

# **Department of Chemical and Biomolecular Engineering**

## **Strategic Plan**

### **Vision**

The Department of Chemical and Biomolecular Engineering will provide the highest quality education to our students and serve the profession and society by creating knowledge through cutting edge disciplinary and interdisciplinary research, and disseminating this new knowledge to industry, government, and the scientific community. We will also create a learning environment that fosters diversity in teaching, scholarship and personnel practices.

### **Mission**

- To create knowledge in the field of Chemical and Biomolecular Engineering through cutting-edge research, including interdisciplinary research, and pass this new knowledge on to our students, our profession, and society in general.
- To educate undergraduate and graduate students in Chemical and Biomolecular Engineering and foster cross-fertilization of allied fields.
- To serve the public, academic, industrial and governmental communities through consultation, collaborative efforts, entrepreneurial activity and dissemination of research results.
- To create a learning environment that fosters diversity in scholarship, approach to teaching and in student, faculty and staff make-up.
- To instill in our students an appreciation of, and the necessity for, life long learning and to provide them the skills to prosper in a global economy.

### **Goals**

- To develop an educational program at both the undergraduate and graduate levels that is recognized as one of the top twenty programs in the nation.
- To develop a research program that is recognized as one of the top twenty programs in the nation.
- To serve as a recognized authority in chemical and biomolecular engineering for the public, industry and all levels of government.
- To establish our innovations in education, discoveries/advances in research, and our successes in diversity as models for other departments, colleges and universities.
- To be housed in a new state of the art Koffolt Laboratories, one that meets the requirements for modern education and research in Chemical and Biomolecular Engineering.

## **Introductory Note:**

The success of the following Strategic Plan is tied closely to the success of a parallel plan to replace the aging Koffolt Laboratories. Especially in certain of the major topical sections of the Strategic Plan -- Undergraduate Education, Graduate Education, Research, Faculty Recruitment -- replacement of a decaying physical plant with a modern Koffolt Laboratories would enhance prospects for success greatly. Because a new Koffolt is such a singular undertaking and because it permeates so much, we have not listed the construction of a new Koffolt as a separate subtopic on a par, for example, with Undergraduate Education. Although it is possible to achieve much in the absence of a new building, the prospects of success of the goals listed in this report would be enhanced immeasurably if a modern Koffolt Laboratories came into being.

## **I. Undergraduate Program**

### **Goal #1: Enhance the undergraduate learning experience**

An essential mission of the department is to prepare undergraduate chemical engineering majors for careers in industry or continued education (graduate school, medical school, etc.). This goal can be accomplished by continuing to streamline and update the curriculum, and following a rigorous and comprehensive assessment program,

#### ***Strategies:***

- Explore possible modifications to the core course requirements.
- Develop a core course for computational tools (MATLAB, Fluent, Aspen, etc.).
- Develop a core course for undergraduates similar to our graduate course ChBE 881 to teach written and oral communication skills.
- Create and implement better instructional assessment tools, including assessment by faculty of the courses they teach and assessment by students (to supplement SEI and individual course evaluations). Reinvigorate the peer-assessment process.
- Improve ways in which we “close the loop” by communicating assessment results and feedback to faculty, students, and alumni.
- Make better use of the Advisory Board Committee.
- Increase number of undergraduate students involved in research: do a better job advertising research opportunities (website); encourage participation in honors research projects and the Denman forum; initiate a quarterly or annual event within the department (e.g., poster session, seminar) to highlight undergraduate research accomplishments.

#### ***Metrics:***

- Assessment results (Senior Exit Survey, Alumni Survey, SEI and other student evaluations of instruction, faculty evaluations of courses)
- Annual summary report of outcomes assessment activities

- Minutes of annual Advisory Board Meeting
- Number of undergraduate students participating in research; number of students presenting at the Denman forum and professional conferences
- Development of new courses in computational tools and communication skills
- Curriculum changes and assessment reports

**Goal #2: Decide whether title of B.S. degree should be changed to *Chemical and Biomolecular Engineering***

Recent data in C&E News show that chemical employment over the last 10 years has declined in every sector except pharma, where it has increased by 2.5%.

***Strategies:***

- Identify pros and cons of changing our degree name to match our department name. Define a minimal bio-related coursework requirement for all students.
- Increase and enhance bio-related topics in ChBE courses, including development of new courses and integration of new content into existing courses.
- Explore impact of degree name change on accreditation efforts. Obtain appropriate feedback from students, alumni, and the Advisory Board.

***Metrics:***

- Number of bio-related courses offered within the department
- Feedback from students, alumni, and Advisory Board
- Summary report of actions taken by other programs in the U.S.

**Goal #3: Enliven students' sense of community and commitment to CBE**

For most undergraduate students, the department of their major is much more than simply where they take most of their classes. Many students wish to have more interactions with faculty, staff, and other students beyond the classroom. Further, we recognize that today's students are tomorrow's alumni, and students with a strong connection to the department during their time here will tend to support the program in the future.

***Strategies:***

- Cultivate a more active student chapter of AIChE: define our expectations of the student group; increase student membership and promote stronger leadership by the officers; define expectations and responsibilities of this group's faculty advisors; promote engagement of the student chapter with the local Columbus AIChE chapter and with alumni interested in taking a more active role.
- Increase opportunities for faculty-student interactions beyond academics.
- Increase involvement of faculty in undergraduate advising.

- Host informal gatherings and gripe sessions.

***Metrics:***

- Student involvement in AIChE
- Senior exit and alumni surveys

**Goal #4: Increase diversity, maintain high number of undergraduate majors, and increase enrollment of non-majors in CHBE courses**

Our target enrollment should be 120 incoming CBE majors per year (students enrolled in ChBE 200 for the first time), which we expect will result in graduation classes of 85-100 students. We are also concerned about recent decreases in the number of women and minority students entering our major.

***Strategies:***

- Increase enrollment and graduation rate of women and underrepresented ethnic groups: coordinate with the MEP program to offer activities for K-12 outreach; aggressively advertise Bates scholarship to Columbus East and Cincinnati Princeton high schools; increase scholarship offers to incoming women through the WIE program.
- Develop a plan to handle an undergraduate population of ~120 incoming students as it moves through the CBE curriculum.
- Implement more aggressive recruitment activities for high school students considering CBE and also for OSU freshmen: visits to high schools; invite high school chemistry teachers and guidance counselors to visit the department; make sure high schools are aware of school- and county-specific scholarships
- Increase number of non-majors taking CBE courses
- For CBE majors, consider increasing the number of required CBE technical elective courses from 2 to 3. Encourage students who complete a co-op or internship to enroll in ChBE 489.

***Metrics:***

- Enrollment and retention statistics for women and underrepresented ethnic groups
- Number of non-majors enrolled in CBE courses
- Average time to degree

***Financial Implications***

Goals 1-3. Can be accomplished with current resources

Goal 4. Success in recruiting has resulted in a situation where we need to hire an additional academic advisor.

## **II. Graduate Program**

### **Goal #1: Recruit each year a top quality, diverse class of Ph.D. students**

Our target enrollment should be a yearly intake of 15-20 Ph.D. students. We need to take steps to increase quality and diversity in terms of U.S. citizens, minorities, and international students from Asia, Africa, Europe and South America.

#### ***Strategies:***

- Coordinate our efforts with the College of Engineering and the Graduate recruitment activities.
  - Provide information for booths at national conferences such as the Society of Women Engineers, National Society of Black Engineers, and Society of Hispanic Engineers.
  - Encourage faculty participation in College booths at these national conferences.
- Encourage Faculty to meet with prospective graduate students while they are visiting other universities.
- Become more active in recruiting faculty and prospective students to attend the OSU Graduate and Professional Schools Visitation Days.
- Send current graduate students back to their alma matter to hold round table discussions with students interested in attending graduate school.
- Continue to promote our non-thesis master's program to local practicing engineers.

#### ***Metrics:***

- GRE scores of incoming students
- The percentage of students we admit who receive University Fellowships and other external fellowships
- Number of Ph.D. students in residence
- Percent of domestic graduate students enrolled

## **Goal #2: Enhance the graduate student learning experience**

### ***Strategies:***

- Reduce required number of course hours to be more comparable with other universities.
- Because of the interdisciplinary nature of many student's research projects, have more flexibility in courses we accept to fulfill requirements.
- Increase faculty/student interactions at the graduate level with the help of the CEGC social events.
- Address changing interests by development of new courses.

### ***Metrics:***

- Average time to Ph.D. degree.
- Ph.D. student retention statistics.
- Number of quarters to Qualifier and Candidacy exams and to degree.

## **Goal #3: Mentoring of graduate students for success in academia and outstanding industrial and governmental research laboratories**

While our Ph.D. placement into academia is small, our graduates entering into industry, government or non-profit organizations are joining some of the best American research laboratories.

### ***Strategies:***

- Increase our national ranking, which will help in students obtaining teaching positions.
- Develop an aggressive graduate student mentoring program.
- Provide interested students with classroom teaching experiences involving team teaching with faculty members.
- Nominate students for local and national awards.
- Increase graduate internships in industry and government labs.
- Increase student publications in high quality journals.

### ***Metrics:***

- Numbers of students placed in academic positions each year.
- Graduate Program Ranking (US News and NRC)

### ***Financial Implications***

Goals 1-3. Can be accomplished with current resources. However attention must be given to retaining and enhancing our Graduate Fee Authorization funding, attracting additional scholarship and fellowship funds and winning sufficient grant support to support our graduate students with (competitive) stipends and tuition.

### **III. Research**

Our goals can, in an overall sense, only be achieved by improving the environment for the current faculty such that they can be more productive and visible nationally and internationally and by careful hiring of faculty with superior potential for research.

**Goal #1. Achieve national recognition for a research program ranked in the top 20 in the nation.** Given that the nature and quality of a research program of a department are dictated by the collective quality of the individual faculty members, and the faculty's ability to collaborate in manners that create research foci or centers that are more productive than the sum of the individuals, the strategies and metrics should reflect these realities.

#### ***Strategies:***

- Improve the Department, College, and University support for focused, collaborative research initiatives that are initiated from the “ground up” by faculty members. This would include streamlining, and improving the ability of faculty to obtain “matching funds” when it increases the chances of faculty receiving outside awards
- Improve the general infrastructure support for faculty so that they can focus on what they can do “best”.
- Promote selected research areas with high potential for significant impacts in the state, nation and international arena, e.g., bioenergy, sustainable and high-efficiency energy, nanotechnology, and nanobiotechnology.

#### ***Metrics:***

- Faculty members elected to the National Academy of Engineering
- Publications and Patents/faculty
- Publication citations/year
- Ph.D. degrees granted/year
- Research support/year
- Named invited lectures

**Goal #2. To maintain research expenditures in the range of \$8.0M/year.**

#### ***Strategies:***

- For Biochemical/Biomedical based research, increase collaborative projects with other Colleges at OSU as well as other institutions. Examples include: The

College of Food, Agricultural and Environmental Sciences at OSU, The College of Medicine at OSU, Columbus Children's Research Institute, and the Cleveland Clinic Foundation.

- For energy area research, foster the continued growth of research projects, potentially creating centers.
- Target State of Ohio funding opportunities: Examples include Ohio Department of Development Energy Programs and the Third Frontier Program.
- Compete with interdisciplinary teams for center grants from NIH, NSF, DOD and DOE.

***Metrics:***

- Number of multi-investigator grants with interdisciplinary teams
- Number of obtaining center grants
- Grants received from the State of Ohio Third Frontier program and related opportunities
- Total research support received by departmental faculty.
- Research expenditures/faculty

**Goal #3. Double the amount of indirect costs generated by the department**

***Strategies:***

- Obtain more research grants that have full overhead.

***Metrics:***

- Fraction of research support from the Federal Government
- Indirect costs generated by departmental faculty.

**Goal #4. To achieve national recognition by superior accomplishments in scientific and technological publication and in awards gained by undergraduate, graduate and faculty members of our department**

***Strategies:***

- Increase the Department's already impressive record of student and faculty awards. Promotion of our undergraduates, graduate students, and faculty for university, national, and international awards.

***Metrics:***

- Professional society awards including AIChE Institute Awards, Society Fellow election, etc
- Undergraduate and graduate student awards, scholarships and fellowships

***Financial Implications***

Goals 1-4. Can be accomplished with current resources. However the need for a new Koffolt Laboratories must be a high priority not only for the department and college, but also for the university. We require an up-to-date, safe and attractive environment to carry out cutting edge research, to attract both undergraduates and

graduate students and new faculty. Regarding a new Koffolt Laboratories we understand the need to raise \$20M in private sector support and are building toward that effort. We expect the campus development office to provide us with a development officer.

#### **IV. Faculty Recruitment**

**Goal #1: Grow faculty to 22 within the next 5 years, with an emphasis on hiring junior faculty.**

*Strategies:*

- Maintain a high profile, national/international faculty recruiting effort that engages all of the current faculty, as well as the graduate students.
- Aggressively identify and nurture relationships with outstanding graduate students in the latter stages of their graduate studies.
- Identify and recruit outstanding candidates from other institutions through personal contacts.
- Increase the diversity of the pool of faculty candidates, and continue to successfully recruit faculty from this pool.
- Offer competitive start-up packages that also take advantage of the unique institutional opportunities OSU offers.
- Provide the infrastructure to carry out state of the art research. This requires a new building.

*Metrics:*

- Number of successful faculty hires and fraction from underrepresented groups.
- Funds raised from both State and Alumni for the construction of a new Koffolt Laboratories which is sorely needed to aid faculty and student recruitment and retention.

**Goal #2: Hire outstanding faculty to enhance our national/international reputation in chemical engineering research and education.**

*Strategies:*

- Participate in faculty hiring in the TIE areas of emphasis in the College, including but not limited to energy reaction engineering, systems engineering, biomolecular or cell/tissue engineering, and computational materials science and engineering.
- Identify outstanding candidates who would specifically build upon existing strengths or current initiatives in the Department.
- Identify outstanding candidates with research expertise that bridges research and educational activities in the Department with other academic departments or programs at OSU.
- Recruit exceptional prospects in related science and engineering fields from “non-traditional” institutions.
- Offer competitive salaries and start-up packages to prospective faculty

***Metrics:***

- Ratio of acceptances to offers made to faculty candidates.
- Early success for new faculty in establishing their research program –numbers of grants won, publications, seminar invitations, invited talks at conferences, graduate students attracted, activities in professional societies, awards won, etc.
- New faculty activity in terms of courses developed, enhancements in existing courses, new educational approaches fostered, positive faculty peer evaluations, positive student feedback, etc.

***Financial Implications***

Goals 1-2. We only have one Academic Enrichment position available to the department. To achieve our goal of 5 new faculty over 5 years we will have to successfully compete for new TIE positions in the college or positions which the state makes available for competition. We are well positioned with possible hires in the energy area, nanomaterials, biomolecular systems, computational materials, catalysis and reaction engineering areas.

**V. Diversity**

The Chemical and Biomolecular Engineering Department (CBE) values and promotes diversity in all respects. It acknowledges that varied human experiences and backgrounds enrich the community, and that by bringing a broader range of perspectives to the field, diversity can advance science and engineering. The following goals have been identified by the department as critical to ensuring a strong and diverse work environment.

**Goal #1: Increase the numbers of women and minority undergraduate and graduate students in the department**

Increasing diversity of students is one way to increase the enrollment CBE, at both the graduate and undergraduate level. Women, for example, represent more than 50% of our undergraduate (graduate) population university-wide but are only about 20 – 30 % of the CBE majors and about 30% of the graduate population. Unfortunately, following a national trend, the number of undergraduate women entering CBE at OSU appears to be slowly declining. Minority student (including African American, American Indian and Hispanic) enrollment in CBE is 9.0% (majors). While this number is not as high as we would like, the department was recognized in 2007 by the Minority Engineering Program for its work in recruitment and retention.

***Strategies:***

- Continue to work closely with the Women in Engineering (WiE) and Minority Engineering Program (MEP).
- Increase department visibility at recruitment functions by continued coordination with WIE and MEP programs.
- Aggressively identify and nurture outstanding underrepresented undergraduate students and encourage them to continue to graduate school.

- Offer competitive scholarships to underrepresented students at all levels.
- Use existing programs, like the non-thesis MS, as recruiting tools to increase diversity in the graduate student population.

***Metrics:***

- The percentages of the undergraduate graduate student populations that are women and minorities.
- The number of awards for our recruiting and retention efforts by external groups such as MEP and WIE.
- The number of our under-represented undergraduates that continue on to graduate school.

**Goal #2: Increase the number of underrepresented faculty members to reflect the demographics of our undergraduate population.**

CBE currently has three female faculty members and one minority faculty member of a total faculty of seventeen. Faculty recruitment (from three to five positions over the next several years) provides an opportunity to expand on this.

***Strategies:***

- Hire at least one woman or minority faculty member within the next three faculty additions.
- Use personal contacts to identify and nurture potential faculty candidates from under-represented groups.

***Metrics:***

- The number of additional faculty members recruited from underrepresented groups.

***Financial Implications***

Goals 1-2. Can be accomplished with current resources

**VI. Outreach**

The Department serves the public, academic, industrial and governmental communities through departmental activities which are consonant with the land grant mission of our university. We will enhance this through consulting, collaborative efforts, generation of useful intellectual property and publications in the open literature.

**Goal #1 Participate in patenting intellectual property and assist in start-up company activities**

***Strategies:***

Encourage faculty to work with the technology licensing office to apply for patents of intellectual property having the potential for licensing and new corporation development.

***Metrics:***

- Number of patents applied for and issued.
- Licensing revenue.
- Number of start-up companies founded based on departmental IP.

**Goal #2 Participate in K-12 initiatives aimed toward increasing the number of students interested in Chemical and Biomolecular Engineering as a career.**

***Strategies:***

- Increase faculty participation in assuring that the pipeline for the next generation of our students is filled with well-prepared and enthusiastic students.

***Metrics:***

- Number of collaborative activities with elementary, middle and high school teachers and students
- Undergraduate enrollment numbers and trends
- Number of faculty directly participating in K-12 efforts
- Number of collaborative activities in K-12 efforts through federally funded programs and centers

**Goal #3 Promote collaboration with industry, particularly in Ohio**

***Strategies:***

- Increase faculty collaboration with industry to gain more research funding and to generate more internship and job opportunities for our undergraduate and graduate students.

***Metrics:***

- Number of collaborative activities with Ohio and non-Ohio industry
- Number of internship and job opportunities for our students
- Number of collaborative proposal submissions to federal funding agencies and Ohio Third Frontier Program

***Financial Implications***

Goals 1-3 can be accomplished with current resources