM – K – P – E</i>)	5? Thipaisha teams	9-12
Power: Definition and Units (The <u>rate</u> at which we use energy & how we measure it)		12-13
Energy Use in the US (How much energy <u>do</u> we use anyway?)		16-22
Law of Conservation of Energy (The good 1 st Law of Thermodynamics)		22-23
Energy Conversion and Efficiency (The better 2 nd Law of Thermodynamics)		23-24
Heat Engines and the Carnot Efficiency (Using the 1 st and 2 nd Laws)	Diesel demo?	64-69
Real-Life Heat Engines (Energy-producing devices)	5? Thipaisha teams	69-79
CoGeneration (or, how we can apply the 1 st and 2 nd Laws to improve efficiency)		82-85

<i>SEPTEMBER 04: Library Workshop (Library Rm 107) and Assignment distribution</i>	<i>WED SEPT 4</i>
<i>SEPTEMBER 09: Library Assignment due (task-related lit searches)</i>	<i>Library Time</i>
<i>SEPTEMBER 16: Big Homework due: Scientific Notation, Units, Unit Conversions; Q&A</i>	<i>15-16</i>

(3) NON-RENEWABLE ENERGY – FOSSIL FUELS (14 classes):

9/30-11/1 WEEKS 6-10

Introduction to fossil fuels and their maturation	5? Thipaisha teams	<i>Web Sites</i>
COAL: Formation, Properties, Reserves, Recovery, and Use		51-54
OIL: Formation, Properties, Reserves, Recovery, and Use		32-44
GAS: Formation, Properties, Reserves, Recovery, and Use		44-51
NON-TRADITIONALS: Shale Oil – Groups 1 & 2		54-57
Tar Sands – Groups 3 & 4	15 Switch-Reports + 5 mins	57-59
Gas Hydrates – Groups 5 & 6		whyfiles.org
Environmental Effects of Fossil Fuel Recovery, Refining, and Use (5? Thipaisha teams)		286-321

<i>OCTOBER 04: Half-Class Exam Review Session</i>	<i>OCT 04</i>
<i>OCTOBER 07: EXAM 1: Energy Fundamentals and Use</i>	<i>OCT 07</i>
<i>OCTOBER 16: Essay 1 due: ANWR – the pros and cons of oil production (Team essay)</i>	<i>OCT 16</i>
<i>OCTOBER 25: Big Homework 2 due: Tabulation - State "X" vs PA: Energy resources, sources, and usage.</i>	<i>OCT 25</i>

(4) NON-RENEWABLE ENERGY – NUCLEAR FUELS (6 classes): 11/4-11/15 WEEKS 11-12

Introduction to Nuclear Fission (The big picture and the "nuclear difference")		171-172
Principles of Nuclear Fission (Basic chemistry we need for meaningful discourse!)		173-177
Applications of Nuclear Fission (How we use the atom in a heat engine)		177-185
Nuclear Energy and the Environment (The good and the bad)	(Thipaisha teams)	185-198
+/- Nuclear Fusion: Seawater as a resource		

<i>NOVEMBER 01: Half-class Exam Review Session</i>	<i>NOV 01</i>
<i>NOVEMBER 04: EXAM 2: Fossil and Nuclear Fuels</i>	<i>NOV 04</i>
<i>NOVEMBER 13: Essay 2 due: The "Alt X" Industry (excl. wind) in State "Y"</i>	<i>NOV 13</i>

(5) SELECTED ALTERNATIVE ENERGIES (4 classes): 11/18-11/29 WEEKS 13-14

Solar Energy	Group S			90-121
Hydroelectric Energy	Group H			126-133
Wind Energy	Group W		5 Thipaisha teams	133-141
Geothermal Energy	Group G			158-163
Tidal Energy	Group T			164-166

<i>NOVEMBER 27: LRC Essay 3 due: The Future of US Wind Energy</i>	<i>NOV 27</i>
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(6) THE FUTURE AND THE GLOBAL PICTURE (6 classes) 12/2-12/13 WEEKS 15-16

The Future?	325-348
Distribute Country Reports in class (study resource): Review Country stats	DEC 09

<i>DECEMBER 06 & 09: Country EA Projects due: 2-page report and 8-minute PowerPoint presentations on Country X</i>	<i>DEC 06</i>
<i>DECEMBER 13: Last class: Half-class Final Exam Review Session</i>	<i>DEC 13</i>

DECEMBER 16-20: FINAL COMPREHENSIVE EXAMINATION -----

TEXTBOOK, RESERVE/ONLINE TEXT, OTHER MATERIALS:

Course Text: **Energy and the Environment** by R.A. Ristinen and J.J. Kraushaar (1998). Published by John Wiley and Sons, Inc. This text forms the framework for this course and will be supplemented with web-based information and material from the optional support text (see below).

Optional Support Text: **Energy and Fuels in Society – Analysis of Bills and Media Reports 2e** by L.R. Radovic (1997). Published by McGraw Hill Companies, Inc. On reserve in the Behrend library and readable online at www.ems.psu/~radovic/matsc101.html. Contains additional information and example calculations relevant to material in R&K.

Interesting Reading:

The Little Ice Age – How Climate Made History, 1300-1850 by B. Fagan (2000). Published by Basic Books.

The Prize: The Epic Quest for Oil, Money, and Power by D. Yergin (1991). Published by Simon and Schuster. Documents the history of oil exploration in NW Pennsylvania.

HOW CAN I DO WELL IN THIS COURSE?

This is a one-semester course. Your final grade will be fair and will reflect the amount of effort you (and for several learning exercises, your team-mates) put into the learning process.

Your grade will reflect your ability to conduct specific assignments outside of the classroom (to include a library assignment, 3-page essays, big and small homeworks, a team project, assigned readings; optional proof of “currency” in energy issues, and participation in note card surveys) which will make up ~50% of your final grade.

Your final grade will also reflect your ability to understand facts and concepts and how to apply critical thinking skills to develop informed and educated opinions on energy issues (2 intra-semester exams, 1 final comprehensive exam, several quizzes) which will also make up ~50% of your final grade.

Quizzes, Readiness Assessment Tests (RATs), and examinations will consist of multiple-choice, short-essay, short-calculation, and true/false questions designed to test your understanding of key concepts, ideas, and processes relating to energy and the environment.

Unless indicated otherwise, all quizzes, homeworks, and essays are due in class (by hand and in person) on the due-date indicated and should reflect individual work done by you. Late turn-ins will cause the worth of the product to decrease by 20% for each day (or part of a day) it is late. Only documentable proof of legitimate curricular and extracurricular commitments/emergencies will alleviate the penalty for late turn-ins. Examinations will be given once only: If you miss an examination, only documentable proof of legitimate curricular and extracurricular commitments/emergencies will be considered.

With regard to attendance, Penn State policy states that *“a student should attend every class ... and should be held responsible for all work covered in the courses taken. A student whose irregular attendance causes him or her, in the judgment of the instructor, to become deficient scholastically, may run the risk of receiving a failing grade or receiving a lower grade than the student might have secured had the student been in regular attendance.”* From my point of view, it is to your definite benefit to attend all classes and be prepared to participate. Topics covered in class (which may not necessarily be covered in as much detail in the text book nor in the order presented in the text book) will be examinable and will also be useful for homeworks, essays, etc. To benefit from class participation and to do well in this course, you must attend class.

This course covers a lot of new material quickly, and you will have a lot of reading! To do well, attend all classes, take notes on the key points discussed in class and in the assigned pre- and post-class readings, review and annotate your notes each evening after each class, participate in class discussions, and meet or

otherwise communicate with the instructor if you have any questions on any matter related to the course. Study regularly and for at least 2 hours for each hour of class, and review end-of-chapter key terms, problems, and multiple-choice questions pertaining to the material covered. Complete all home and in-class assignments (individual and team-based) punctually and thoroughly, and take charge of your learning. For group assignments, put in your best effort because you and your group peers will be evaluating your (and their) contributions to the group effort ... if you let the team down, they will know it and consequently I will! Lastly, monitor your e-mail on a regular basis as there may be times when I need to contact the class outside of class periods (for example, to distribute an assignment).

GUIDELINES FOR THE THREE ESSAYS & THE BIG HOMEWORKS:

All essays and big-homework energy discussions must use SI units (e.g. Joules, Watts) unless indicated otherwise. The essays must be double spaced, single sided, and "typed up" with an 11pt Times font. The Title Page must have your name, your co-authors' names (if a team assignment), the title of the paper, and your estimate of your and your co-authors' contributions to the paper (in percent). The essay must incorporate an Introduction, a Discussion (which may have sub-headings such as Problems, Solutions, Environmental Concerns, etc.), Conclusions, and a Reference List. Numbered Figures and Tables must appear on separate (extra) pages and be referred to in the text. References must be properly cited (ask me if you don't know how to do this), and at least one reference must be a real science/engineering/business journal article. Any quoted material in your essays must not exceed two sentences. Feel free to check out the *Behrend College Style Manual* for further guidance. Essay #3 should theoretically be your best essay as you will have had two earlier essays to perfect your techniques! In Essay #3, I will be looking for evidence of critical thinking on the wind energy issue. Because of this added emphasis, you will have the opportunity to resubmit the essay for a revised grade by early December provided that you meet with a tutor at the Learning Resource Center (LRC) and make concrete, critical-thinking-related, changes to your essay.

AFTER HEAT ENGINES ?????? Week 15

Overnight Web mini: Go to www.energyguide.com or www.energysmart.org and do a home analysis of your family home with "Analyze Your Use."

How much energy does a home like yours typically use?

What is the expected annual cost of energy for your home?

What is the single biggest factor affecting monthly energy use?

What is your lowest energy-consuming month? Why?