Days-Times: Monday and Wednesdays, 3.30 to 4.45pm
Location: SCOB 101
Instructors: Matt Fraser (matthew.fraser@asu.edu)
Office Hours: No set time, but please email for an appointment
Tom Seager (thomas.seager@asu.edu)

Course Goals
This course is designed to increase your understanding of the role energy in modern society, the current sources of energy and more sustainable alternatives, the fundamental thermodynamics that govern energy consumption and use, the energy embedded in material use, and the energetic implications of materials processing (such as separations). Through work in this class, a student successfully completing the course will:

- Know the current major sources of energy, how each of these sources is used, and the environmental impacts of their extraction, transportation and use.
- Understand what alternative sources of energy are being pursued, their limitations and the prospects for alternative sources replacing traditional sources of energy.
- Understand how the fundamental laws of thermodynamics govern the use of energy.
- Be able to use life-cycle, process-cycle and systems efficiency analysis to quantify embodied energy in different materials.
- Have a working knowledge of the role of physical properties that govern selection of materials.

Teaching Philosophy
This course will be taught at an advanced undergraduate/graduate level, which means that there is an expectation that you arrive motivated and willing to engage in the course discussion which will include leading discussions on related topics through case studies. There are three sections to this course: undergraduate (CEE 494), graduate in-person (CEE 516), and graduate on-line (CEE 516). While the
method of instruction may differ between sections, the overall course goal and teaching perspective is the same for each.

This will not be a unidirectional lecture format where the instructor provides all the information to the students who then have to remember that information for the quizzes or homework. Although the course will begin in a structured manner, I see my job as to provide you with some pedagogical “training wheels”, in the form of basic unifying background plus an intellectual framework to help you organize your analysis of energy and materials use. This will be done in a series of lectures covering energy (weeks 1-6) and materials use (weeks 9-12). The students will be responsible for going beyond the material presented in lecture by independent investigations through case studies and then providing that information to the rest of the class in both oral presentations and written summaries. Oral presentations can be daunting, but effective presentation of technical material in both written and orally are critically important, and the best way to improve is through practice. I haven’t figured out how to do the oral presentations for those students taking the course on-line, but we’ll be able to figure something out.

When it comes to these case studies, please do not ask me “how long do you want the paper to be?” or “how many papers do you want me to read for a case study?” Instead, ask yourself “how long a paper do I need to write to do justice to the topic as I’ve defined it?” and “how many papers do I need to read to understand the issue enough to present and discuss it?” Of course, I will be glad to help you define the case studies and the breadth of material to investigate so that the scope is reasonable.

Course Website

This course has an accompanying Blackboard website available through myASU. The course will rely heavily on Blackboard for course communication and content delivery. Log in to the site at http://myasucourses.asu.edu/ using your ASURITE ID and password. You should see “SOS 494/516: Sustainable Energy and Material Use (Spring 2012).” The website contains the reading materials for each topic, assignments, links, and email addresses for all in the class.

Note: myASU uses your email address from ASU’s student records. This means that you will have to check your ASU email, or have it forwarded to your preferred account, to get information sent from instructors or from your classmates.

Required Readings

For the first part of the course covering energy, there will be no assigned text, but readings will be pulled from a number of sources, including *Energy and the Environment* by James Fay and Dan Golomb, *Energy: Its Use and the Environment* by Robert Hinrichs and Merlin Kleinbach, and *Energy and the Environment* by Robert Ristinen and Jack Kraushaar.

For the second part of the course on materials use, we will use *Materials and the Environment* by Michael Ashby extensively. This is both a good text as well as a
very useful reference book and it is recommended that each student have ready access to the book.

**Assignments, Assessment, and Evaluation**

*Homeworks (20% of course grade).* A series of homeworks will be assigned during the lecture sections of the course. Homework must be turned in electronically through the Blackboard site using the Assignment feature by the beginning of class on the day it is due or it will be considered late. Homework turned in late will be marked down by 25% (0-2 days late), 50% (3 or more days late). Once solution sets are posted on the Blackboard site, late homeworks will not be accepted.

*Quizzes (40% of course grade).* There will be two in-class quizzes throughout the semester that cover the lecture material. The quizzes will consist of short answers (a few sentences) and short calculations covering the first half of the course (energy) and second half of the course (material use). Quiz material will be based on both the assigned readings and material presented in lectures.

*Case Study (40% of course grade).* You will be assigned two case studies over the course where you will be required to do background research on a topic related to the course material. The topic of each case study must be agreed upon by both the student and the instructor. Once a topic has been agreed upon, the student must collect information, summarize the topic and write a summary of the application of the course material to the topic. In addition, a class-room presentation (~30 minutes) will be made presenting the case study to the rest of the class. The case study will be graded based on content (40% of grade), coherency of the case study (30% of grade), and the class presentation (30% of grade).

**Class Policies and Procedures**

*Academic Development.* Formal classes are only one part of your education. Participation in the broader intellectual life of the ASU academic community is equally important to your academic development. ASU is host to a very wide variety of academic and social events surrounding sustainability, many of which are targeted to undergraduate students. We will inform you of these opportunities and hope you participate in these events.

*Academic Integrity.* All students are expected to be ethical in their behavior. While collaboration between students is encouraged, it is important that all work submitted for a grade be your own.

*Assignments.* Individual homework assignments can either be submitted electronically using the Assignment feature in Blackboard or a hardcopy at the beginning of class. Assignments turned in at the end of class will be considered late. This is to prevent you from working on the assignment during the class period.

*Cell Phones, MP3 Players, etc.* Please turn off.
Conflicts. If you have a conflict with any part of the course, please contact Prof. Fraser as soon as possible. The earlier you notify of a potential conflict, the greater the effort to accommodate.

Disability Accommodations. If you need disability accommodations for this class, please contact Prof. Fraser as soon as possible, so that we may work with the Disability Resource Center (http://www.asu.edu/studentaffairs/ed/drc/) to meet your needs. Information regarding disability is confidential.

Writing
Writing well for an academic audience takes practice. Please look at the Writing Resources section on the course Blackboard site to find resources that will help you develop and improve your skills. These include a document outlining our general expectations about written assignments, links to online resources like style guides, and information about campus resources.

Tentative Course Schedule

Week 1: Global Perspective on Energy

Weeks 2-4: Energy Fundamentals
- Unit conversions
- Zeroth Law of Thermodynamics and Thermal Equilibrium
- First Law of Thermodynamics and Mass Balance
- Second Law of Thermodynamics and Entropy of Mixing

Weeks 3-6: Sources and Uses of Energy
- Traditional sources: coal, oil, natural gas, nuclear
- Renewable sources: hydro, geothermal, wind, solar thermal, photovoltaic

Week 7-8: First quiz and first round of case studies

Weeks 9-12: Materials Use
- Embodied energy (life-cycle, process cycle, system efficiency)
- Material purification and exergy
- Material selection

Week 13-14: Second quiz and second round of case studies