EME 580 – Sp 2010
Integrative Design of Energy & Mineral Engineering Systems

A Critical Assessment of Sustainable Energy Choices for the United States

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Location: 107 Willard, 1.00 – 2.15, TuTh
Plus additional group meetings to be arranged by teams

Credits: 5

Objective: The principal objective of this problem-based course is to facilitate active and cooperative, or collaborative, learning to solve a contemporary problem in energy and/or the environment. This will be completed via literature search, critical literature review, concept mapping, road mapping, engineering and economic evaluation, and written and oral presentations of results. The development of critical thinking and problem solving skills as a team in academic and industrial settings is the major focus of the course.

Students will work in teams. Each team will produce a final design which must include consideration of appropriate scientific, engineering, economic and policy concepts related to their chosen theme.

Rationale: This problem-based class will allow students to connect basic concepts and principles assimilated during prior classes to **solve an industrial problem of societal significance**. Students will work collaboratively as a team to finely prescribe the problem, to gather resources, and to synthesize a solution.

Assignments: Students will select a topic from below, or develop a new one and work in teams to develop a solution. They will take charge of the learning process as they attempt to solve the selected problem. Importantly, they should identify and fully utilize the diverse knowledge present within the group – this will identify the key knowledge bases and learning needs required for the re-formulation and solution of a given problem.

Throughout the semester, students will be asked to identify their 'area of expertise' towards the group effort. Students may use concept mapping to formulate the learning issues and map out the relationships between different concepts and principles to solve the assigned problems. Road mapping will be used to develop a strategy and a time line for problem solution.

Students will make a critical review of the relevant literature to assess/reassess the proposed concept and road maps. The students will be expected to evaluate their solutions in terms of economic feasibility and policy considerations, comparing their group's solution to solutions proposed by other groups. The results of the literature review and analytical work will be conveyed in written reports and oral presentations throughout the semester.

Depending on the problem, teams will identify the key societal and technical issues, identify and compare the current and potential future options, evaluate the scientific and economic feasibility, and recommend a solution which matches the goal of the original or modified problem statement. A quantitative approach must be considered.

Project Foci: A series of potential projects are identified from which students may self-select, in teams of 3-5. In each topical area identified below, examples of specific problem statements with contemporary industrial significance are given. Students will be grouped based on topical interest; each group should then develop a problem statement focusing on a specific research topic. Examples of timely topics that would allow a meaningful contribution are given below, but others can/should be considered as well. Further refinement and restatement of the problem statement by the groups will be completed in the first couple of weeks of the class.

General Theme: A Critical Assessment of Sustainable Energy Choices for the United States (by region/Pennsylvania)

1. **Unconventional gas recovery, conversion, utilization and environmental management, e.g.: tight gas shales, tight gas sands, enhanced coal-bed methane or hydrates**
2. **Advanced technologies for coal conversion and/or utilization related to reduced CO_2 outputs to the environment, e.g.: gasification modeling, advanced materials requirements (high pressure, high temperature), precombustion CO_2 capture (methods and/or modeling), oxycoal combustion, or biofuel co-firing**
3. **CO_2 Utilization and/or Sequestration, e.g.: post-combustion CO_2 capture, geologic sequestration**
4. **Engineered geothermal energy (EGS) recovery paired with integrated gasification and/or combined cycle plants**
5. **Renewable energy options: wind, solar and/or geothermal and energy storage**
6. **Integration of novel materials for energy transformation, separation, or storage, e.g.: photocatalytic conversion of CO_2,**

H_2 separation, air separation, natural gas upgrading, sensors, high-pressure high-temperature materials for gasification

7. **Integrated energy systems for plug-in cars**
8. **Others TBD**

Teams: Students will be grouped into teams of 3-5 in size. Teams may self-select, and the faculty facilitators/instructors will aid this process in the first meetings of class. The desire is to have individual teams represent a mixture of expertise – science, engineering, policy and economics.

A team size of 3-5 is optimal. This is large enough that the many disciplines can be properly represented and that meetings can occasionally occur with a single individual absent, but small enough that the scheduling of meetings is straightforward and that no individual becomes sidelined in the development of their soluton.

Involvement: Students will collaborate in a team and take charge of the learning process as they attempt to solve the assigned problems. Importantly, they should identify and fully utilize the diverse knowledge within the group – this will identify the key knowledge bases and learning needs required for the re-formulation and solution of a given problem. Students may use concept mapping to formulate the learning issues and map out the relationships between different concepts and principles to solve the assigned problems. Road mapping will be used to develop a strategy and a time line for problem solution. Students will make a critical review of the relevant literature to assess/reassess the proposed concept and road maps. The results of the literature review and experimental or computational work will be conveyed in written reports and oral presentations throughout the semester.

Grading: Your course grade will depend on three components:

30%	Team Work: Progress / Planning / Product
50%	Individual presentations and final exam
20%	Peer evaluation on Contributions to Team Effort

The factors contributing to grades in these assigned distributions include:

1. **Team deliverables (30%).** This grade will be determined from and assessment of the team's *critical* and *creative thinking*, *problem solving skills*, and *clarity* and *integrity* of reports and presentations.
   a. 15% Identification of learning issues (or Concept Map).
   b. 15% Road Map
   c. 20% Literature Review

d. 15% Progress Reports
e. 10% Oral Presentation
f. 25% Final Report

2. **Individual presentations and final interview (50%).** This grade will be determined from individual presentations and participations in discussions throughout the semester and a final oral interview on the whole problem.

The following will be considered as equally important in assigning the grades for individual presentations (**20%**) and participations in discussions (**10%**).
a. Active involvement in the learning and problem solving process
b. Understanding of the problem and the related background issues,
c. Critical and creative thinking,
d. Problem solving skills and cooperation with other team members, and
e. Clarity and integrity of presentations (progress and final).

For the final oral interview (**20%**), each student will give a 5 minute presentation of the final report, highlighting as appropriate their 'area of expertise'. After the 5 min. presentation, each student will be questioned on the important learning issues for the whole problem.

3. **Peer evaluation (20%).** This grade will be determined from confidential assessments (grades) from your team members. Each student will assign an individual **confidential grade** to each of her/his team members to evaluate their contribution to the learning issues, including **work load**, **leadership**, **resourcefulness**, **creativity**, and **peer teaching** effort . The criteria for the grade for peer evaluation will be discussed in the first class meeting. The overall peer evaluation grade for each student will be calculated as the mean of the assigned grades after discarding the top and bottom grades.

Course Schedule and Assignments - Tentative

Date/Week	Topic
Week 1	Introduction of the problem and discussion of course procedures and logistics for problem-based learning; Teaming assignments.
1 (end)	Presentation and discussion of individual and team concept maps (or any other format used for key issues) for defining the learning issues; student responses to assigned reading materials.
2 (beg)	Student presentation and discussion of learning issues for solving the problem, and individual and team re-statements (written) of the problem.
2 (end)	Student presentation and discussion of **individual** and **team work plan (or road maps)** for solving the problem
4 (end)	Presentation of a **critical literature review** and reassessment of the proposed **road map** for solving the problem; **finalize the team road maps**.
6-7	Progress updates. Each group meets with instructors individually during class period.
8	Submission of the **literature survey** and **submission and presentation** of **progress report and a comprehensive plan for future work (e.g. Gantt chart) to enable an engineering and economic evaluation of the proposed solution**
	Spring Break
9	Feedback from faculty facilitators
10	Revision and modification of **critical literature review**. Preliminary engineering and economic analysis. Presentation of **critical-path plan** for recovery-through-utilization and identification of **final work-plan (e.g. Gantt chart) activities**
11	Presentation of progress
12	Presentation of progress
13	Presentation of progress
14	**Final Presentations**
15	**Final Oral Interview**
16	**Submission of Final Report**

Some Initiating Resources

Past Projects: http://www.ems.psu.edu/~elsworth/courses/egee580/index.html

Web Resources About Problem-Based Learning:

National Teaching and learning Forum: http://www.ntlf.com/html/pi/9812/v8n1smpl.pdf

Wikipedia PBL: http://en.wikipedia.org/wiki/Problem-based_learning

Concept Mapping Program: http://cmap.ihmc.us/

Academic Integrity

Following University Policy 49-20, students are expected to maintain a high degree of academic integrity throughout all the course. Accordingly, activities such as cheating, plagiarism, facilitating dishonesty to others, etc., will not be tolerated. This course adopts the College's academic integrity policy. For more information, please check http://www.ems.psu.edu/students/integrity/index.html

PEER EVALUATION FORM

Please rate yourself and your team members on the relative contributions that were made in solving the problem and preparing and submitting your group reports. *Your ratings will not be disclosed to other students.* Be honest in this evaluation!

In rating yourself and your peers, use a one to five point scale, where **5 = Superior; 4 = Above Average; 3 = Average; 2 = below average; and 1 = weak.**

Insert **your name** in the first column and your peers' names in the remaining spaces. (One name at the top of each column).

Names							
Participated in group meetings or discussions							
Helped keep the group focused on the task							
Contributed useful ideas							
Quantity of work done							
Quality of work done							
Enter total scores here							