“Andean ingot of glory, paschal candle of the sky, 
Flame at the heart of mystery, our system’s burning eye.”

John Montague - ‘Sun Hymn’

Study Abroad Program - Summary

This program seeks to promote and disseminate knowledge of the various topics and technologies of renewable energy and is therefore aimed at assisting students to keep abreast of the new developments and to unite in finding alternative energy solutions to current issues such as the greenhouse effect and the depletion of the ozone layer.

Costa Rica, where 50% of the energy matrix is supplied by geothermal energy, sugar cane waste, biomass, and other renewable sources, is the perfect location for the proposed study program. Sustainable development is possible, but it implies intense development (and deployment) of renewable technologies. Although Costa Rica is taking steps to implement renewable natural resources, conservation of energy, reforestation, natural farming, and eco-tourism, a lot more is required.

Take advantage of this opportunity to enjoy Costa Rica’s most undiscovered regions while learning about renewable energy.

Note: in Summer 2008, PHYS 3160: “Renewable Energy in Costa Rica” will be taught together with an upper-division course offered by the Department of Anthropology.

Instructor
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General Information

Course name: “Renewable Energy in Costa Rica”
Course number: PHYS 3160
Course Offerings: 3 credits. Students will earn a total of 6 upper-division credits (3 for each course) from the University of Utah. Both courses can be applied towards the Environmental Studies major or minor.

Department offering the course: Physics
Meeting time(s) and location: with the only exception of the pre-departure seminar the course is taught completely on location in Costa Rica.

Honors Coursework Opportunities: if you are a student in the Honors Program, it is possible to register for these courses and receive Honors credit. The Honors Program also offers a scholarship to Honors
students participating in the Honors Study Abroad Program. To find out more about these opportunities, please contact the Honors Program.

Description

Renewable energy sources are essentially carbon-free and more sustainable than fossil or nuclear fuels. This course reflects the remarkable progress that has been made in the field in recent years. Our program is focused on learning through hands-on work. We will spend about one-third of our time in “the classroom,” studying renewable energy systems, their underlying physical and technological principles, their economics, their environmental impact and how they can be integrated into the World’s energy systems. The rest of the time will be in the field, getting our hands dirty, learning by doing.

While Costa Rica is well known as a World leader for conservation policies and eco-tourism, the Central American country also stands out for its environmentally oriented policies and its success in mainstreaming energy sustainability into national policy. Currently, 99.2% of the total primary energy supply in Costa Rica is of renewable type, with geothermal accounting for over a third, hydroelectric dependency not exceeding 50%, and a very small share from fossil fuels (0.6% non-sustainable biomass, and 0.2% from oil). Costa Rica also aims to cut its net greenhouse gas emissions to zero by 2021, its 200th birthday.

Learn about renewable energy technologies for the developing world in one of only a few countries in the region that have taken a concerted structural approach to the issue of sustainable development.

Figure 1: Costa Rica’s total primary energy supply. Data taken from the document “Sostenibilidad de la Oferta de Energía Primaria en los países de América Latina: el aporte de las fuentes renovables,” Hugo Altamonte, ECLAC/GTZ project, 2003.
Objectives

This course deals with the issues of renewable resources and sustainable energy. The intent is to perform an objective analysis on each form of renewable energy in order to determine what is practical on a large scale, as well as on the scale of the individual homeowner. As one of my primary concerns is with the deterioration of renewable natural resources and the resulting threat to human well-being in many developing countries, we will pay particular attention to the efficiency of each renewable source as well as what limitations exist in terms of extracting useable energy.

At the end of this course students should be able to:

- have an understanding of the various renewable energy sources,
- analyze what is feasible on the large scale and what is not,
- understand some of the various obstacles associated with actual implementation of production line renewable energy facilities, and
- perform simple calculations regarding energy usage and the required infrastructure to deliver a certain amount of power.

As the instructor, my main goal is to produce a course in which a wealth of information is presented in a lucid and comprehensible form to any student with an interest in renewable energy technologies. I will do my best to strike a balance between making the underlying principles as understandable as possible and endeavoring not to oversimplify important technological aspects.

Content

Through a set of case studies of renewable energy systems the principles of sustainable energy is developed. These studies include the major renewable energy technologies, grid connected and remote area applications in Costa Rica. The course also includes a review of the renewable energy industry and a discussion of evaluation methods for renewable energy projects.

The course will start out covering solar energy but will then move to other renewable energy sources such as biomass, wind power, hydroelectric, and geothermal.

Chapter 1: Introducing Renewable Energy

Present-day energy use in the World and in Costa Rica in particular. Fossil fuel and climate change. Renewable energy sources in a sustainable future.

Chapter 2: Solar Thermal Energy


Chapter 3: Solar Photovoltaics

Chapter 4: Bioenergy


Chapter 5: Hydroelectricity


Chapter 6: Wind Energy


Chapter 7: Geothermal energy


Chapter 8: Integration


Class schedule

The departure date, the classes dates and times, and the assignments’ due dates are under development and will be available before the pre-departure seminar.

The course format will consist of technical lectures and seminar-style discussions (in approximately equal amounts). During the seminars, students will act as daily discussion leaders for assigned readings, first in small teams and later individually, and the instructor will act as facilitator. Students will receive evaluations based on both their active discussion and written assignments. (See Grading below.)

Grading

Grades will be determined upon students’ performance in five areas: contribution to the classes and field experiences, applied exercises, thoughtful reflections and insights in a journal they will keep while in Costa Rica, a written final exam, and a research paper.
1) **Class participation (20% of the grade):** students are expected to actively participate so they can learn from each other. We know that active involvement in learning increases what is remembered, how well it is assimilated, and how the learning is used in new situations. In making statements to peers about their own thoughts on a class topic, students must articulate those thoughts and also submit them to (hopefully constructive) examination by others. In listening to their peers, students hear many different ways of interpreting and applying class material, and thus are able to integrate many examples of how to use the information. Especially in a course that stresses application of material, extensive participation in class discussions is an essential element of students' learning.

Participation will be graded on a scale from 0 (lowest) through 4 (highest), using the criteria below. The criteria focus on what you demonstrate and do not presume to guess at what you know but do not demonstrate. This is because what you offer to the class is what you and others learn from. I expect the average level of participation to satisfy the criteria for a "3".

<table>
<thead>
<tr>
<th>Grade</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>0</td>
<td>Absent.</td>
</tr>
<tr>
<td>1</td>
<td>Present, not disruptive. Tries to respond when called on but does not offer much. Demonstrates very infrequent involvement in discussion.</td>
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<tr>
<td>2</td>
<td>Demonstrates adequate preparation: knows basic case or reading facts, but does not show evidence of trying to interpret or analyze them. Offers straightforward information (e.g., straight from the case or reading), without elaboration or very infrequently (perhaps once a class). Does not offer to contribute to discussion, but contributes to a moderate degree when called on. Demonstrates sporadic involvement.</td>
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<tr>
<td>3</td>
<td>Demonstrates good preparation: knows case or reading facts well, has thought through implications of them. Offers interpretations and analysis of case material (more than just facts) to class. Contributes well to discussion in an ongoing way: responds to other students' points, thinks through own points, questions others in a constructive way, offers and supports suggestions that may be counter to the majority opinion. Demonstrates consistent ongoing involvement.</td>
</tr>
<tr>
<td>4</td>
<td>Demonstrates excellent preparation: has analyzed case exceptionally well, relating it to readings and other material (e.g., readings, course material, discussions, experiences, etc.). Offers analysis, synthesis, and evaluation of case material, e.g., puts together pieces of the discussion to develop new approaches that take the class further. Contributes in a very significant way to ongoing discussion: keeps analysis focused, responds very thoughtfully to other students' comments, contributes to the cooperative argument-building, suggests alternative ways of approaching material and helps class analyze which approaches are appropriate, etc. Demonstrates ongoing very active involvement.</td>
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2) Homework (20% of the grade): there will be daily applied exercises and homework assignments. Although students can work in groups, they must solve the problems individually and write up not only the final answer but also show the work involved to get full credit.

3) Trip journal (20% of the grade): students will keep an analytical journal during our time in Costa Rica, detailing activities, discussions, related travel, information received during the visits, comparing and contrasting (where applicable) significant differences between the United States and Costa Rica, and generally reflecting upon the study-abroad experience. The purposes of the journal are to help prospective students gain a better understanding of the benefits of studying abroad, to use the theoretical knowledge and skills you have acquired in your coursework abroad, to place your experiences in Costa Rica in a broader context and to learn from them.

4) Final exam (20% of the grade): there will be one written test covering the material from the whole course. The exact date will be announced before departure, but it will be approximately one week after returning to Utah. (So students can have access to the library.)

5) Research paper (20% of the grade): students will write a research paper that explores some aspect of “Renewable Energy in Costa Rica.” It may consist of literature review and technology assessment or practical investigation of renewable energy system or device. The purpose of the research article is to present new or refine conceptual ideas, or to present new evidence for conceptual ideas. The grading will result from critically examining if the topic has been fully discussed, well explained and well-justified.

A list of suitable topics will be available before departure, but students may choose their own topic provided it is approved by the instructor. The topic must have been agreed upon before returning to Utah. The topic must be researched and then certain questions answered in detail with quantitative analysis. All references must be included and all written work in the article must be their own or properly cited. (A good example of style preferences is the Physical Review Style and Notation Guide, available on the web site of the American Physical Society at http://authors.aps.org/STYLE/.) Any example of plagiarism will result in a failing score.

The scientific article must be at least 20 pages long (typed, 12 point font, double-spaced). All references and possible figures or tables should be included at the end and are not counted as part of the 20 pages. Not conforming to this format will result in a returned paper.

I strongly encourage either double-sided printing or “once-used” sheets of paper. No cover sheets or folders. Use a single staple. No email submissions are accepted. The grading criteria on the research paper will consider: writing quality, clear expression, and good organization; application of course material, direct use of the readings, lectures, and other materials discussed during the course; demonstrated understanding and synthesis of the course concepts.

Materials list


There will also be required readings during the course. The reading schedule will be announced in the pre-departure seminar. (There will be generally one article to be read for each class.) Readings will be available in a course packet at the Copy Center in the Union.
University Information

Students with Disabilities

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.

All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Accommodations Policy

Some of the writings, lectures, films, or presentations in this course may include material that conflicts with the core believes of some students. Please review the syllabus carefully to see if the course is one that you are committed to taking. If you have a concern, please discuss it with me at your earliest convenience. For more information, please consult the University of Utah’s Accommodations Policy, which appears at www.admin.utah.edu/facdev/accommodations-policy.pdf.

Rights and responsibilities

Faculty

Responsibilities of faculty are spelled out in Rights and Responsibilities, which can be found on the web at: http://www.admin.utah.edu/ppmanual/8-8-12-4.html. The instructor’s responsibilities include the following:

- Convene classes unless valid reason and notice given.
- Perform and return evaluations in a timely manner.
- Inform students at beginning of class of:
  1. General content and course activities
  2. Evaluation methods and grade scale
  3. Schedule of meetings, topics, due dates.
- Ensure environment conducive to learning.
- Enforce student code.

Students Responsibilities

The mission of the University of Utah is to educate the individual and to discover, refine, and disseminate knowledge. The University supports the intellectual, personal, social, and ethical development of members of the University community. These goals can best be achieved in an open and supportive environment that encourages reasoned discourse, honesty, and respect for the rights of all individuals. Students at the University of Utah are encouraged to exercise personal responsibility and self-discipline and engage in the rigors of discovery and scholarship.
The Code of Student Rights and Responsibilities has seven parts. The full text is available on the web at http://www.admin.utah.edu/ppmanual/8.8-10.html, and also in Student Affairs.

All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, and I will do so, beginning with verbal warnings and progressing to dismissal from the class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.