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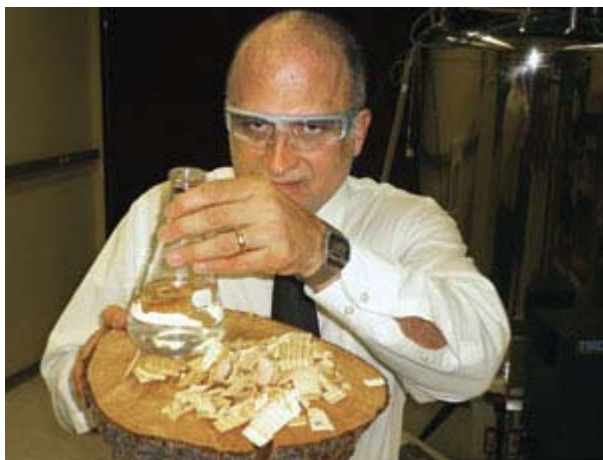
Opportunities for 2007 and Beyond

Biotech's 'Perfect Storm'

The push for energy independence may yield more bioenergy-related jobs

[Corinne A. Marasco](#)

The pursuit of biofuels has become a red-hot area for research, fed by a fervor that rivals the California Gold Rush. Academia, government, and industry are collaborating to find practical and affordable ways to produce and use biomass for energy. These R&D and production efforts cut a swath across specialties: chemistry, agricultural science, microbiology, materials science, biochemistry, and engineering, just to name a few.



Courtesy of Art Ragauskas

Chip power Cellulosic feedstocks such as wood chips can be used to produce ethanol.

In the 10 years since the publication of Sebastian Junger's book "The Perfect Storm," that term has come to refer to a set of factors that combine simultaneously to create a powerful event. Biotechnology appears to be brewing its own perfect storm—biotechnology breakthroughs, geopolitical tensions, falling inventories, and soaring oil prices are working together, creating conditions that just might churn out a more energy-independent nation.

The momentum behind the demand for alternative energy sources is strong, but what does it mean in terms of job opportunities for chemists? It seemed like a good time to ask the question, so C&EN contacted representatives from industry, government, and academia to find out what they see on the employment horizon. The early verdict: Biotechnology is entering an exciting time, and the employment opportunities in biofuels are about as good as they could be.

[Art Ragauskas](#), a professor in the [School of Chemistry & Biochemistry](#) at Georgia Institute of Technology, remembers that not too long ago, biomass chemistry wasn't so attractive. "Around 2000, there was a passionate subgroup interested in this field, but it wasn't mainstream science," he recalls.

The interest in this area started to grow when oil prices began creeping up in 2003. In the 2006 State of the Union address, President Bush said, "America is addicted to oil, which is often imported from unstable parts of the world. The best way to break this addiction is through technology."

"This catalyzed everything," Ragauskas says. "We started seeing students coming in who wanted to make a career based on sustainability."

Ragauskas' research program focuses on the green chemistry of biopolymers such as cellulose, hemicellulose, and lignin. He believes students with cross-disciplinary skills are the ones who will do well in this arena. "There's a need for people to understand the chemistry and genomics of biomass, and the chemistry of biopolymers is also important," he says. "But you still want a good solid education in fundamentals that incorporates biomass and biofuels wherever possible."

Energizing as it is, the growing interest in biofuels is a double-edged sword for Ragauskas in his role as professor. "I have a very difficult time finding postdocs in this field because people who are trained in the field are in such demand in the marketplace," he says. "Not a week goes by that I don't get a request from a company looking for graduates to hire."

One company that is hiring aggressively is Mascoma, based in Cambridge, Mass. Founded in 2006, the firm now has 33 employees. The company's website lists 15 science and engineering job openings between its Cambridge and Lebanon, N.H., locations. Mascoma's goal is to double the number of its employees by the end of the year, according to Chief Technology Officer Andrew Richard.

"Between Mascoma and the other companies that are planning to put facilities on the ground, we have a real sense that we've moved beyond R&D to engineering," Richard says. "There are tremendous opportunities, and it's hard to find good people. Mascoma may be a young company, but we're well-supported by investors and good money."

The skills Mascoma needs all involve scaling up research knowledge to practical biofuel production systems. That transition entails process development (such as pilot and vendor trials), bioprocess development (such as fermentation), and engineering (such as operations engineering).



Poet

Biofuels Brawn Poet's R&D facility in Scotland, S.D.

Mascoma is hiring at all degree levels. In process development and engineering, the company is placing a great emphasis on experience than on whether a person has a Ph.D. The company, according to Richard, also is looking for people with a "get it done" attitude, which, he says, can take the place of years of experience. "I'd much rather take someone who is a go-getter and train them in the specifics of the process," he says.

One benefit of cellulosic ethanol is the opportunity for expanded geography in its operations. "Biofuel plants are most cost-effective when located near the source of biomass," Richard observes. This geographic spread brings in local job seekers who have a diversity of skill sets that the industry needs.

Last December, Mascoma secured a \$14.8 million matching grant from New York State to build and operate a

\$20 million biomass-to-ethanol demonstration plant in Rochester ([C&EN, Jan. 15, page 38](#)). Mascoma's partner the project is [Genencor](#), which is supplying the enzyme that's central to the process.

Mike Craig, Genencor's human resources director, tells C&EN that the company has hired several people at different levels in the technology and applications area to round out the laboratory skills in the organization. "We've brought in Ph.D.s with experience in protein chemistry, M.S.-level people with two to five years' experience, and even Ph.D.s with no experience," he says. "We take advantage of the skill sets we have and leverage them."

Down the road, Craig says, the company will need people with chemical engineering degrees who are conversant in both science and business. He says Genencor offers exceptional opportunities for technical people who want to work in nontechnical positions. "It's a matter of people being willing to step outside of the lab and being open to those opportunities that will use their expertise. The competition to find the right candidates is tough," he says.

Andrea R. Danforth, vice president of human resources at [Codexis](#) in Redwood City, Calif., agrees: "There is a huge demand for people in the biotech industry here."

Codexis, which recently launched a collaboration with Shell Oil to explore "next generation" biofuels ([C&EN, Nov 20, 2006, page 21](#)), develops biocatalytic processes for the bioindustrial, pharmaceutical, and generic industries. The firm has a facility in Germany and a sales office in India, and it is setting up a new R&D operation in Singapore.

"We have a highly collaborative environment that brings together bright, creative people who welcome accountability," she explains. "Team members need to know how their job fits into multidisciplinary projects to be both strategic and tactical." Despite the company's aggressive time frames, its employees are thriving. The turnover rate at Codexis last year was 11%—half the industry average.

Although Codexis has an ongoing need for process and analytical chemists, biochemists, and molecular biologists at all levels, growth in the company's bioindustrial business, which develops biocatalysts, calls for additional talent in metabolic engineering, Danforth says. To serve its three business units, the company has on technology platform, which enables it to move people among projects depending on business needs.

"We have momentum from a proven technology platform and a successful commercial track record," Danforth adds, noting also that the advent of green thinking is helping the company recruit talent. "Winning a [Presidential Green Chemistry Challenge](#) Award from the Environmental Protection Agency last year validates our commitment to clean technology," she says.

Another company recently remade itself to strengthen its position as one of the leading ethanol R&D companies in the U.S., according to the firm. With 20 years in the industry, Broin Companies is practically a veteran. Plus, it just gave itself a new name: [Poet](#). The new name is intended to unify the company's six different brands under one name that reflects the company's creativity and vision, according to the company's president, Jeff Broin.

Right now, the company has 300 employees and is looking to hire 66 more. "The critical hires are engineers and research scientists," says human resources Director Michele Henriksen. "We want people who are very passionate about what they do and who will challenge themselves."

Henriksen notes that many job candidates are recruited through the company website. In February, when Poet announced it had received an \$80 million Department of Energy grant to construct a commercial cellulosic ethar production facility in Iowa, the number of inquiries by job applicants on the website doubled.



Poet

Stowers

"We really strive for an environment that people find attractive, to stimulate their creativity," says Mark Stowers, vice president of R&D. He says there is tremendous opportunity at Poet for people to follow multiple career path from project management to research. "We like to manage research at the edge of chaos, where multiple ideas and alternatives are managed simultaneously," he says.

Both Henriksen and Stowers stress that workplace culture is what moves the company forward. Not only is teamwork emphasized, "we always overcommunicate, and we all park our egos at the door," Henriksen says.

Good job opportunities aren't limited to industry. For chemists interested in biofuels, the federal government has opportunities for program managers, who evaluate the science, write solicitations, and perform strategic program planning. There are also opportunities in DOE's laboratories and technology centers, where scientists and engineers perform cutting-edge research.

One such center is the [National Renewable Energy Laboratory](#) in Golden, Colo. NREL is the nation's primary laboratory for renewable energy and energy efficiency R&D. With two-dozen job openings, NREL is also competing for people.

Biofuels has been a "hot field for five years, but it's been red hot in the past two years," says Michael Pacheco, director of NREL's National Bioenergy Center. "Although there's a fair amount of collegial camaraderie, there's also competition for talent."

The current pipeline of students in the biofuels area isn't large. "Universities are trying to build up programs and find qualified people who can teach and attract funding," he notes. "A lot of schools didn't think it was worth their time and energy, but now they realize this is important and are getting into the field."

Industry has also played a role in supporting academic programs. For example, Iowa State University recently announced that it would receive \$22.5 million over eight years from ConocoPhillips for research to develop biofuels from crops as a replacement for gasoline. Another example is the [Colorado Center for Biorefining & Biofuels](#) (C2B2), an association of four of Colorado's research institutions and NREL. ConocoPhillips is one of the founding corporate investors, along with Dow Chemical, Chevron, and Shell ([C&EN, March 19, page 12](#)).

A good way for students to position themselves to work in biofuels is to look at universities that have integrated programs across several departments. "The integrated programs recognize that this isn't a discipline-specific program because of the flexibility and the state of the science," Pacheco says. "A traditional biochemistry or chemical engineering program won't really prepare you to work in biofuels. Graduate students should make sure the programs have a cross-disciplinary nature to them.

"It's not really clear yet which technologies are going to win out in the end," Pacheco adds. "Cellulosic ethanol is critical chapter, but there are other approaches with different technologies that could be major players, such as butanol or pyrolysis. Biochemical methods have gotten a lot of attention, but there are thermochemical methods converting biomass to biofuels that aren't as widely recognized. Companies are trying to position themselves with the right portfolio."

The general outlook for biofuels is exciting, and expectations for the next 10 or so years are high. Although the interest in alternative fuels isn't new, it appears that the pieces are falling into place to bring biofuels to the

marketplace easily and inexpensively. Chemists and chemical engineers are definitely part of that equation.

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