EVE 559 Energy Use and Global Climate Change

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Spring Semester
Tuesday 5:00-7:30 pm
JE 335

Catalog Description: Examination of the scientific, social, economic and political aspects of global climate change due to energy production using fossil-fuels.

Rationale:

Global climate change is arguably one of the greatest threats to our natural environment; it represents a tremendous challenge to politicians, citizens, environmentalists and educators who need to identify and implement equitable policies to reduce projected temperature increases. The combustion of fossil-fuels for energy production results in the production of carbon dioxide (CO_2), one of several greenhouse gasses (GHG) whose concentrations are increasing in the Earth's atmosphere. The recent United Nation sponsored Intergovernmental Panel on Climate Change estimated an average global temperature increase ranging from 1.5-4.5 °C by 2100 as a result of the projected increase in atmospheric GHG concentrations. Temperature increases of this magnitude are expected to result in such consequences as changing weather patterns, migration of ecosystems, sea level rise, and coastal flooding. An international effort is underway (Kyoto Protocol) to try to reduce the production of CO_2 and other GHGs; however, the fate of this agreement is uncertain. Environmental educators need to be well equipped if they are to teach students the relationships and consequences of our current energy use and projected global average temperature increases. In addition, educators should be aware of the extent to which alternatives to fossil-fuels for energy production and energy efficiency can contribute to decreasing future GHG emissions.

Course Objectives

Specific objectives of this course are to:

1) Provide an in-depth examination of how humans, through fossil-fuel combustion to meet energy demands, are changing the composition of the Earth's atmosphere resulting in projected global average warming.
2) Examine the environmental, economic, policy and technological aspects of energy production and its relationship to projected future global temperature increases;
3) Develop an understanding of the complexity of ecosystem responses to increased global average temperature; and
4) Evaluate current and future policy and technology responses to global warming.

Learner Outcomes:

On completion of this course, students will be able to:

1) Identify the major energy sources available to meet current and future world energy demands.
2) Identify the major sources and sinks (where and how GHGs are removed from the atmosphere) for GHGs.
3) Define the relationship between increased concentrations of GHGs in the Earth's atmosphere and projected increases in global average temperature.
4) Identify projected changes in ecosystems due to a projected increase in average global temperature.
5) Recognize the complexity of economic and environmental consequences associated with current and future energy choices.
6) Identify non-GHG producing alternative energy sources and contrast their potential to meet future energy demands with existing fossil-fuel resources.
7) Critically evaluate current policy and/or technology approaches to reduce world reliance on fossil-fuels for energy production.

Course Outline

Week 1	Introduction – Course overview and introduction to global carbon cycles. Earth's heat budget, the importance of greenhouse effect to life on Earth. Hardy, 2003 (Chapter 1); Freese, 2003 (Chapters 1-2) (6%)
Week 2	Current world and US energy use and policies. Fossil-fuels and atmospheric CO_2. Future world energy demands, role of developing nations. Freese, 2003 (Chapters 3-4); Botkin and Keller, 2000 (Chapter 16). (6%)
Week 3	Other GHGs (methane, CFCs, water vapor). Sources, relative importance, sinks and projected influence on the global heat budget. (6%) Hardy, 2003 (Chapters 1-2); Freese, 2003 (Chapters 5-7)
Week 4	Alternative and renewable energy (solar, wind, nuclear, hydro, biomass). Current and projected energy demand (1st Student paper due). (6%) Freese, 2003 (Chapters 8-9); Botkin and Keller, 2000 (Chapter 17)
Weeks 5-6	Student Group Workshops and Presentations. Current and projected energy use for industrialized and developing nations of the world. Including demographic and economic information for select countries and practices related to GHG emissions. (student assigned countries) (13%)
Week 7	Current estimates of future global temperature change in response to increased anthropogenic GHGs. Why do the experts disagree? Uncertainty in climate models. (7%) Hardy, 2003 (Chapter 4)

Weeks 8-9 Potential Effects of Global Climate Change – (Physical) changing weather patterns, increased storm severity, coastal flooding, polar ice caps (Biological) biome migration and species extinction, impacts on agriculture, tropical diseases, food web disruption. (13%)
Hardy, 2003 (Chapters 5-8)

Week 10 Role of feedback mechanisms in global response to CO_2 levels – Negative feedback) CO_2 sinks (oceans, temperate forests) and Positive feedback (methane hydrates, water vapor). (6%)
Hardy, 2003 (Chapter 4)

Week 11 Student Presentations. Life in a warmer climate. Who wins and who loses? Presentations will examine anticipated consequences of climate change in select industrialized and developing nations of the world. (Socioeconomic and environmental). (6%)

Week 12 Strategies for reducing anthropogenic greenhouse gas contributions to the atmosphere. Role of alternative energy (nuclear, geothermal, solar, wind). (2^{nd} Student paper due). Hardy, 2003 (Chapter 11) (6%)

Week 13 International negotiations for reducing anthropogenic CO_2 emissions (fate of the Kyoto Treaty). Hardy, 2003 (Chapter 12) (6%)

Week 14 Current and future US energy policy. Where do we go from here? Energy conservation, CO_2 emissions trading and the role of technology (efficiency) in reducing global CO_2 emissions. Hardy, 2003 (Chapter11) (6%)

Week 15-Finals Student Group Workshops and Presentations. Global responses to GHG emissions and global climate change. What is the likely scenario for industrialized and developing nations? What actions are proposed to address GHG emissions? (13%)

Modes of Instruction

Modes of instruction will include lecture, videotapes (CBS 60 Minutes and PBS Frontline news features concerning energy use and climate change), class discussions, small group workshops, and student group oral presentations.

Evaluation

Each of the assignments described in this section are linked to specific learner outcomes identified in Section III. Learner Outcomes. Students will be assessed based on the following criteria and assignments:

_ Student participation in class discussions is considered an important component of the final grade (20%). Students are expected to be prepared for each class and complete any assigned readings prior to class. Student participation will be evaluated by the instructor based on the frequency and quality of contributions to class discussions. (Learner outcomes 1, 2, 3, 7)

_ Two research papers (5 page maximum including appropriate citations) will be assigned to allow students to more fully explore the role of alternative energy (renewable or non-renewable) to address projected US energy requirements (30%). Each student is responsible for selecting an alternative renewable or non-renewable energy technology and completing the following two assignments.

Assignment #1 Alternative and Renewable Energy Technologies

The US and the World currently rely on the use of fossil-fuels as the primary energy source for fueling our economies. Alternative energy forms (solar, wind, nuclear, hydro, biomass and others) are frequently identified as a means of providing energy while decreasing our reliance on fossil-fuels. The assignment is to select an alternative energy source and examine its potential as a fuel source for the future. Students will discuss some of the following issues with respect to the fuel source you chose when completing the assignment. How does it work? What are its principles of operation? What makes this an attractive alternative to fossil-fuels? What sector of the economy is this technology best suited? Is this technology being used today? If so, where and in what form? What % of our total energy use is currently attributed to this technology? How expensive is this technology? Other comments/additional information
(Learner outcomes 1, 6)

Assignment #2 The Future Role of Alternative and Renewable Energy

The second research paper assignment is designed to assess the future exploitation of your selected alternative energy technology and examine its contribution to reducing future GHG emissions. Students will discuss some of the following issues with respect to the fuel source you chose when completing the assignment. Are we fully exploiting this technology? Are further technological developments necessary? What is the primary technical/operational constraint associated with this technology? What is the potential market for this technology? Does this technology produce greenhouse gas emissions anywhere in its life cycle? Will this technology reduce GHG emissions? If so, to what extent? Are there other environmental concerns associated with the manufacture, distribution, or use of this technology? Is it economically feasible? If not, how could it become economically feasible? Other comments/additional information.
(Learner outcomes 1 and 6)

_ Students (3-4 students/group) will also prepare 3 brief (15-20 minute) PowerPoint presentations addressing current and future energy requirements (1), projected effects of a warmer climate (2) and strategies for reducing GHG emissions (3) for specific countries throughout the world (50%). Students (groups) will be randomly assigned instructor selected nations of the world for examination.

Each group (3-4 students/group) is assigned the task of acting as representatives of six nations of the world (ex. China, Italy, Indonesia, Argentina, Nigeria and Canada).

Part 1. The task is to examine the nations current energy use patterns, socio-economic and environmental conditions and project changes in these conditions into the future (2100). Where in the world is your nation? (maps helpful). Some demographics should be discussed (population/geography/ economics, etc.). What is your nations current energy profile? What are the projected energy demands? How will your nation meet growing energy needs? What are your countries current GHG emissions? Future emissions? Does your country have abundant energy resources? Import/Export? These projections must represent a realistic scenario. (Learner outcomes 1, 6)

Part 2. What effects can be expected to occur to the nation due to projected changes in average global temperature? What are the greatest threats to your nation? Will agricultural changes occur? Flooding? Ecosystem migration? Are any benefits expected due to a warmer climate? Try to locate most recent data and projections in you scenario. Are there problems unique to the country? Perhaps rank the greatest threats/benefits. What economic/demographic changes will occur due to a warmer climate? (Learner outcomes 2, 3, 4)

Part 3. From your perspective, are the current global climate treaties adequate? Can your nation meet its emission reduction targets with respect to greenhouse gas emissions while fueling economic development? Does your nation require additional resources to meet goals? How does your nation propose to meet target goals? How can these needs be met while trying to act as a global citizen and attempt to reduce emissions of global warming gasses? What is your country required to do as a signatory to current climate treaties? What strategies will you pursue to reduce GHG emissions? What contribution can your country realistically make to world wide GHG reductions? (Learner outcomes 5, 6, 7)

Each group will act as representatives of each country and present its case. These oral presentations should be practiced and professional. Presentations should be prepared using PowerPoint software where possible. Each group presentation should last 15-20 minutes maximum. This time will include several minutes for questions from the audience. Everyone is expected to participate in the questioning of the presenters. Each student should participate in the preparation of the group presentation. Each group will submit copies (disk or photocopy) of their PowerPoint presentation to the instructor as part of the final grade (group grade).

Required Text(s): *Climate Change: Causes, Effects, and Solutions*. J.T. Hardy. 2003. John Wiley and Sons, NY. pp. 260. ISBN 0-470-85019-1

Coal: A Human History. B. Freese. 2003. Perseus Publishing. pp. 320. ISBN 0-732-820400-5

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* Denotes source available at the SCSU Buley library.