ENERGY IN THE EARTH SYSTEM (ERS 191)

Summer 2017, 3 credit online course

Course Description: Explores the Earth Science concepts that underlie energy, energy sources, energy distribution and flow, and the role of energy in climate. We will consider the ways in which society interacts with and extracts energy from the Earth System, the energy balance of Earth and the climate implications of energy use, and gain an understanding of renewable and non-renewable energy sources. This course satisfies the General Education Applications of Scientific Knowledge and Quantitative Literacy requirements. Credits: 3.

Prerequisites: None.

Instructors: Professor Karl Kreutz (karl.kreutz@maine.edu) and Graduate Teaching Assistant Kimberley Miner (kimberley.miner@maine.edu), School of Earth and Climate Sciences, and Climate Change Institute. Email is the best way to contact us with questions, concerns, help, etc. There will be an ERS191 Help Center available in Blackboard, which is another efficient way to get questions answered.


While not required, I recommend the following books for additional information. Each discusses energy issues in more depth than the textbook, but are written for a general audience and thus at a level appropriate for ERS191.


Electronic resources: This is an online class, and all course materials, discussion, and exams will be accessed via the internet. You will need a Blackboard account, which is available to you free as a UMaine student. For information and help with setting up your Blackboard account, go to the UMaine Information Technologies website (http://www.umaine.edu/it/). Course materials (slideshows, videos, discussion boards, and links to other online resources) that are in addition to the textbook reading will be available in Blackboard; as such, you will need to know how to login and navigate Blackboard confidently. A high-speed internet connection will be required to view video content. You will have full time access to the course, and thus can determine your own schedule each week for working through the assigned materials. This, however, means that you will need to practice effective time management to be prepared for each exam, and to submit your weekly discussion board posts on time (see below).
Course Goals and Learning Outcomes

Course goals: In ERS191: Energy in the Earth System, students will:

- Improve their Earth science, energy, and climate literacy
- Gain perspective on energy and climate issues by using a systems approach
- Become familiar with the range of energies in nature and society
- Appreciate the energy-based linkages among resource extraction, energy production and use, environmental change, Earth’s energy balance, and climate
- Practice fundamental habits of scientific thinking
- Apply critical thinking and quantitative skills to energy and climate issues in society

Course learning outcomes: Upon successful completion of ERS191: Energy in the Earth System, students will be able to:

1) Identify different forms of energy in the Earth system, and define using simple equations
2) Distinguish between concepts of energy and power, and convert between energy and power units across a range of Earth system sources and societal uses
3) Examine the magnitude of internal and external sources of energy in the Earth system using observational data, and compare energy reservoirs in the Earth system to historical, current, and future societal energy use
4) Identify interactions between surface and solid earth cycles related to energy flow and energy extraction
5) Evaluate the relative importance of natural processes and human activities that impact the distribution of energy
6) Calculate personal energy use, and compare to societal energy use and Earth system energy reservoirs
7) Explain the Earth system processes responsible for renewable and non-renewable energy resources;
8) Evaluate, using a simple quantitative (i.e., back of the envelope) approach, Earth science-related energy issues in society
9) Manipulate energy balance models of Earth, and use them to quantitatively assess the natural and enhanced greenhouse effect
10) Generate time-series graphs and spatial maps of Earth system data related to energy, energy use, and climate

These learning outcomes pertain to the overall course, as well as the General Education Applications of Scientific Knowledge and Population & Environment requirements.

Learning assessment: Assessment of course learning outcomes will be based on the following items:

1. Three exams (30% of the final grade/300 total points): There will be three 40-item multiple-choice exams in the course (two during the semester, and one during finals week). All three exams will be taken online using Blackboard. You will have 80 minutes to complete each exam,
and the results will automatically be recorded. You will be able to access your results immediately upon completing the exam. Exam questions will cover the assigned textbook reading, additional readings, and videos; I suggest you review the chapter summaries and questions for review at the end of each assigned chapter to prepare for the exams.

*Exam #1 (100 points): Exam 1 covers textbook chapters 1-4, and the assigned videos and additional reading for Week 1.

*Exam #2 (100 points): Exam 2 covers textbook chapters 5-8, 10-12, and 15, and the assigned videos and additional reading for Week 2.

*Exam #3 (100 points): Exam 3 covers textbook chapters 2, 9, 13, and 17-19, and the assigned videos and additional reading for Week 3.

2. Weekly Discussion (30% of final grade/300 points)

Each week you will be required to contribute to a discussion of current events related to energy. To do so, please find and summarize a piece of energy-related media coverage published during that week. I define energy broadly (energy resources, energy policy, energy use, etc.). The criteria are that you: 1) discuss the energy-related aspect of the piece; 2) identify one (or more) quantitative aspects pertaining to energy in the Earth system or society; 3) identify one (or more) systems aspect in the piece (i.e., how one component, action, etc. affects something else); 4) provide a citation (i.e., where exactly did you find it – source, date, author), and 5) relate the content of the piece to the textbook reading for that section of the course. Each summary post should be a minimum of 200 words, and is due by 6 pm Sunday of that week. Any post that is late, too short, contains spelling or grammatical errors, or plagiarizes in any way, will be given a zero. Additionally, I would like everyone to comment on at least one media piece posted by another student, to stimulate discussion. The posts for each individual week are worth 100 points (3 weeks x 100 points = 300 points total). Grading will be as follows: 50 points for energy discussion, quantitative, and systems information, 25 points for relating to textbook reading, and 25 points for commenting on another post. During the first week of class, I’d like everyone to introduce himself or herself with a post.

3. Energy Problems (40% of final grade/400 points)

You will complete ten energy-related assignments pertaining to topics covered during each of the three course sections. The assignments will involve analyzing, interpreting, and discussing energy and/or climate data, energy and/or climate model output, or other data sources. Details for each assignment will be available in the relevant discussion forum. You can work on the assignments anytime during the week, and they are due by 6 pm Sunday of the week they are scheduled in. Each assignment will be worth 40 points.

4. Extra Credit

Throughout the course, I may offer extra credit opportunities. These will involve data analysis, discussion of a particular energy-related topic or news item, reflection on energy or climate
issues, etc. Details and points will be announced when opportunities are available in the Extra Credit discussion forum.

5. Determining your grade for the course

Exam #1 100 points
Exam #2 100 points
Exam #3 100 points
Weekly discussion 300 points
Energy assignments 400 points

TOTAL 1000 points (plus any additional extra credit)

A = 900 – 1000 (or more) points
B = 800 – 899 points
C = 700 – 799 points
D = 600 – 699 points
F = 599 points or less

Course Policies: Attendance at all lecture and laboratory sessions is required. Students are responsible for all material presented in class as well as in the required readings. By turning assignments in on time, you are eligible for full credit. Late assignments forfeit the right to any credit; any partial credit for late assignments will be up to the instructor’s discretion. We expect appropriate use of electronic devices during class.

Academic honesty: Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

Students with disabilities: If you have a disability for which you may be requesting an accommodation, please contact Disabilities Services, 121 East Annex, 581-2319, as early as possible in the term.

Course schedule disclaimer (disruption clause): In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

Course Schedule for Summer 2017
<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Reading</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1; June 5-11</td>
<td>Earth system science</td>
<td>Ch. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Earth system reservoirs and interactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>What is energy?</td>
<td>Ch. 2</td>
<td>Energy problem #1 (personal energy use)</td>
</tr>
<tr>
<td></td>
<td>External and internal energy sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Earth's energy cycle</td>
<td>Ch. 2</td>
<td>Energy problem #2 (solar insolation)</td>
</tr>
<tr>
<td></td>
<td>Energy and society</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy and matter</td>
<td>Ch. 3</td>
<td>Energy problem #3 (SECS solar panels)</td>
</tr>
<tr>
<td></td>
<td>Earth materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Space, time, and the sun</td>
<td>Ch. 4</td>
<td>Week 1 discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EXAM 1</td>
</tr>
<tr>
<td>2; June 12-18</td>
<td>The tectonic cycle</td>
<td>Ch. 5, 6, 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radioactivity, heat flow and geothermal energy</td>
<td></td>
<td>Energy problem #4 (precipitation)</td>
</tr>
<tr>
<td></td>
<td>The hydrologic cycle</td>
<td>Ch. 8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydropower</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The oceans</td>
<td>Ch. 10</td>
<td>Energy problem #5 (ocean temperature and heat)</td>
</tr>
<tr>
<td></td>
<td>Ocean currents, tides, heat, and ocean energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The atmosphere</td>
<td>Ch. 11, 12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Composition, structure, and wind energy</td>
<td></td>
<td>Energy problem #6 (surface winds and AOT)</td>
</tr>
<tr>
<td></td>
<td>Ecosystems, past and present</td>
<td>Ch. 15</td>
<td>Week 2 discussion</td>
</tr>
<tr>
<td></td>
<td>Photosynthesis and fossil fuel energy</td>
<td></td>
<td>EXAM 2</td>
</tr>
<tr>
<td>3; June 19-25</td>
<td>The climate system</td>
<td>Ch. 2, 13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Earth's energy balance</td>
<td></td>
<td>Energy problem #7 (energy balance model)</td>
</tr>
<tr>
<td></td>
<td>Energy resources</td>
<td>Ch. 17, 18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Renewable vs. non-renewable</td>
<td></td>
<td>Energy problem #8 (Carbon dioxide)</td>
</tr>
<tr>
<td></td>
<td>The changing Earth System</td>
<td>Ch. 19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Population, energy use, emissions, and climate</td>
<td></td>
<td>Energy problem #9 (climate modeling)</td>
</tr>
<tr>
<td></td>
<td>Climate impacts: The Cryosphere</td>
<td>Ch. 9</td>
<td>Energy problem #10 (sea level)</td>
</tr>
<tr>
<td></td>
<td>Sea level rise</td>
<td></td>
<td>Week 3 media discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EXAM 3</td>
</tr>
</tbody>
</table>

**Sexual violence policy**

**Sexual discrimination reporting:** The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell any of your teachers about sexual discrimination involving members of the campus, your teacher is required to report this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

Behaviors that can be “sexual discrimination” include sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct, and gender discrimination. Therefore, all of these behaviors must be reported.

**Why do teachers have to report sexual discrimination?**

The university can better support students in trouble if we know about what is happening. Reporting also helps us to identify patterns that might arise— for example, if more than one victim reports having been assaulted or harassed by the same individual.
What will happen to a student if a teacher reports?

An employee from the Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity will reach out to you and offer support, resources, and information. You will be invited to meet with the employee to discuss the situation and the various options available to you.

If you have requested confidentiality, the University will weigh your request that no action be taken against the institution’s obligation to provide a safe, nondiscriminatory environment for all students. If the University determines that it can maintain confidentiality, you must understand that the institution’s ability to meaningfully investigate the incident and pursue disciplinary action, if warranted, may be limited. There are times when the University may not be able to honor a request for confidentiality because doing so would pose a risk to its ability to provide a safe, nondiscriminatory environment for everyone. If the University determines that it cannot maintain confidentiality, the University will advise you, prior to starting an investigation and, to the extent possible, will share information only with those responsible for handling the institution’s response.

The University is committed to the well-being of all students and will take steps to protect all involved from retaliation or harm.

If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

For confidential resources on campus: Counseling Center: 207-581-1392 or Cutler Health Center: at 207-581-4000.

For confidential resources off campus: Rape Response Services: 1-800-310-0000 or Spruce Run: 1-800-863-9909.

Other resources: The resources listed below can offer support but may have to report the incident to others who can help:

For support services on campus: Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the OSAVP website for a complete list of services at http://www.umaine.edu/osavp/