



Chemical + Biomolecular Engineering

ENGG

CORNELL ENGINEERING

Degree Programs and Research Areas

The School of Chemical and Biomolecular Engineering offers three Chemical Engineering degree programs: BS, M. Eng. and MS/PhD.

We are a department of 17 faculty, two lecturers, 85 PhD students, 15 M. Eng. students, and over 250 ChE-affiliated undergraduates. This cohort of 370 chemical engineering faculty and students are assisted by only 10 administrative staff, some shared with BME. Faculty: staff ratio of ~40:1.

Our **primary areas of research** are:

- **Biomolecular engineering:** a tradition that dates back to research leadership in the 40s, carried with pride today by over one-third of the current faculty
- **Complex fluids, polymers and soft materials.** A hallmark of the department: We, with our colleagues in M&AE, MS&E, T&AM and C&EE are national leaders
- **Sustainable energy systems.** A new growth area for us. We quickly jumped to the vanguard of activities through new faculty hire and curriculum development
- **Electronic materials and microchemical systems.** Highly interdisciplinary area leverages strength in MS&E, Chemistry, and Applied Physics.

Considerable synergy between these four areas leads to important leverage of investment

Trends

- Growth in **entrepreneurial business activity** by faculty, manifested by creation of new businesses, licensing of research output, Intellectual Property issues, *etc.*
- **Community-wide interest** in the life sciences (turn of the century) now rivaled or perhaps superseded by interest in **sustainable energy systems** (ongoing).
 - Slow Federal government funding for energy
 - Oil and gas company funding to universities is too narrowly distributed. A new model needs to be developed
 - This huge endeavor deserves a Manhattan Project-scale response from government and corporate support
 - It also begs for a broad-based university, like Cornell, rather than an Institute, to attack the problem
- **Size of the undergraduate program has doubled** from 45 to 90 seniors per year (historically, interest in ChE was ~10% of the freshman class; now it's 15%).

This increase in student/faculty ratio hurts our rankings. We are a private school with a public school sized program. We rival the enrollment of traditionally large programs, like ECE and MAE with less than half the faculty.

Achievements

Olin Hall Renovation

- The School is currently undergoing its first **infrastructure renovation** since Olin Hall was built in 1941. This \$15M renovation will provide 21st Century facilities infrastructure through new power systems, HVAC installation, new windows, and safety systems (sprinklers and alarms).

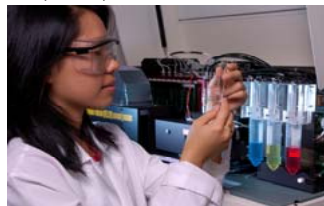
- The School's portion of this **renovation cost** is ~\$5.5M, of which we already have \$2.3M in cash and pledges. We urgently need to find ~\$3M to avoid debt service.

Strategic and "discipline-forward" faculty hires

- Faculty hires define research direction and our young faculty hires over the past 5 years have provided us with arguably the best cohort in ChE in the country
- This is now transitioning to strength in mid-career faculty as these stars are awarded tenure
- Now we need to keep them (see "Challenges")
- Pivotal hire through the Croll Chair moving Jeff Tester from MIT (geothermal energy expert)

Recent research achievements include

- * Development of an energy-free "switch" based on surface tension (Spiderman effect) [Steen]
- * Creation of an artificial tree rivaling the ability of redwood trees to draw water upwards [Stroock]
- * Development of melt electrospinning process and associated computational modeling to produce novel nanoscale materials [Joo]
- * Development of organic layers that can tailor the subsequent nucleation and growth of inorganic thin films for interconnect and packaging applications, esp. use of "nucleation site multipliers and amplifiers" to seal porous materials [Engstrom]
- * Pioneering new droplet transport strategies for miniaturized digital fluidic devices [Daniel]
- * New hollow metal oxide nanostructures with high lithium storage capacity for next-generation rechargeable batteries [Archer]
- * Developed nanoparticle organic hybrid materials (NOHMS).



PhD candidate Didi Waraha (DeLisa group) studies high-throughput production of proteins using the cell's own Tat "machinery"

Priority Goals

- **Education & research:** Continue to play a leadership role in the College's programs in sustainable energy systems (esp. with the arrival of Prof. Jeff Tester)
 - Curriculum development
 - Seed research projects
 - Outreach to the public (Energy Literacy)
- **Education:** Continue to provide outstanding undergraduate and graduate programs
 - Maintain tradition of innovation in coursework
 - Maintain 10-yr history of engaging alumni industrial practitioners to provide professional polish to our students' education
- **Research:**
 - Retain star faculty
 - Increase faculty in biomolecular engineering/molecular biotechnology and in sustainable energy
- **Infrastructure:**
 - Build a new wing to house the energy initiative in the College and expand our laboratory facilities, especially for hoods (we have no more capacity for hoods)



Dr. Bettina Jahn and Francisco Martinez (Escobedo group) use advanced computational algorithms to study new materials



Dr. Ashish Batra (now Dow Chemicals) and Geoff Genesky (Cohen group) study the structure and properties of novel polymers.

Challenges

- **Retention of star faculty.** We need endowed chairs to offer to the newly tenured (a critical point for losing faculty)
- **Paying for our renovation** in the light of the current financial crisis
- Recent compliance with federal auditing practices has left us precariously vulnerable to **funding first-year graduate students**. We need about \$250,000 per year in gifts to provide stability
- **Diversifying the faculty.** Given the very competitive nature of recruitment from our peers, this will be a big challenge. Here again, an endowed chair could help lure a senior woman faculty member to the School (the College has yet to make such a hire)
- **Maintaining faculty and staff morale** through the difficult financial times ahead
- **Containing the growth of bureaucracy** from the federal government and passed down from Day Hall that threatens to reduce faculty and staff productivity towards our core mission

Opportunities

- **Energy Funding:** Despite the lack of federal activity to date, we remain optimistic that funds will come to allow us to contribute significantly to ameliorating the energy crisis. We are now perfectly placed to lead the College and the University in this arena. Alumni could play a decisive role in helping to bring alumni and corporate sponsorship to Cornell.

Example: The Dean's \$180K seed research funding initiative in 2007 realized 400% ROI in one year!
- **Structure of the College allows us to be nimble and powerful:** The wellspring of our power to seize opportunities stems from:
 - nimble flexibility and innate intellectual prowess of our faculty, students and staff to respond to federal initiatives,
 - access to magnificent facilities (Duffield/CNF, CCMR, etc.)
 - our hallmark characteristics of interdisciplinary research and field system
- **Global financial squeeze can be a chance for Cornell to seize opportunities**