The emphasis of the class is to focus on the essential integration of a technical, economic, environmental and management approach to problem solving. The best solution to a problem from only one aspect is seldom the best when all aspects are taken into account.

The goal of the class is to cover three broad topics: energy and materials management problems, water related concerns and current environmental issues. These are broad ranging topics and, as the depth of coverage will reflect class interest, some topics will be more exhaustively covered than others.

**Learning Outcomes:**
The purpose of this class is to have students explore, expand, integrate and assess their knowledge in three broad areas of earth resources: energy and materials management problems; water related concerns; and current environmental issues, in an interdisciplinary manner. By the end of this course, each class member should be able to:

- Identify, define and describe many of the fundamental scientific principles that apply to their various areas of study
- Evaluate interdisciplinary principles that must be integrated into managing the earth’s resources
- Identify, define and describe the differences between various energy resources and their uses and environmental impacts
- Understand the connections between ground water and surface water and their interactions
- Apply the reinforced understanding of numerous scientific principles
- Identify, define and describe the basic underlying legal principles guiding the environmental issues
- Explain science in uncomplicated terms
- Present and become more accomplished at public speaking and making presentations
- Be aware of environmental/resource concerns related to sustainability

**Class Structure:**
The course will consist of three different approaches:

a. Regular lecture format

b. Invited speakers, from both inside and outside of the University on specialist topics

c. Seminars and discussion. The hope is that about an hour a week will be devoted to discussion of the class topics, individual presentations, and/or assigned reading. This may vary from week to week for on occasion an entire class may be devoted to a seminar.

**Readings:** Collections of papers and articles as assigned in class and via BlackBoard (http://blackboard.sc.edu);

**Books:** Sustainability of Ground Water Resources, USGS circ. 1186 (available on line; see link on Blackboard)

**Course Topics**

<table>
<thead>
<tr>
<th>Week 1</th>
<th><strong>Introduction to Course</strong></th>
<th>Background</th>
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<tbody>
<tr>
<td>August 22</td>
<td><strong>Energy: Hydrocarbons</strong></td>
<td>Introduction to hydrocarbons &amp; oil</td>
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<tr>
<td></td>
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<td>Economics and reserves, global distribution</td>
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**Assignment & Reading for 8/29**

Gulf Oil & Dome Petroleum and Fracking paper

**Assignment 1,2 Due August 29**

**Week 2**

| August 29 | **Energy: Hydrocarbons** | Discussions of Gulf Oil and Dome Petroleum Analysis |
(lead by 2 from class and all provide input)
Discussion: Exploration vs. Exploitation
Lecture: Fracking: the new hydrocarbon debate
Discussion: 3 issues: energy, water, earthquakes

Readings: Reading: Oil – Fate, Transport and Spill response readings for 9/12
Assignment 3 assigned – graduate students

September 5 – Labor Day – No Class

Week 3
September 12
Guest Lecture, Dr. Jacqui Michel, President of RPI.
Energy: Hydrocarbons and Oil Spills
Diluted Bitumen and pipelines
History of Oil Spills,
Oil properties, behavior, and fate
Scientific Support of Oil Spills
Deepwater Horizon Oil Spill: Shoreline Cleanup Assessment
Discussion on assigned readings

Assignment Readings: XL Pipeline papers and web sites (assign teams/discussion)

Week 4
September 19
Energy: Hydrocarbons
Pipeline debate: 3 perspectives:
Government environmental impact, landowner impact, energy (pipeline co.) impact
(If not covered 8/29) in Lecture: Fracking; the new hydrocarbon debate
Discussion: 3 issues: energy, water, earthquakes

Assignment: See Blackboard for readings
Readings: 1- Coal, reclamation, & water quality

Week 5
September 26
Energy: Coal
Formation, Source of energy
Mountain top mining impacts
Source of pollution
Discussion on coal papers assigned
Readings: as provided by groups

Week 6
October 3
Alternative Energy
Assignment 3 presented (Graduate Students only)
Reading: On minerals - formation, scarcity, politics.

Assignment 4 announced
Week 7  
October 10  
**Minerals**  
Nature of deposits, mineral exploration  
Discussion of assigned Case histories  
*Reading:* Legal issues related to water policy & contamination

Week 8  
Oct. 17  
**Environmental Law and Regulation**  
Environmental laws & regulations  
*Readings:* Environmental Management Systems (EMS), ISO 14000

Week 9  
Oct. 24  
**Environmental Management**  
Case studies on Environmental Impacts and implications of impacts on energy and natural resources.  
Guest lecture.  
**Discussion on Business Plans**  
Work on Group projects; provide outline for review and discussion

Week 10  
Oct 31  
**Assignment 4 presented by class groups : Sustainable Mining**  
*Reading:*  
Sustainability of Ground Water Resources pp.1-54  
Other Readings – as announced  
**Assignment 5 announced**

Week 11  
Nov 7  
**Hydrology**  
Intro., hydrologic cycle, aquifers and groundwater, pollution potential, discussion of readings  
*Reading:*  
Sustainability of Ground Water Resources pp.55- end  
Other Readings – as announced

Week 13  
November 14  
**Hydrology & Water Quality**  
Ground & surface water pollution problems, landfills  
Case studies *  
Readings – China’s water resources, ND’s Water Management plan, CA water storage , GEMI – Water Project

Week 14  
November 21  
**Hydrology & Water Quality**  
World water concerns; drought, overuse  
Case studies * - GEMI
Land Use Planning & Agriculture

Land use planning; Climate change impacts on agriculture and food nutrition.
Time available to work on project
Assignment 5 group discussions
Reading: Smart Growth

Week 15
November 28 work on Final Project

Final EXAM- DECEMBER 5: Assignment 5 presented

GEOLOGY 560: Earth Resource Management

There will be individual assignments and group reports with presentations. Grades will be based on class participation (i.e. questions and discussion contributions), individual assignments, and the group reports.

<table>
<thead>
<tr>
<th>Undergraduate Grading</th>
<th>Graduate Grading</th>
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<tbody>
<tr>
<td>Assignment 1</td>
<td>5% of grade</td>
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<tr>
<td>Assignment 2</td>
<td>10%</td>
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<tr>
<td>Assignment 3</td>
<td>-</td>
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<tr>
<td>Assignment 4</td>
<td>35%</td>
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<tr>
<td>Assignment 5</td>
<td>35%</td>
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<tr>
<td>Class participation</td>
<td>15%</td>
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</tbody>
</table>

Assignments: There will be two types of assignments, individual and group assignments.

Individual assignments will usually involve reading a paper and reporting either or both oral and written.

Group Assignments will be joint efforts of a group of three to four students and concern specific topics.

The principle assignments will be term reports in which each person contributes a section, a single report will suffice but each person must add a personal interpretation/conclusion to the joint report. Teams will be chosen to represent the variety of interests and backgrounds of class members.

The emphasis of the class is to focus on the essential integration of a technical, economic, environmental and management approach to problem solving. The best solution to a problem from only one aspect is seldom the best when all aspects are taken into account.

The goal of the class is to cover three broad topics: the energy and materials management problems, water related concerns and current environmental issues. These are broad ranging topics and as the depth of coverage will reflect class interest, some topics will be more exhaustively covered than others.
Assignment 1
Gulf Oil’s management has to decide how to allocate the available corporate funds and whether the shortfall should be taken from US activities or from overseas operations. Read the document, prepare a written assessment and come prepared to have one member of the class make a presentation followed by a class discussion. Be prepared to discuss:
1. how you would allocate the fund and
2. the reasons for your choice.

The parameters to consider:
- production costs (and therefore profits) in the stable areas
- political risks of take-over
- does the company look for replacement of reserves or increased production?
- Profit margin

Based solely on the Gulf report, how would you prepare to maximize profit, how to maximize security and how to increase reserves? These are personal judgment calls; consequently the reasons for your choices are as important as the choices themselves. Hand in your written assessment prior to the class discussion – this does not have to be long and can be in outline form.

Assignment 2
Read the history of Dome Petroleum Ltd. and comment on the wisdom of their acquisition of Hudson’s Bay Oil and Gas Co. Make your written report on the economics involved, why acquisition proved to be desirable/necessary, the magnitude of the debt commitment and whether the assessment of world conditions at the time made it a wise investment, reasonable risk or foolhardy. (2-3 pages)

We will have a class discussion after one member from the class presents the case history.
- What went wrong with Dome Petroleum, could it have been avoided?
- Under the circumstances how do you think the company should have handled the Hudson’s Bay deal?
- Was Dome well enough financed to have made a major undertaking?
- How long before Dome could expect financial returns from the Beaufort Sea to have a significant effect on their bottom line?
- Was it realistic to have gone so far without the assurance that they had Canadian Bank support?

Class Discussions: XL Pipeline debate; Fracking; and weekly discussions

Assignment 3 (Group Project) – Graduate students only
This is the first group project. Select a non-fossil fuel energy source (such as nuclear, bio-fuels, hydrogen, solar, etc.) and prepare a long-term report to submit to the US government as if you were a select committee of the National Research Council. The purpose of the report is to discuss the future demand growth within the US (or you may select to discuss this on a worldwide basis), evaluate how these resources are controlled and/or owned and hypothesize what the future will hold 50 years from now as these resources change or develop. In looking towards the future, suggest how aspects of human life may change: will the transportation sector change, will houses be re-designed, could cities be re-planned to accommodate new realities, etc. You will have four weeks to complete this and make a class presentation when you turn in your report. (Rpt = 50% of grade; presentation = 50% of your grade) This assignment is for Graduate students only, however, undergraduate students will be responsible for learning the material presented. Please inform me of the energy source you have selected by Sept 2. By September 23, please provide the class with at least one article to read (preferably which can be made available on Blackboard).

Assignment 4 – All Students
You are the new ventures group of a large minerals group to whom you are presenting a PLAN (including the Business Plan and Management Plan) for the exploitation of a major copper discovery, one you consider too large for the group to ignore, which has been made in a third world country. You have analyzed the economic potential of the deposit based on limited geological information, as the country has never been mapped. As a result of preliminary discussions you can see ways of financing through the Export-import bank, World Bank, AID and even through the national government. (Read the paper on Chilean nationalization of its copper resources). In your report, summarize the geology of the deposit, what is going to needed in terms of manpower, negotiations concerning free import of equipment, export of profits, whether there will be advantages in processing the ore in the country or whether it will be more economical to export the ore. The development costs are such that a long-term contract, whether as a potential joint venture either with other copper mining concerns or with the national government, will probably be necessary. You anticipate that as part of the negotiations you will have to face the
need for the development of harbor and airport facilities, the development of transport within the country, the need for accommodation, medical and educational facilities within the scope of a long term contract. You must consider the World Market to assess the demand, now and in the future, for copper and what the chances are for stable long-term contracts for your product. You will have four weeks to complete this and make a class presentation when you turn in your report. (Rpt = 50% of grade; presentation = 50% of your grade).

Assignment 5 – All Students –
Your team has been requested to submit a plan for an integrated irrigation scheme in a hot arid region in a competitive bid. You will have to provide not only for irrigation of a large area and the selection of crops (which means soil and fertilizer requirements), but for a drastic increase in population as the scheme develops, which will involve the farming community, its health, education, communication, and social needs as well as the anticipated influx of nomadic herders attracted by the existence of semi-permanent water supplies. You may assume that within a reasonable distance you can channel water from a permanent river (or from a distillation plant built for the purpose), you will have to decide whether to develop only the irrigation or whether to establish reservoirs to maintain water levels. Be ambitious in what you intend to do and assume that finances are forthcoming whatever your required budget. Be prepared however to justify your requests and to have a contingency plan in case funds are curtailed. You should include some estimate of the anticipated economic impact, population the project will serve, income which will be generated (and applied to the cost of the project). You may select an actual country or create one of your own.

You will have one week to decide upon what you intend to do and present a breakdown of who will do what (by Nov. 4), there will be an intermediate discussion with the UNESCO manager (guess who?) and a formal presentation during final exam time. Each section of the report will have the student’s name on the section and will be graded separately, however, the conclusion section must be integrated and a group effort. (Rpt = 45% of grade; presentation = 45% of your grade; peer review = 10% of your grade) Peer review = Each class member will be asked to submit an evaluation for each plan presented and a written evaluation of the plan selected as the best and the basis of the choice.