

Strategic Plan

Department of Chemical Engineering

I. Mission Statement

The chemical engineering department seeks to provide an environment that enables students to pursue their goals in an innovative program with a diversity of course offerings and research opportunities that is both rigorous and challenging.

Specifically, our mission is threefold:

- 1.) To provide a high quality undergraduate program at the B.S. level and a graduate program at the M.S. and Ph.D. levels. We strive to prepare our students for productive careers in industry or government as well as to provide a solid foundation for graduate studies.
- 2.) To develop research activities and to acquire external funding support with the aim of enhancing our graduate programs and contributing to the generation of new knowledge.
- 3.) To serve the needs of the public and the State through outreach activities including consulting and speaking engagements.

II. Department Vision

The department of chemical engineering seeks to achieve the goals articulated in its mission statement by designing a quality undergraduate and graduate curriculum that emphasizes depth, breadth and professionalism. This vision can be achieved by providing high quality instruction and research opportunities; and fostering in our students a sense of innovation. The success of the mission statement will be gauged by the success of our alumni who contribute to the profession in the global society.

III. Department Plans

Strengths

The chemical engineering program is entering a period of exciting times. For the first time in more than half a century, the program has been provided with high quality, state-of-the-art facilities as the result of the KEEP-NH Program funding. Meanwhile, the discipline of chemical engineering plays an important role in meeting the challenges the society faces in energy, environment and the rapid growth of biotechnology industry. In addition, the conventional

broad-based demands for chemical engineering remain strong. The department has a number of core strengths in the areas of energy and environment, bioengineering, electrochemical engineering and transport phenomena. We have a highly dedicated faculty who are directly involved in providing quality education at both the undergraduate and graduate levels. Our graduates are landing good jobs with lucrative salaries or pursuing graduate studies in top notch schools. Many of our seniors compete in the AIChE national design competition, and some have won awards.

The ChE department is clearly an important contributor to the research and educational mission of the University of New Hampshire, and has a significant impact outside UNH in the quality of its graduates and program interactions with industry. The department has developed a strong foundation over the years. However, there are some challenges that need to be addressed.

Challenges

Challenges include outdated laboratory equipment that need to be replaced, securing federal funding for research on a consistent basis, providing funding for new graduate students as research assistants, enabling faculty to allocate more time for research activities, and addressing space needs.

Strategic Plan

The departmental strategic plan provides a blueprint for departmental initiatives for the near future (1-5 years), subject to appropriate modifications when needed. It covers undergraduate curriculum, enrollment, research and graduate program, revenue enhancement, public service, and other initiatives and ideas.

1.) Undergraduate Curriculum

- a. Provide support to enhance instruction in ChE 410 - Energy and Environment - when the Discovery Program is implemented*

Preamble:

Since the 2001-2002 academic year, ChE 410 has become a 3T general education elective. It was designed to serve the general student body by enhancing technological literacy. Since FY04, enrollment has increased 713% as shown in the table below:

Year	Enrollment
FY 04	23
FY 05	50
FY 06	57
FY 07	67
FY 08	187

Under the guidance of Prof. Farag, ChE 410 students have been active in energy project outreach. They contributed to the recent EPA Award of ENERGY STAR to UNH. As the first University recipient of ENERGY STAR in the nation, the announcement of the EPA Award got into major news media, including USA Today. Due to increased student interest, ChE 410 was offered in both fall and

spring semesters in the 2007-2008 academic year resulting in a total enrollment of 187. We expect the enrollment will continue its upward growth.

Action (Ongoing)

When the Discovery Program is implemented, ChE 410 (Energy and Environment) will become part of the “Environment, Technology and Society” requirement. We plan to offer this course both in the fall and spring semesters and as a result, we expect enrollments to grow. Thus this is an item that we need to continue to leverage. The department will support the instruction in ChE 410 with quality video tapes and speakers. Students enrolled in this course will also be encouraged to participate in the INCO 590 experience.

b. Enhance Honors Experience

Preamble:

The Chemical Engineering Department offers an Honors in Major program which is open to all students in Chemical Engineering with a GPA of 3.2 or higher. The Honors in Major programs requires 12 credits of honors course work in the major and a 4 credit thesis experience (or completion of the final capstone AIChE problem as an individual). This means that at least three 4 credit courses or four 3 credit courses need to be completed at the honors level. Students have consistently participated in the honors in major program, but many have dropped out of the program due to the academic demands in the junior and senior years. Student enrollment in the University Honors Option has been low.

Action (continuing)

Encourage students who are enrolled in the Honors in Major Option to participate in research projects through UROP or INCO 590. Discuss senior thesis options early on (perhaps in the junior year). Assign a committee chaired by the Honors Liaison to guide them through the senior thesis. Appoint a committee to assess their performance in the senior thesis. Develop guidelines consistent with the college wide honors-in-major program proposed in the CEPS strategic plan.

c. Need for Student Project Space for AIChE projects, INCO 590, Honors and UROP Projects

Preamble:

The increase in enrollment has led to the growth of student involvement in project studies making the need of student project space a vital issue for the program. The availability of the ChE Student Projects Lab will make it possible for junior and senior chemical engineering students to participate in the AIChE Chem-E-Car Competition. Our students have consistently expressed an interest to participate in the annual regional Chem-E-Car competition but have been hampered by the lack of appropriate student project space. The project space can also be used to house INCO 590, Honors and other UROP projects. Many of our students participate in these projects every year. Such projects will also provide the opportunities of interdisciplinary collaborative team work for our students.

Action (1 year)

Coordinate with the Dean's office to secure project space for these worthy projects.

d. Enhance ChE Computer Cluster

Preamble:

With the completion of the Kingsbury Renovation project in the summer of 2007, the department has an expanded space for the ChE computer cluster. We have furnished 7 computers in the cluster. However, due to the growth in enrollment, additional units are needed. Also, the cluster currently lacks printing capabilities.

Action (1 year)

Increase the number of computers to 10 and also provide a network printer.

e. Improve Instructional Laboratories

Preamble:

Some of the equipment is outdated.

Action (ongoing-5 years)

Our goal is to purchase or build new equipment to enhance the quality of laboratory instruction in the unit operations, energy and bioengineering labs. The chair of the department will work closely with the instructors teaching these labs to develop a process to purchase new equipment. The bioengineering lab is temporarily located in Parsons G232. When Parsons is renovated, the lab will move to a new space in Parsons. We will design the lab to provide state-of-the-art facilities in bioengineering lab instruction. We are also in the process of implementing a work-order policy for maintenance. Finally, we take safety seriously and plan to replace any equipment (refrigerators, for example) that does not meet safety requirements.

f. Increase International Education Opportunities

Preamble:

We have held talks with the Universidad de Autonoma in Madrid, Spain, to set up a student scholar exchange program. This was approved by UCSA. However, there are one or two stumbling blocks that need to be resolved.

Action (1 – 2 years)

Resolve the last few items in the protocol and establish the exchange program. Initiate a scholar exchange program followed by a student exchange program.

g. Establish industrial internships

Preamble:

Our students have been getting summer internships in local industries. Nearly 115 students have participated in the Pollution Prevention (P2) Internship Program over the last 15 years. The projects, supervised by faculty, have resulted in nearly \$3.3 million savings to the companies. When the bioengineering option was started, we contacted local industries and were able to create a few summer

internships in Anheuser-Busch, Lonza etc. This year, we were able to contact Glycofi (Merck) and to send one of our students.

Action (continuing basis)

Establish additional internships with industries in the bioengineering, energy and other sectors by announcements as well as site-visits to industries.

2.) Student Enrollment

a. Increase/sustain growth in undergraduate enrollment and student quality

Preamble:

Undergraduate enrollment continues with a healthy growth pattern. From 2002 to 2007, there has been an enrollment increase of 98%. Since 2005, the increase is 38%. The following table provides the enrollment data from 2002 to 2007 (R + 30, fall semester).

	2002	2003	2004	2005	2006	2007
Fresh.	14	20+4 (ENE:IP)	23+4 (ENE:IP)	24+2 (ENE:IP)	28+6 (ENE:IP)	37+3 (ENE:IP)
Soph.	18	17+1 (ENE:IP)	21+4 (ENE:IP)	17+5 (ENE:IP)	25+2 (ENE:IP)	23+6 (ENE:IP)
Jrs.	12+1 (ENE:IP)	17	20+1 (ENE:IP)	16+3 (ENE:IP)	14+6 (ENE:IP)	21+1 (ENE:IP)
Srs	16	14+1 (ENE:IP)	14+1 (ENE:IP)	17+2 (ENE:IP)	18+4 (ENE:IP)	18+8 (ENE:IP)
TOTAL	61	75	88	86	103	117

In view of the increase in the number of freshman applications in the spring of 2008, we have scaled back the number of Chemical Engineering Freshman Scholarship offers this year. Offers were made only to applicants with total SAT score of 1400 or above.

Action (ongoing – 5 years)

Visit high schools on a regular basis and give talks on career opportunities in chemical engineering. Traditionally, the department has been able to attract students with high GPAs and SAT scores. We plan to continue this tradition by offering scholarships to students with high SAT scores.

The ChE program brochure was revised in the summer of 2006. We mailed brochures to NH high schools in the fall of 2007 and the feedback has been positive. We plan to mail brochures to schools in the New England region as well. The brochure will be revised again to reflect new research activities and personnel.

b. Enhance department website

Preamble:

The department had a dynamic website on an external server. Unfortunately, the server has been subject to “SQL injection” attacks and it has become difficult to maintain the dynamic website.

Action (ongoing – 1 year)

Migrate the website to the UNH server. Nancy Littlefield, Administrative Assistant, will maintain the website by providing up-to-date information on faculty and curriculum. Periodically, surveys will be placed on the website to solicit alumni feedback.

c. Develop Alumni Database

Preamble:

The department had a good database containing information on alumni. Unfortunately, this will not be available when the website is moved to the UNH server.

Action (ongoing – 1 year)

We have just created a new Chemical Engineering Alumni Group on LinkedIn. We expect membership to grow when the information for joining the group is placed on our new website. The database will provide valuable information on alumni placement, and will be a valuable resource for providing information on career opportunities to current students.

d. Accreditation: Program Assessment

Preamble:

The department has received accreditation from ABET till September 30, 2012. The department adopted the following procedures for program assessment:

1. Review of Program Objectives will be done by ChE faculty (every year).
2. Graduating seniors will be requested to participate in an exit survey (every year).
3. Alumni will be requested to participate in an alumni survey (every 5 years).
4. Meetings will be held with the Departmental Advisory Board (DAB) (at least one meeting per year).
5. Employers of our graduates will be requested to participate in a generic survey (5 years).

Program review and discussion of academic issues is an ongoing process and discussions routinely take place during weekly department faculty meetings. The program educational objectives, outcomes and the assessment process are reviewed in annual faculty retreats. Our last faculty retreat was held in April 2008. The department of chemical engineering has continually made enhancements to its program based on the feedback from different constituencies.

Action (1 year)

Currently, our list of constituencies include

1. Graduates who entered graduate/professional schools
2. Graduates who entered work force
3. Members of the Departmental Advisory Board (DAB)
4. Departmental faculty

Based on the 2007 draft ABET statement, a specific employer group will be added to the constituent group.

3.) Research and Graduate Program

a. *Reduce Teaching Load*

Preamble:

The current teaching load in the department is 4 courses per year.

If the size of the faculty is increased to 8, the teaching load will average out to be

$$\frac{22}{6.5} \approx 3.5$$

courses per year. However, if the university decides to support research effort in chemical engineering at a level close to that of some other CEPS departments, the addition of a 9th faculty will move the department teaching load closer to a level that will permit substantial increase in research activities. For CEPS departments, the faculty teaching load ranges from 2 to 4 courses per year. Consequently, faculty time allocated to research activities varies significantly among departments. With a 9 faculty department, the time available for research will increase by 2-3 times. With the increase in research activity, a substantial part, if not all, of the funding for the faculty addition can be covered by indirect cost recovery from external funding sources.

At the current staffing level, it is very difficult to develop a sustained, substantive, well funded research program. According to the ABET report of August 2000, the research accomplishment of the faculty under the heavy teaching load was recognized by the ABET program evaluation as a marked Program Strength. The following excerpt is taken from the 2000 ABET report:

Program Strengths

“The chemical engineering program benefits from a small but dedicated and highly-regarded faculty. Many are actively involved in research and/or professional activities on top of a heavy teaching workload. Their commitment

to the undergraduate program and their dedication and unity have been of vital importance in sustaining this small program.”

In a modest but concrete step to facilitate the development of our research program, the department will use funds in the Shuttleworth account for summer student support, travel to develop external funding support and other research related initiatives. The faculty has always been committed to pursue active, high quality research as is evidenced by their productivity in student and consulting projects and scholarly publications. However, we strongly feel that there is a crucial need to bring our teaching load to a more equitable level within CEPS and to that of a “research university” nationally.

In the ABET 2006 Final Statement on accreditation, the department received the following assessment:

“The Chemical Engineering Department offers a quality undergraduate program to their student body, which has grown from new enrollees of 11 in 2001 to a current day enrollment of 24. The total number of majors served is 86, including 10 in the environmental engineering Industrial Process (IP) program. The chemical engineering program is effective in meeting traditional program requirements in a way which is sensitive to contemporary multidisciplinary opportunities where this process engineering background can made a unique contribution, particularly in energy, environmental husbandry, and bioengineering. The faculty of seven is dedicated to their teaching responsibilities, a fact which has been confirmed by spontaneous student commentary.”

Action (1 – 3 years)

Hire eighth faculty member in summer 2009. This position has already been approved by the Dean and Provost. Hire 9th faculty member in three years when one of the senior faculty is expected to retire in 2010. Institute a mentoring process that promotes the fulfillment of the goals in the strategic plans of the department and the college.

b. Graduate Student Recruiting

Preamble:

The recruiting of high quality graduate students is almost as challenging as the seeking of external research funding. Universities in China and India still represent two major sources of promising graduate students.

Action:

- Develop ties with quality Indian and Chinese institutions for a steady source of high quality graduate students. Such development will be more feasible when our support base for graduate students becomes more substantial.
- Exchange list of seniors interested in graduate school with other US universities.

- Develop additional financial resources to fund first year graduate students. Significant changes can be generated with 50-100,000\$ per year. Consider foundations and industrial consortia (2-4 years).
- Increase student enrollment to about 20 total M.S. and Ph.D. (3-5 years).
- Establish graduate committee (consisting of 3-4 members) to monitor the performance of graduate students; contact universities – both local and international – to exchange lists of prospective undergraduate seniors who may be interested in graduate school; and, bring increasing visibility to the strengths of the department (see next bullet) (1 – 2 years).
- Enhance the department website pertaining to graduate education as well as the alumni database (ongoing – 1 year).
- Develop seminar series (1-2 years).
- Utilize the department’s strengths in the areas of electrochemical engineering, bioengineering, energy and environment, transport phenomena to foster interdisciplinary ties with other departments and colleges (1-3 years).
- Assign the graduate committee to look into the establishment of a non-thesis MChE degree for departmental review. The non-thesis option (which may cater to non-traditional students in industry) would have a set of core courses taught on a regular basis. Furthermore, many of these courses could be taught via Far-View (the effort to teach graduate courses via Far-View will be tried in spring 2009) (1 year).

c. Self-study

Action (1 year)

Complete self-study report for program review. With the completion of the program review, one of the items in the strategic plan of the college and the university will be fulfilled.

4.) Revenue Enhancement

a. Fund Raising

Preamble:

We are in the process of developing an accurate and current alumni data base. Departmental annual fundraising campaigns provide crucial financial support to academic programs at many other universities.

Action:

Coordinate with the Dean and others to allow department to conduct annual fund raising.

b. New Discovery Program Courses

Action (2-3 years)

Offer inquiry 444 and other general education courses.

The department has approved the offering of an inquiry 444 course and is considering a new general education course on Energy and Society: From Fire to Weapons of Mass Destruction. Manpower limitation is a major impediment. We should be able to move for implementation when we have a faculty of 9.

5.) **Public Service & Outreach**

Preamble:

The faculty is active in providing consulting services to many industries in the State and the New England area. Companies include PolyVac, Cubic Wafer Inc., Nexx Systems, Duralectra, Sanford Process, Ballard Material Products, Electrochem and Rohm and Haas. These industrial interactions, in addition to providing technical assistance, have led to equipment donations and job placements for our graduates. In addition, the Pollution Prevention Internship Program with support from the EPA, the State and industry has been very successful.

Action (2 – 3 years)

Introduce an outreach continuing education program to high school science (especially chemistry) teachers on the topics of energy, pollution and biotechnology (utilizing Far-View where feasible). We plan to seek both external and internal support for the program. It is also possible to use part of our endowment income for this initiative. If a sound and sustainable relation is established with high school science (e.g. chemistry) teachers, we will help to improve the quality of their programs and consequently strengthen the preparation and motivation of our prospective students. This should have a positive effect on our undergraduate enrollment as well.

6.) **Program Initiative and Ideas**

a. **Department Advisory Board**

Action (1year)

Expand the DAB membership to 6 – 8 members with representation from both genders.

b. **Energy**

Preamble:

Energy is an area of exciting opportunities. Ongoing activities in fuel cell (and nanomaterials), electrochemical engineering and biofuels form a good basis for growth.

Action (2-3 years)

The department will provide support for faculty efforts to develop new programs in energy technology and resources. The department formed a Clean and Renewable Energy Center based on faculty research activities and program course offerings. It is anticipated the presence of the Center will add to our competitiveness in seeking external funding and facilitate interdisciplinary cooperation with other groups on and off campus. It will also be helpful in the recruitment of prospective students and faculty.

c. Five Year Projection and Future Action Items**Preamble:**

As noted in previous paragraphs, the ChE department has successfully leveraged many of its strengths to enhance the undergraduate and graduate missions of CEPS and UNH. With the expected addition of the eighth faculty member in academic year 2009 and the possible growth to a faculty size of 9 members in academic year 2010-11, production of graduate degrees and research output are expected to realize significant growth.

Action (3-5 years)

The following items are worth leveraging

- Department's strengths in the area of energy as previously noted and the establishment of the Renewable Energy Research Center to foster interdisciplinary activities and secure funding.
- Success of the bioengineering option to create an interdisciplinary B.S. program in bioengineering with the collaboration of colleagues in Biochemistry and other related areas.