Calvin College Wind Energy Design Project

Fall 2006
Engr 333
Prof. Heun

Calvin College both purchases and generates electricity for use on its Knollcrest campus. Electricity purchases are made from "the grid." Electricity is generated on-site by (a) converting natural gas into electricity using Calvin's Co-generation system, located in the basement of the Commons and (b) photovoltaic solar panels on the roof of the Ecosystem Preserver Interpretive Center.

There are many benefits to generating electricity on-site: providing options for lowest-cost electricity generation among multiple sources (reduced college operating costs and *lower tuition*), independence from traditional electricity sources for extreme events such as storms and power failures, and protection of critical infrastructure. There are also drawbacks, chiefly up-front capital investment in infrastructure and ongoing maintenance requirements.

Your challenge for this semester-long project is to construct a realistic plan to make a *significant impact* on the Calvin College campus with electrical power generated from wind resources. Doing so will continue to demonstrate Calvin's interest in alternative and renewable energy resources.

Elements of your proposed plan should include:

- Evidence of thorough research into technology options for achieving the stated objectives, including print and online resources and personal interviews and contacts
- A schedule showing a timeline for construction of facilities
- Proposals for locations of any new facilities required to meet the goal
- Detailed documents describing the design of the wind energy systems
- Detailed documentation showing that the proposed systems will meet the stated requirements
- A realistic plan to finance capital projects
- A financial evaluation of the economic advisability of your design plan.

Your deliverables are:

(a) a single final report from each section that proposes a feasible plan for make a significant impact on campus with wind energy,
(b) two posters to be presented at the Calvin Environmental Assessment Program (CEAP) conference on 30 November 2006, and
(c) a departmental seminar given by the classes (each section has 30 minutes) on 1 December 2006.

The customer for this design analysis project is Calvin's Vice-President for Finance, Henry DeVries.

The first phase of this plan is already underway. During the summer of 2006, Calvin College submitted a proposal to the Energy Office of the State of Michigan for funding to erect a small 1–3 kW demonstration turbine that would be integrated with the interpretive center's renewable energy emphasis. One task this semester is to define the site, height, hardware (turbine, tower, generator, inverters, instrumentation, etc.), schedule, assess and solve zoning issues, etc. for the demonstration project.

Beyond the small demonstration project, for which we will receive external (and some internal) funding, you must develop plans for making a significant impact on the campus using wind power. You must define financing options, assess turbine technology options, address site issues, determine how best to

integrate with the campus infrastructure, define schedules, identify how later phases grow from the first phase, etc.

To develop the required plan, the class will be divided into several small teams of 5 students each. (One team will have 4 students.) Each group has initial roles and responsibilities defined, but you may find it necessary to adjust the management structure as the semester progresses. The following table provides details about the groups.

Team	Initial Responsibilities
Management	Coordinate team activities throughout the semester Define class priorities Define schedules for the plan Develop economic models Develop funding and financing plans
External Relations	Understand zoning regulations and issues Develop a communications strategy for interactions with • campus politics • neighbors • utility companies • etc.
Long-term Technology	Define hardware, siting, integration plan, etc. for anything beyond the demonstration turbine. Identify costs for various design options.
Short-term Technology	Define hardware, siting, integration plan, etc. for the demonstration turbine. Identify costs for the various design options.
Campus Infrastructure	Assess how "significant impact" can be made (grid segmentation, perhaps) Define control systems Define energy storage systems

The first tasks for each group will be to focus your area of inquiry for the project, in consultation with the other groups, and develop a schedule for your work this semester.

All groups must arrange a tour of Calvin's existing physical plant facilities (including the co-gen plant) with Paul Pennock (see *Resources* below).

There will be three short, in-class progress reports in the form of oral presentations. There will be a longer in-class final presentation that summarizes the results of the Calvin design project. Each student must give either one of the progress report presentations or part of the final presentation. The presentations must be professional quality, must concisely report your progress, and provide sufficient technical detail for peer and professor review of your progress.

The in-class progress reports must include the following elements:

- Status relative to your schedule (and any re-planning that has occurred since your last report)
- Work accomplished since your last report (including technical details)
- Issues or concerns (and plan for addressing them)
- Work planned for upcoming reporting period

The final in-class oral report should provide the final technical details of your analysis, how your technical analysis was used in the final plan for your group, and the final conclusions for your group.

Bring printed copies of your presentations for guests and the professor.

The final written report should follow the technical memo format, including a two-page summary with conclusions. The management group is responsible for the introductory two pages. Each of the other groups should provide a detailed appendix (in technical memo format, of course) to the overall technical memo that describes the analysis performed and the proposals developed by the group.

Students will be graded on (a) the quality of their group's contribution to the overall effort of the class and (b) peer evaluation. The professor, in conjunction with our external resource persons, will select an exemplary student for a teamwork award.

As stated above, the audience for the final written report is the Calvin College Vice President for Finance, although the final grade will be assigned by the professor. Your final report will consist of

(a) a paper copy of a technical memo with extensive appendices and

(b) electronic copies of any programs or analysis tools that you developed during the project.

You must distribute copies of your final report to the VP for Finance, your resources (see below), and the professor. You must also send a note of appreciation to your resources for their assistance during the semester.

Resources:

- Paul Pennock, Calvin Physical Plant: contact for physical plant tours and general physical plant information
  (616) 262-9230 (mobile)
  pennockp@aol.com (email)
- Henry DeVries, VP for Finance, hdevries@calvin.edu, 6-6148
- Chuck Holwerda, Electronics Shop, 6-6438
- Classroom learning on exergy, economics, and thermal analysis
- Prior laboratory and lecture classes

Group selection will be conducted by the professor. To apply for one of the available positions, prepare a cover letter and resume and deliver it to the professor by **Monday 11 Sept 2006**. Your cover letter should indicate your interest in either a management, external relations, long-term technology, short-term technology, or infrastructure position.

Calvin ENGR 333 Wind Energy Project Schedule (2006)

Class meets MTWF 11:30–12:20 in SB102

Day	Date	Activity
Wed	6 Sep	Project introduction, objectives, deliverables
Mon	11 Sep	Cover letter and resume due
Tue	12 Sep	Group assignments announced via KnightVision Project work
Tue	**19 Sep**	**In-class group presentations (7 minutes + 2 for questions)** **Report on objectives, work schedule, and proposed analysis approach**
Tue	26 Sep	Project work
Tue	**3 Oct**	**In-class group presentations (7 minutes + 2 for questions)** **Report on analysis performed to date**
Tue	10 Oct	Project work
Tue	17 Oct	Project work
Tue	24 Oct	Project work
Tue	**31 Oct**	**In-class group presentations (7 minutes + 2 for questions)** **Report on preliminary results**
Tue	7 Nov	Project work
Tue	14 Nov	Project work
Wed	15 Nov	Project work
Fri	17 Nov	Project work
Mon	20 Nov	Project work
Tue	21 Nov	**Project final presentations (13 minutes + 2 for questions)**
Wed	22 Nov	**Project final presentations (13 minutes + 2 for questions)** **Report on final results**
Thur	**30 Nov**	**CEAP Poster Session**
Fri	**1 Dec**	**ENGR Department Seminar**
Fri	15 Dec	Final written report due at Noon