IOWA STATE UNIVERSITY
COLLEGE OF ENGINEERING
ME UPDATE
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Biorenewables fuel a new economy

What's the best alternative to fossil fuels? ME Professor **Robert C. Brown** thinks the answer is biomass. As director of Iowa State University's Office of Biorenewables, he and 60 other faculty and staff across campus are working on this alternative. Their focus: develop and improve technologies that convert biorenewables, such as agricultural crops and residues, into everything from transportation fuels and electric power to chemicals and plastics.

"We have a petroleum-based economy," says Brown, who holds the Bergles Professorship in Thermal Sciences and has joint appointments in chemical and biological engineering and agricultural and biosystems engineering. Brown contends development of thermal, mechanical, chemical, and biological processes that convert plant-based materials into fuel and other products would not only reduce dependence on imported oil, but also decrease pollution while creating new agricultural markets.

Brown's research focuses on biomass gasification, a process that turns organic material into a flammable gas. In one project, he has developed techniques and instrumentation to convert switchgrass, an Iowa prairie plant, into the hydrogen-rich gas needed for transportation fuel. While pleased with the progress, Brown says biomass gasification has potential for many uses. "Gasification produces a mixture of hydrogen and carbon monoxide," he explains. "We can take that directly to a power plant and use it like natural gas to produce electricity. For that purpose, it's easier and more cost effective than converting it to hydrogen."

In another project, which includes ME Associate Professor **Ted Heindel**, agricultural residues like cornstover, the leaves and stocks left after harvest, are gasified. The gas is run through a fermentation reactor and microorganisms consume the gas and produce hydrogen and polyester molecules that can be used for biobased plastics.

Professor Robert Brown describes one of the biomass projects at the Iowa Energy Center's BECON facility in Nevada, Iowa.

Recognized as a national leader in biorenewable resources and technology, Iowa State also established the first graduate program to prepare engineers and scientists to work in this interdisciplinary area.

For more information about the Bioeconomy Initiative, visit the Web page at www.biorenew.iastate.edu.

Audit teams look for energy savings

Manufacturers get a free service, and Iowa State engineering students get to apply what they've learned to industrial situations. "It's a winning combination," says **Gregory Maxwell**, ME associate professor, as he describes the work of the Iowa State Industrial Assessment Center (IAC).

The IAC is a U.S. Department of Energy-funded program with centers at 26 universities nationwide. The mission is twofold: provide students a hands-on engineering experience; and help small- and medium-sized manufacturers find ways to reduce energy use, minimize waste generation, and increase plant productivity.

Since its start in 1991, the IAC has helped 350 manufacturers throughout Iowa, Nebraska, Minnesota, Missouri, and South Dakota. An audit team, consisting of a faculty member, 2 graduate students, and 2–3 undergraduates, collects background information, conducts a thorough assessment of plant facilities and operations, and submits a detailed report complete with projected savings and implementation costs.

"It gives students a chance to see a variety of industrial processes and how energy is played out in different manufacturing venues," says Maxwell, IAC director. The team spends 8–10 hours at a plant, taking an in-depth look at such things as compressed air systems, boilers, and other equipment to determine if they are working properly and efficiently. Recommendations are developed and discussed with plant

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Teams help students develop camaraderie

If trying to get one student's class schedule worked out seems like a challenge, imagine doing it for 100 students over four semesters. That's the task for **Doug Beck**, academic advisor and coordinator of the ME Learning Teams (MELTs). MELTs, which has 7 teams with a maximum of 16 students each, is one of 50 learning communities at Iowa State.

The participating students are assigned to teams at freshman orientation. Beck reserves spaces for the teams, which each take specific sequences of courses (math, physics, and chemistry) as well as statics and mechanics. "Peer mentors, who are ME upperclassmen, are assigned to each team," says Beck. "They lead a weekly seminar guiding students through the engineering orientation materials, going over homework assignments, and helping them prepare for exams."

The peer mentors give input on the students' coursework plans. "I share what I have learned as a student," says **Ann Shelton**, an ME senior from Clarinda. Students will ask for recommendations regarding their schedules. They often want to know what classes work well to take during the same semester or which technical or social science and humanities electives might best help them achieve their career goals.

While the MELTs are not a residence-based community, the peer mentors also organize social gatherings as well as special activities to give students a firsthand look at ME as a profession. "They are eager to help the students learn about the field," Beck adds. Using contacts they've made doing internships or co-ops, the peer mentors arrange tours of companies and labs and bring speakers to class.

The ME learning teams pool their problem-solving skills and engineering knowledge to see who can launch an egg the furthest and have it land safely on the ground.

During spring semester, the focus is on developing teamwork skills. The teams are given a problem-solving exercise that requires them to pool their knowledge and creativity to come up with a solution. Last year, for example, the assignment was to see how far they could launch an egg and have it land on the ground without breaking.

As a former learning team student herself, Shelton says the camaraderie that develops among the team members is the biggest benefit. "We have a great atmosphere for working together," she says. In addition, the friendships made that first year often last throughout college.

The learning teams do help students make a successful transition to college. "In comparing grades," Beck says, "we found students in the learning teams have a slightly higher GPA than those in a control group. But it's the qualitative components—the teamwork and communication skills, the community building, and what they learn about campus life and the field of mechanical engineering—that are the positive outcomes we hope to achieve."

Next fall, Beck anticipates having eight learning teams and also would like to establish a team for transfer students.

Team CyMix "blends" in space

"THE thrill of a lifetime!" That's how **Clayton Neumann**, an ME junior and member of ISU's CyMix team, sums up his flight aboard NASA's Boeing KC-135A aircraft this past July. Nicknamed the "Weightless Wonder," the plane flies in a parabolic pattern, climbing steeply to the top of a trajectory and then going into a free-fall, creating weightlessness on board. During these times of zero gravity—there are 32 parabolas on each flight—experiments are performed to determine how a machine, like CyMix, would work in space.

Neumann and fellow CyMix team members—**Kevin Schroeder**, a senior in ME; **David Chipman**, 2004 graduate in biology; **Russ Uthe**, senior in computer engineering; and **Jonathan Gettler**, senior in electrical engineering—designed and built a blender that can process food, such as soybeans, in space. To overcome the challenge of zero gravity, their prototype operates like a rolling pin, crushing the food rather than cutting it.

CyMix was one of 70 undergraduate teams from across the nation selected to participate in NASA's Reduced Gravity Flight Opportunities Program.

While the flight was the climax of the nine-day visit to the Johnson Space Center in Houston, Texas, Neumann says the

Team PrISUm creates Fusion

Justin Steinlage has his mind made up—it's not enough to just finish the 2005 North American Solar Challenge, he wants to win! And as project director for Iowa State's solar car entry, the ME senior says this Team PrISUm has the right combination of people and parts to make it happen.

Immediately following the 2003 solar challenge where ISU finished 18th, the team started work on their design for 2005. The new car, named Fusion, has a much different look and feel. "We've learned a lot from past experiences and have made major changes," says Steinlage. "We reshaped the body to improve the aerodynamics and made everything on the car lighter weight, which will help the suspension work better. And, we flattened it out on top because we discovered the solar cells break when bent to a heavily curved surface."

After doing research and a cost analysis, the team selected a less expensive, but higher quality, solar cell. "This is going to be the cheapest but best car that we've built," says Steinlage. "It isn't just the money that helps a car succeed. It's the people working on it, and we have a really good team." The team comprises 40–50 students from majors all across campus and two faculty advisors—Professors **Ron Nelson**, ME, and **James Hill**, ChE.

Construction will be completed in December with the solar array added in March or April. In May, each team must pass qualifying rounds that include everything from safety to maneuverability. The solar challenge begins July 17 in Austin, Texas, and ends in Calgary, Canada, July 27.

Building a solar car and participating in the solar challenge costs around $400,000, says Steinlage. Of that, around $120,000 is in cash with the rest donated materials. The team recruits industrial as well as individual sponsors and still needs to raise about $50,000 according to Steinlage.

Justin Steinlage, director of Iowa State's Team PrISUm, shows the frame for Iowa State's entry in the 2005 North American Solar Challenge. Named Fusion, the new car is designed to be more aerodynamic and lighter weight than past entries.

While the solar challenge garners lots of media attention for 10 days every two years, Team PrISUm performs countless outreach activities throughout the year. They take the car and visit high schools and businesses across Iowa, and they host many groups on campus giving prospective students a firsthand look at what a dedicated team of college students can accomplish. Steinlage speaks from experience when he tells visitors, "Find something you like to work on—it makes college all the better. "

To learn more about Team PrISUm, visit www.prisum.org.

whole experience was extraordinary. In addition to their preflight training and working on their project, the students toured the space center and met with astronauts. Also, because the CyMix experiment was selected as a potential segment on the cable TV show ***Destination Tomorrow***, the team got a special behind-the-scenes tour of the kitchens used to prepare the astronauts' food.

The experiment itself went well with some adjustments made between flights, reports Neumann. "We underestimated the effect of gravity on the wheel, so we had to vary the force for the second flight. It's amazing how little force it takes to do everything. Even standing up, you shoot to the ceiling," he explains. While lots of work must still be done on the design, Neumann is hopeful that someday the technology will be used by astronauts in space.

Clayton Neumann with the CyMix blender

Minority students find support system at Iowa State

Cristina Saint-Blancard's parents weren't surprised when she said she was going to study mechanical engineering. After all, she came from a family of engineers. But then she told them she wanted to attend Iowa State University. That was a shock. They lived in Puerto Rico, and Iowa represented a new culture and climate some 2,300 miles away!

Saint-Blancard's initial interest in Iowa State was based on mailings she had received and people she had spoken to. When she came to campus as part of Preview Day in February 2002, her decision was confirmed. The visit provided the opportunity to talk with faculty, interact with current minority students, and meet other prospective students who would become her classmates. She found a welcoming environment.

Preview Day is the cornerstone program for recruitment of minority students to the College of Engineering, according to **Monica Bruning**, director of outreach and recruitment. "We bring in students who have been accepted to Iowa State and offered scholarships. They are high-achieving students with an average ACT score of 33 on a scale of 36. Most have never been to Iowa before and typically come from areas with much higher minority populations." During the visit, the students are immersed in the campus culture. They tour the campus and college, meet with an advisor, and learn about the resources and opportunities available to students.

The college and university are focused on attracting a student body that comes from a variety of cultural, geographic, and economic backgrounds. Diversity is seen as a way to help broaden students' views of the world and prepare them to live and work in a global society.

Currently, about 8 percent of ME students are ethnic minorities. The percentage has risen slightly the last few years; however, a recent ACT study, Maintaining a Strong Engineering Workforce, reports a dwindling applicant pool of high-school students who select engineering as a career path and who have the necessary academic preparation. With engineering schools competing for students, intense recruitment and outreach efforts are needed in order to increase or even maintain current enrollment numbers. "Students have options," says Bruning.

From left: Jonas Estrada, Cristina Saint-Blancard, and Blaise Cordier

"They don't need to adapt and prove themselves in a place where they don't feel comfortable."

Preview Day sets the stage for helping minority students feel comfortable and succeed in engineering at Iowa State. The program is successful with about 80 percent of the participants enrolling. The visit convinced **Blaise Cordier** that Ames was the place for him. The ME junior from New Orleans was so impressed with the people he met that even the cold weather was a non-issue. "The people we talked to gave the message that they really wanted us to come here and succeed," he explains. "They said there would be a support system to help us make the transition. It wasn't just a show to get us here."

The support system begins with the connections students make on that first campus visit. "College is a different culture for everyone, but being far away from home in a completely new environment means there are added challenges," says Saint-Blancard. "For the most part, the warmth of the people here and having a strong network of friends to share things with have made it a very positive experience."

Now Saint-Blancard helps other minority students feel at home too. She is a peer mentor, is active in the Society of Hispanic Professional Engineers, and also works as an academic resource coordinator in her residence hall where she organizes programs that promote academic achievement and excellence. While these roles are time consuming, Saint-Blancard sees the benefits. "I'm helping other students, but I learn from them too. It's a window of opportunity. Education is much more than books."

Cordier reaches out to other minority students too. A member of the National

Society of Black Engineers, he co-chairs the pre-college initiative. "It's a mentoring program to match minority students in high school with engineering students at Iowa State," he explains. "We want these students to hear about the opportunities in engineering and what they need to do to prepare for college." One thing he tells students: "There's no substitute for hard work. If you put in the effort, there are enough resources to help when you need it, and you'll succeed."

At Iowa State, minority students also get assistance and form friendships through involvement in departmental clubs such as the American Society of Mechanical Engineers (ASME) and special organizations like LEAD (Leadership through Engineering Academic Diversity). The LEAD program offers the opportunity to participate in learning communities, one-credit courses, and workshops designed to help students succeed in the engineering curricula and build leadership and teamwork skills.

Like many other students, **Jonas Estrada**, a senior from a Chicago suburb, was surprised at the difficulty of his first-year classes. "In high school, I didn't have to work very hard to do fairly well. I got here, and it was a new experience to have to do all my homework to learn how to do the problems. With 300 students in the class, the instructor doesn't keep tabs on you; you have to learn to be responsible for yourself," he says. "But I didn't have to do it alone. The friends I made my freshman year were in ME or AerE. We had the same struggles, so we worked through things together and supported each other."

Tyrone Moore

Talking with your professors when classes are large can be difficult, but it's worthwhile, according to **Tyrone Moore**, a senior from Davenport. "Professors have different styles of teaching. I sat down and talked with them so I could learn how they present material and how they write their exams," he says. "I'm a serious student; I don't want to just pass an exam, I want to understand the material. Getting to know my professors helped me do that."

Moore's strong work ethic has led to many opportunities. He served as an undergraduate research assistant with ME Professor **Robert Brown**; he spent a semester at Southern University, in Baton Rouge, Louisiana, as part of a National Student Exchange Program; and he participated in ISU's Experience Yucatan, an international studies program that includes a week in Mexico.

Royal Elmore

Royal Elmore, a senior from Papillion, Nebraska, also recognizes the importance of building relationships. With a double major in ME and political science, he's dedicated to his studies but also has gained extensive leadership experience and encourages students to get involved in activities that interest them.

Elmore's experiences—he did undergraduate research with Associate Professor **Greg Luecke** in the Virtual Reality Applications Center; he's on the Tau Beta Pi cabinet, serves as president of the student council in the College of Liberal Arts and Sciences, and is secretary for the ASME student chapter—helped him land internships with Lockheed Martin in 2003 and with U.S. congressmen **Tom Latham** and **Lee Terry** in 2004. "It's the contacts you make," he says, "combined with the experiences that will help you achieve your goals."

ME students awarded NSF graduate fellowships

Cris Schwartz, a PhD candidate in ME at Iowa State, and **Randy Ewoldt**, who completed his BS degree last spring, are recipients of National Science Foundation Graduate Fellowships for 2004. These prestigious awards provide full stipends and tuition for three years of graduate school.

After earning his BS and MS at Iowa State in 1996 and 1998, respectively, Schwartz spent five years as a senior research engineer with Southwest Research Institute® in San Antonio, Texas. He began his PhD studies in fall 2003 working with University Professor **Shyam Bahadur**. For his research, Schwartz is investigating laboratory-grown cartilage specifically in terms of friction and wear properties to determine its suitability for use in biomedical implants such as hip joints or knee replacements.

Ewoldt is currently a graduate student at the Massachusetts Institute of Technology. He plans to earn his MS and PhD degrees and hopes to work in academia. At Iowa State, Ewoldt worked with **Michael Olsen**, ME assistant professor, as an undergraduate research assistant.

Another student with ME connections, **Melinda Cerney**, was awarded an NSF Graduate Fellowship in 2003. Cerney is a PhD candidate studying human computer interaction. **Judy Vance**, ME professor and chair, and **Dean Adams**, assistant professor of ecology, evolution, and organismal biology and of statistics, are her co-major professors. Cerney earned her MS in ME in 2003 and her BS in engineering science in 2001, both at Iowa State.

Meet Qingze Zou—ME's newest assistant professor

If you had asked **Qingze Zou** five years ago where he'd be in 2004, Iowa wouldn't have made the list. But today, ME's newest assistant professor is excited to call Iowa State University his home. The reason is simple: the Institute for Combinatorial Discovery (ICD).

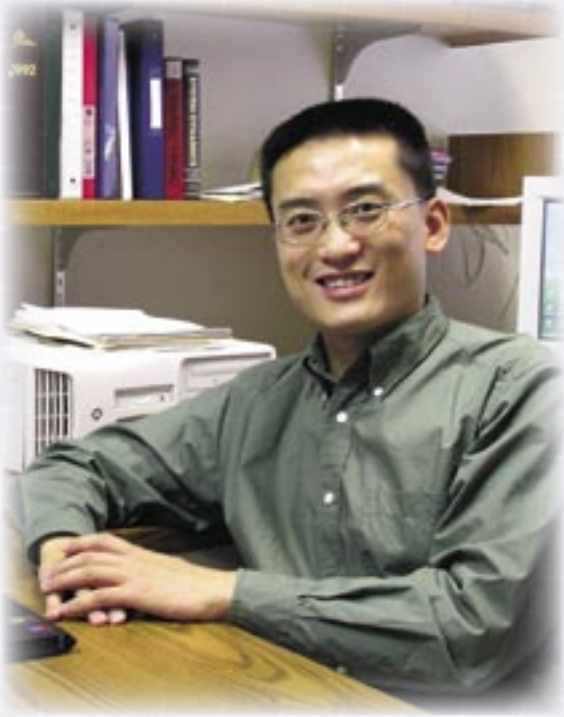
One of six university initiatives announced in 2002, the ICD has over 35 faculty members conducting research. They come from 5 colleges and 12 departments. The ICD focuses on the discovery and testing of new materials for advanced applications, such as drug delivery or gene therapy. Stated simply, the combinatorial method assembles molecules into thousands of combinations of compounds that are then screened to select the best options.

With its connection to the ICD, the ME department offered Zou a perfect match for his research and teaching interests. He has a BS in automatic control from the University of Electronic Science and Technology of China and an MS in mechanical engineering from Tsinghua University in Beijing. While earning his PhD at the University of Washington in Seattle, Zou gained expertise in developing novel control techniques for positioning the probe used on the scanning probe microscope (SPM), an instrument central to combinatorial work.

"I'm very excited about the research opportunities," says Zou. "It's the chance to work with faculty from many different areas, such as chemistry, chemical engineering, and Ames Lab, as well as other engineering departments."

For Zou, the research provides an opportunity to build on his PhD work. "Using the SPM, the probe scans samples at a micro- to nano-level high resolution. It tells you all kinds of things such as the topography and stiffness of the sample," Zou explains. "The challenge is to scan samples quickly. You must use control techniques when you adjust the input applied to the SPM, so that you won't excite the dynamics of the system and induce vibrations of the probe relative to the sample. If you do," he cautions, "it can cause many problems, such as image distortion, sample damage, and loss of measurement precision."

While setting up a research program consumes a lot of time, Zou is also very enthused about the class he's teaching, Mechanical Systems and Control (ME 421). "I teach the students," he says, "but I also learn a lot from them."



Bryden recognized for superior teaching

Mark Bryden discusses the project for the power plan design class, ME 446, with seniors Beth Schwendinger and Jeff Kloster.

Mark Bryden, ME associate professor, has received the College of Engineering's Superior Engineering Teacher Award for 2004. During his six years at Iowa State, Bryden has established a record as an outstanding teacher committed to making a positive difference in the lives of his students.

In teaching a variety of graduate and undergraduate courses, Bryden draws on 14 years of industrial work experience. He plans his classes so students will develop teamwork and communication skills while gaining the fundamental theory and design knowledge they will need as professional engineers. To help students understand the real-world applications for their studies, he consistently links course material to current events and issues.

Bryden has also played a key role in improving the ME curriculum. He developed ME 270, Introduction to Mechanical Engineering Design, to link the concepts taught in the freshman introductory design course to the senior design project. In addition, he redesigned ME 446, Power Plant Design, to focus on the design tools and emerging technologies and issues affecting power plants.

Bryden directs an active research program in virtual engineering of fluids and heat transfer systems within collaborative, immersive, synthetic environments. He mentors both undergraduate and graduate students, helping them develop their own research and engineering skills.

A member of the ME faculty since 1998, Bryden earned his MS and PhD at the University of Wisconsin-Madison. Prior to his graduate studies, Bryden worked in a wide range of engineering positions at Westinghouse Electric Corporation within the Naval Reactors Program.

Alum credits Iowa State and ME for his success

Fifty-five years ago, young **Leland Haack** left Vinton, Iowa, to study engineering at Iowa State College. It's a decision he relishes. "I owe everything I achieved in my career to Iowa State," he says. "The learning process, the atmosphere, the example set by people who cared and helped me—I am thankful for all of that."

It was the faculty that laid the groundwork for success. "Our professors primed us with the background material and then applied it to how we'd use it on the job," Haack explains. "We got the sense they wanted us to do well."

Earning his BS in 1953, Haack spent two years in the military, then returned to Ames and completed his MS in 1957. He began his professional career at Oak Ridge National Laboratory in Tennessee, where he participated in the design of the high flux isotope reactor (HFIR) and later worked for the Tennessee Valley Authority.

At Oak Ridge, Haack was on the design team for the control rods and fuel element. When the HFIR went on line, he was assigned to do calculations to predict the power level at which surface boiling would occur on an experimental rig positioned inside the nuclear reactor core. "Our calculations came fairly close—5–10 %. It gave us an idea of what to expect. I learned the techniques we used at Iowa State," Haack proudly notes. "You analyze the problem and work through it!" The correlation used in the calculations has another Iowa State tie—it was developed by **Arthur Bergles** and **Warren Rosenhow**. Bergles served as ME department head from 1972 to 1983.

So it's with a keen sense of gratitude that Haack and his wife, Loretta, contribute annual support and have included the ME department in their estate plans. "I benefited from financial aid and from Iowa taxpayers because they support the university," Haack explains. "We live in Tennessee, but I have strong feelings for Iowa and am deeply appreciative of the opportunities I had."

In 1997, the Haacks established an endowed scholarship fund that is used to support students with financial need and high scholastic ability. "You have to keep learning all of your life, but I believe the college-age years are the best time for background learning," Haack says. "We want to help students who, because they're having to work, might not be achieving their full academic potential, whatever that level might be."

For more information on the many ways you can support the Department of Mechanical Engineering, please contact Rod Simpson at 515 294-1431 or Sallie-Grace Tate, director of development, at 515 294-0934.

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Battaglia appointed director of CBER

Francine Battaglia, ME assistant professor, has been appointed director of the College of Engineering Center for Building Energy Research (CBER). She succeeds **Mike Pate**, ME professor, who now serves as associate director. A member of the faculty since 1999, Battaglia's research interests include using computational fluid dynamics and developing computational models to explore issues related to the thermal sciences.

Established in 1991, CBER is an interdisciplinary research center that focuses on efficient and renewable energy technology issues related to buildings. An outgrowth of a long-standing emphasis in the ME department in the areas of heating, ventilating, and air conditioning (HVAC), as well as energy conservation, CBER supports activities for developing new technologies and improving existing technologies to reduce energy consumption while maintaining performance and productivity.

For more information about CBER, go to www.me.iastate.edu/cber/.

Audit teams continued from page 1

personnel. The entire process gives students the opportunity to enhance their leadership, teamwork, problem-solving, and presentation skills, to name just a few.

The faculty members who serve on the teams—Maxwell, along with Ron Nelson, ME professor, and Frank Peters, associate professor in industrial and manufacturing systems engineering—benefit as well. "I learn something every time," Maxwell says, "and I incorporate the information into my classes."

For manufacturers, the assessment means five or six fresh pairs of eyes looking at their operations. "Plant personnel work in the environment every day. They often don't have the time or resources to address energy-related issues," Maxwell says.

The feedback from IAC clients has been very positive. On average, they implement a little over half of the recommendations. "In some cases," Maxwell notes, "we've proposed an idea that got the client thinking about it in a broader way. This reevaluation results in changes that lead to overall process improvement."

For more information about IAC, please visit www.me.iastate.edu/iac/.

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