Leaders discuss Iowa’s role in bioeconomy

More than 400 leaders from Iowa industry, government and higher education gathered on the Iowa State University campus November 28 for a day-long discussion of Iowa’s leadership role in the bioeconomy. The following are links to video of some of the conference sessions.

- Welcome, Michael Gartner, President, Board of Regents
- Growing the Economy in Iowa: Fueling the Future, Gregory Geoffroy, President, ISU
- The Future of Biorefining in Iowa, Robert C. Brown, ISU Office of Biorenewables
- Implications of Bioenergy on Agricultural Production, Craig Lang, President, Iowa Farm Bureau Federation
- Economic and Social Impact of a Growing Bioenergy Industry on the State and its Policy Implications, Bruce Babcock, Center for Agricultural and Rural Development, ISU
- Innovating for the Future, Ted Crosbie, chief technology officer for the state of Iowa
- Presentations by summit work groups
The Final Report and Recommendations: www.iastate.edu/~biorenew/06/summit/report.doc

Iowa State hosts bioeconomy conference

Nearly 600 bioindustry leaders from all over the United States converged at Iowa State University on August 28-29 to hear 70 speakers discuss the manufacture, distribution and marketing of biobased products (www.bioeconomyconference.org).

Keynote presenters Vinod Khosla, prominent venture capitalist and founding CEO of Sun Microsystems; Lee Lynd, professor of engineering at Dartmouth College; and plenary speaker Thomas Dorr, Undersecretary, USDA Rural Development, highlighted the importance of developing biofuels to break the United States’ dependence on foreign oil.

Dorr told participants that there was a lot of profit to be made by Midwestern farmers in the biorenewables market. Khosla urged the crowd to be boldly optimistic about the capacity of biofuels to eventually eclipse the fossil fuel market.

Participants selected from 14 breakout sessions covering biobased business development, cutting edge research, and emerging industry trends. Many toured Lincolnway Energy, LLC; a cattle farm using distillers dried grains; and Iowa State demonstration plots of energy crops such as kenaf, miscanthus, and tritacale.

Congressmen Leonard Boswell and Jim Nussle, Governor Tom Vilsack, and Mark Reisinger, State Director, USDA Rural Development, attended the conference.

The Center for Crops Utilization Research co-sponsored the event and provided staff for conference planning and execution.

Jay-lin Jane, Lee Lynd and Larry Johnson in their breakout session, Innovations and New Directions in Carbohydrate Production and Processing.

Tom Brumm, professor, Agricultural and Biosystems Engineering, gives a biodiesel demonstration during a breakout session.
Corn/soy plastics to be made into hog feeders

Mike Kratfi, Iowa State University News Service

Richard Larock sorted through a pile of neatly labeled baggies filled with the plastics he makes from corn, soybean and other biobased oils.

Larock, a University Professor of chemistry at Iowa State University, found the thin, square piece he was looking for and smacked it against his hand. This one is made from soybean oil reinforced with glass fibers, he said. And it is the kind of tough bioplastic he and his industrial collaborators will use to develop, test and manufacture new hog feeders.

Larock said his research project is about as Iowa as you can get. The state, after all, is the country’s leading producer of corn, soybeans and pork.

The project is partially supported by a grant of $96,000 from the Grow Iowa Values Fund, a state economic development program. Larock is working with AgVantage Inc., a Rockford, Illinois, company with manufacturing facilities in Iowa, and R3 Composites, a Muscatine manufacturer.

Larock has invented and patented a process for producing various bioplastics from inexpensive natural oils, which make up 40 percent to 80 percent of the plastics. Larock said the plastics have excellent thermal and mechanical properties and are very good at damping noises and vibrations. They are also very good at returning to their original shapes when they are heated.

And so Larock is optimistic about the future of bioplastics in commercial applications: “This project should create new technology and jobs, expand opportunities for biobased industries and agricultural suppliers, decrease our dependence on oil, strengthen the agricultural economy of Iowa, utilize ISU patented technology, provide new markets for farmers and marry new agricultural product development with sophisticated manufacturing skills and the knowledge to commercialize these projects,” he wrote in a summary of the hog feeder project.

Ron Hagemann, a principal with AgVantage, said designs for a bioplastic hog feeder have been drawn up. The designs include radio frequency identification technology that can monitor and record the feeding habits of individual hogs. Molds for the high-tech feeders should be completed later this year and prototypes should be ready for testing in a hog building next spring. If all goes well, he said a product should be ready for commercialization by the end of next year.

Hagemann said the feeders’ biggest advantage in the marketplace will be material costs. Corn and soybean oils are significantly cheaper than petrochemicals. And that’s particularly true when oil prices are high.

Hagemann said he expects this project to be a very good test of Larock’s plastics. Hogs, after all, aren’t known for being gentle with their feeders.

“I’ve told Richard that if we can do this, it’s all downhill from here,” Hagemann said.

But Larock is not stopping with the feeder project. He is looking at adding other low-cost agricultural ingredients to his bioplastics. He is now studying whether distillers dried grains, a co-product of ethanol production that is sold as animal feed, can add strength to his bioplastics.
David Grewell picked up the little plastic model of a molecule he keeps in his office.

He scrunched the model’s folding pieces into a ball. That’s about the shape of a soy or corn protein, said Grewell, an Iowa State University assistant professor of agricultural and biosystems engineering. Then he unfolded the model into a long, straight loop. That’s what happens when researchers add some glycerin – a byproduct of biodiesel production – and some water to the molecule. And that is how biorenewable, biodegradable plastics can be made from the proteins in Iowa crops.

But those aren’t the strongest plastics. So Grewell is working with a team of Iowa State researchers to reinforce the plastics with nanoclays, pieces of clay that are just 10 to 20 billionths of a meter thick.

It’s not easy to work with those tiny pieces of clay. They tend to stick together in clumps because of electrostatic forces, said Michael Kessler, an Iowa State assistant professor of materials science and engineering who is also working on the project. Those clay platelets need to be separated and mixed evenly throughout the plastic to be much good as a reinforcing agent.

The researchers are turning to high-powered ultrasonics – high-frequency sound waves too high for human hearing – to separate and disperse the platelets. It’s a technology Grewell knows a lot about: he worked 12 years in research and development for the Branson Ultrasonics Corp. of Danbury, Conn. He has used ultrasonics to freeze strawberries, process rice and handle many other applications.

The researchers are also using microcellular foaming technologies from Trexel Inc. of Woburn, Massachusetts, to mold and extrude the plastics. The processing technology is expected to enhance the biodegradable plastics while allowing the researchers to use less base material to make the plastics.

Grewell said the potential applications for plastics from crop proteins include disposable wraps for hay bales, pots for plants and packaging for the food industry.

Grewell, Kessler, Howard Van Auken, a professor of management, and Gowrishankar Srinivasan, a graduate student in industrial and agricultural technology, are working on the plastics project with two Iowa companies, the Vermeer Manufacturing Co. of Pella and Vibroacoustics Solutions Inc. of Ames. The project is partially supported by a $68,758 grant from the Grow Iowa Values Fund, a state economic development program.

Jay Van Roekel, the segment manager for Vermeer’s ag product group, said the company will test hay wraps made from the plastics developed by the Iowa State researchers. Van Roekel said the company is very interested in helping the research project.

“It’s exciting to be involved in the development of biorenewable technologies and the harvesting of biomass,” he said. “We see biorenewables taking hold and expanding every day.”

Sam Senti, an application specialist for Vibroacoustics Solutions Inc., said the company would like to use biorenewable and biodegradable
Expansion of ethanol production in Iowa raises many questions about corn exports and imports and the use of co-products for livestock feed. The Perspectives on Present and Future Corn-Based Ethanol Industry webcast was presented by Iowa State University Extension on Monday, November 13. Seven Iowa State economists presented economic information on several aspects of the industry.

“The infrastructure changes necessary to support a major shift from crops for feed and food to crops for fuel could have an impact on rural jobs second only in magnitude to the changes in farming seen over the last half century,” said Arne Hallam, chair, Iowa State Department of Economics.

“Experts with a variety of perspectives addressed the current state of the corn ethanol complex and its near-term prospects and challenges,” said Hallam. “No matter how you consider the issues, Iowa agriculture is in for a wild ride over the next five years.”

The following presentations and papers are available at www.extension.iastate.edu/ag/ethanol.htm.

**Economics of ethanol industry program webcast**

- **Demand Drivers for Ethanol and Outlook for Prices** by John Miranowski, professor, Economics.
- **Situation and Outlook for the Ethanol Industry** by Paul Gallagher, associate professor, Economics.
- **A Firm Level Perspective on Ethanol Expansion** by Robert Jolly, professor, Economics and Extension economist.
- **The Long-Run Impact of Corn-Based Ethanol on the Grain, Oilseed, and Livestock Sectors: A Preliminary Assessment** by Amani El Obeid, associate scientist, Center for Agricultural and Rural Development.
- **Potential Infrastructure Constraints on Ethanol Production in Iowa** by Roger Ginder, professor, Economics and Extension economist.

**CCUR Visitors**

Edenspace Systems Corporation, Dulles, Virginia, toured CCUR on August 29. Edenspace is a commercial leader in the use of plants for environmental protection and renewable fuels.

Broin Companies visited CCUR on September 14-15.

Producer group Innovative Growers, LLC met at CCUR on September 19.

Researchers from Fidelity Investments in Boston toured CCUR on September 20.

A Chinese Ministry of Agriculture delegation interested in soybean processing research and quality testing visited CCUR on September 20.

Kenyatta University researchers and administrators visited CCUR on September 27.

A media team from Korean Broadcasting Entertainment for Satellite and Terrestrial, Inc. (K-BEST) filmed Nicolas Deak, Larry Johnson, Deland Myers and Lester Wilson, FSHN; Richard Larock, Chemistry; and David Grewell and Maria Vlad, Agricultural and Biosystems Engineering. The September 27 interviews were about innovative food products and biorenewables.

Scientists from the Department of Agricultural and Biological Engineering at the University of Illinois, Urbana-Champaign visited CCUR on October 16.

The Charoen Pokphand Group (CP) visited CCUR on October 23. CP is a global conglomerate focused on the production and processing of agricultural products.

BP p.l.c. visited CCUR on November 7.


Dr. Kalidas Shetty, professor of food science and human nutrition at the University of Massachusetts, Amherst visited CCUR on November 16.

The Vice Mayor of the People’s Government and Deputy Director, Private Enterprises Economic Development Committee, both of Jining City, Shandong Province, China toured CCUR on November 27.

Cargill, Inc. visited CCUR on November 29.

ConocoPhillips Company visited CCUR on December 12 and held a “Town Hall” meeting on the following day.

Pioneer Hi-Bred International, Inc., a DuPont subsidiary, visited CCUR on December 18.

ICM, Inc. visited CCUR on December 19.

The Soyfoods Council visited on December 21.
The current marginal energy balance in the dry-grind corn to ethanol process is in no small part due to the separation of dissolved organic substances in the thin stillage by evaporating the water to recover the solubles. The water is recovered by condensation, along with unwanted volatiles.

Ethanol production in dry corn mills is the main objective, but recovery of other co-product is often the key to profitability. The solubles add nutrients and taste to a main co-product of dry-grind corn milling – distillers dried grains with solubles (DDGS) for animal feed. The high cost of drying and water recovery makes feed production marginal compared to value and its use is limited by the dietary composition to cattle feed primarily.

Current work at Iowa State has demonstrated that Rhizopus fungi are able to remove as much as 90% of the dissolved organics and almost 100% of all remaining suspended solids from thin stillage – a major co-product remaining after fermentation of corn and distillation to remove the ethanol. The main product resulting is fungal biomass, which is easy to harvest by simple screening, filtration or settling. This fungal biomass has superior qualities as an animal feed for both ruminant and monogastric livestock due to a favorable amino acid balance. This will create a larger and more localized market for DDG with fungal biomass, DDGF.

Furthermore, fungal biomass is known to be an excellent source of chitin and chitosan (circa 8% of dry Rhizopus mass) with a current value of $8,000 to $10,000 per ton and a huge demand in the nutraceutical industry to help in lowering cholesterol in humans.

The preliminary work also indicates that the fungal process releases the corn oil emulsified in the stillage. Oil recovered from this process can be used in biodiesel production or poultry feed. Production needs to be quantified and enhanced, and separation technology developed.

Further work envisaged is evaluate (1) the use of whole stillage in fungal fermentation (2007); (2) the use of immobilized sanitizers or ozonation for low energy water recycling (2008); (3) cultivating brown/white molds in thin stillage, to produce hemicellulases and cellulases (2009); and (4) microbially encapsulate corn yellow pigment (xanthophylls) in stillage for poultry feed (2010).

From left to right, thin stillage in 5-L vessel on the day of inoculation with spores of R. oligosporus (day 0) until day 8, and the fungal biomass and effluent collected from the reactor.
An old discovery could boost ethanol production from plant fiber

Mike Krapt, Iowa State University News Service

John Verkade remembers just how it happened some 40 years ago: One of his Iowa State University graduate students, David Hendricker, stopped by to report somebody was stealing a little wooden applicator stick from a beaker.

Oh, Verkade said, that's just a prank. Go hide around the corner and do some peeking until the joker shows up again. Thirty minutes later Hendricker was back in Verkade's office.

“You've got to see this,” Verkade remembers him saying.

What they saw was a wooden stick falling apart and sinking into the chemical compound that had been the basis for Verkade's doctoral dissertation.

“That's an interesting observation,” Verkade said at the time.

It was so interesting he asked Iowa State to consider a patent application. But that was a long time before breaking down plant fibers to produce ethanol was linked to energy independence and national security. So the university didn't move on a patent back then. And Verkade, now a University Professor in chemistry, moved on with his work in catalysis and molecular design.

A few years ago, George Kraus, another University Professor of chemistry at Iowa State, brought up Verkade's story of the dissolving wood. He said that compound could be a way to break down the tough cellulose that forms the structure of a plant's cell walls. Breaking down the cellulose can release the simple sugars that are fermented into ethanol. Making that happen could add some value to Iowa crops or the fibrous co-products of ethanol production.

Verkade followed up with a proposal for U.S. Department of Energy funding from the Midwest Consortium for Biobased Products and Bioenergy led by Purdue University in West Lafayette, Indiana. He won a two-year, $125,000 grant and enlisted the research help of Reed Oshel, an Iowa State graduate student in biorenewable resources and technology.

They started using the chemical compound on distillers dried grains, a co-product of ethanol production.

Old discovery

See page 9

Jane honored with award of merit

Jay-lin Jane, professor of food science and human nutrition, was recently honored by the Japanese Society of Applied Glycoscience with its 2006 Merit of Science Award.

The society selects one carbohydrate scientist annually from the world for the award. The award was presented in Osaka, Japan during the Annual Meeting of the Society on September 27-29, 2006.
Iowa State researchers explore turning fuel ethanol into beverage alcohol

Mike Krapfl, Iowa State University News Service

Fuel ethanol could be cheaply and quickly converted into the purer, cleaner alcohol that goes into alcoholic drinks, cough medicines, mouth washes and other products requiring food-grade alcohol, say Iowa State University researchers.

But there’s still a lot of purifying and studying to be done before fuel made from corn is turned into your next vodka or mixed into your morning mouth wash. Jacek Koziel, an Iowa State assistant professor of agricultural and biosystems engineering, is leading a research project that’s attempting to develop and refine two technologies that work together to efficiently purify and remove bad-tasting components from fuel ethanol. The project is partially supported by a $79,900 grant from the state’s Grow Iowa Values Fund.

Koziel is collaborating on the project with Hans van Leeuwen, the vice president of MellO3z, a Cedar Rapids company that has developed technology for purifying alcoholic beverages. Van Leeuwen is also an Iowa State professor of civil, construction and environmental engineering.

Iowa certainly has an abundance of fuel ethanol for the researchers to work with. Iowa is the country’s leading producer of fuel ethanol. The Iowa Corn Promotion Board says the state has 25 plants capable of producing 1.5 billion gallons per year with more plants on the way.

Van Leeuwen said the fuel produced by those plants and the alcohol produced for the beverage industry are very similar. But alcohol produced for fuel is not made with the same care and purity as alcohol for consumption, he said. The multiple distillations required to make food-grade alcohol raise production costs to about 50 cents per gallon more than it costs to produce fuel ethanol.

Van Leeuwen said the researchers are working to develop technologies that can purify fuel into beverage alcohol for less than an additional penny per gallon.

College of Agriculture holds biorenewables briefing

More than 100 faculty and staff participated in the November 7 College of Agriculture Briefing and Discussion on Biorenewable Resources in the South Ballroom, Memorial Union. The meeting was a follow-up to President Geoffroy’s October 23 university-wide town meeting on biorenewables.

The purpose of the College of Agriculture’s November 7 meeting was to facilitate discussion, encourage participation and gauge interest by a wide cross-section of the college, prepare for organized responses to the growing number of opportunities emerging for biorenewables research, extension and education, and to make ISU as competitive as possible for these opportunities.

The November 7 discussion was hosted by Steve Fales, associate director of the Office of Biorenewable Programs and professor of agronomy. Presenters included Wendy Wintersteen, Dean, College of Agriculture; Robert Brown, Office of Biorenewables Programs; Chitra Rajan, Office of the Vice President for Research; Pat Schnable, Associate Director, Plant Sciences Institute; Matt Liebman, Department of Agronomy; Larry Johnson, Center from Crops Utilization Research; and Raj Raman, Department of Agricultural and Biosystems Engineering

Videos and presentations from the meeting are available at www.ag.iastate.edu/news/brtownmtg.html.
plastics in a stick lubricant it has developed. The bio-based lubricant rubs off on metals - it, for example, can be used to help locomotive wheels roll more easily around curves in a track. Senti said biodegradable plastics that add rigidity to the company’s product would be very useful in outdoor applications. And so the company wants to help the researchers with some field tests.

Li and Jiang receive CRA/AACC poster award

Li Li and Hongxin Jiang of Iowa State University won a 2006 Corn Refiners Association/American Association of Cereal Chemists’ (AACC) Outstanding Poster Award. The award provides recognition to outstanding researchers for their efforts to advance scientific principles in the corn wet milling process.

The winners were selected during the AACC annual meeting in San Francisco, California, September 17-20, 2006. More than 382 papers and posters were presented at the meeting, with about 35 focusing specifically on the corn refining process or its end products.

Advanced Food for Health Symposium series

The College of Human Sciences and College of Agriculture at Iowa State University are pleased to announce a new upcoming symposium series, the Iowa State University Advanced Food for Health Symposium Series. The focus of the first symposium in this series is Resistant/Slowly Digestible Starch. It will focus on the principles of resistant starch, examine their nutritional benefits, discuss the agronomic approaches to generate these starches, and look at processing and developing products. The symposium will take place May 8-9, 2007 at the Gateway Center in Ames, Iowa.

Confirmed speakers include: Frank Barresi, Grain Processing Corp.; Kay Behall, USDA; Anne Birkett, National Starch and Chemical Co.; Allen Buck, ADM; Martine Champ, INRA, Nantes; Janine Higgins, University of Colorado at Denver; Dave Lineback, University of Maryland; Andy McPherson, Kraft Foods; Sakharam Patil, SK Patil and Associates; Paul Seib, Kansas State University; Yong-Cheng Shi, Kansas State University; Inge Tetens, Danish Institute for Food and Veterinary Research; Don Thompson, Penn State University; and Rhonda Witwer, National Starch and Chemical Co.

CCUR is co-sponsoring the event which is being led by the Iowa State Wellness Center. More information is available at www.nwrc.iastate.edu/forms/AFH%20Tentative%20Sched.pdf.
CCUR affiliate activities

Faculty members Jacek Koziel and Hans van Leeuwen discussed their efforts to turn fuel ethanol into food-grade alcohol for use in beverages, pharmaceuticals and personal care products during a live national broadcast of “FOX and Friends” on August 30.

Walt Fehr’s development of low linolenic acid soybean varieties was highlighted in the October 2, 2006, Wall Street Journal article *Amid Trans-Fat Fears, Time Appears Right For Dr. Fehr’s Beans*.

Raj Raman and Larry Johnson attended the Renewable Resources and Biorefineries Conference at the University of York in York, United Kingdom.

Tony Pometto and Larry Johnson attended the national renewable energy conference *Advancing Renewable Energy: An American Rural Renaissance* on October 10-12 in St. Louis, Missouri. President Bush addressed the conference sponsored by the United States Departments of Agriculture and Energy.

This fall, Mark Reuber provided Kerry Foods with technical assistance for new fume hoods to be installed at their Vinton facility.

Old discovery
From page 6

production. The initial results weren’t encouraging. Verkade was ready to stop pursuing additional funding for the project.

But, earlier this fall, the researchers treated the distillers dried grains with equal measures of the chemical compound and water. That mixture broke down 85 to 95 percent of the cellulose so it could be dissolved in water.

“That opened a whole new door for us,” Verkade said. “We knew we were tearing some things up in the cellulose.”

They’ve since tried experiments on model compounds of cellulose. Those experiments have been promising. And now they’re working to see if a simpler, cheaper version of the compound can also break down cellulose.

“We have preliminary evidence that it works, too,” Verkade said.

Verkade isn’t identifying the compound until he can explore the potential for patents. But he’s working on a grant proposal that would keep the research going. There are still questions to answer about the compound’s performance and characteristics as a pre-treatment for converting cellulose to ethanol. Verkade also wants to see how the compound works on corn stalks, switchgrass and other crops grown for their fiber. And tests need to be done to determine the compound’s compatibility with fermentation enzymes.

“This is an exciting time,” said the 72-year-old chemist. “I’m now cautiously optimistic about this.”

Ethanol
From page 7

“That’s the whole point,” van Leeuwen said. “And based on my experience treating water and wastewater with these technologies, this could cost a lot less than a cent per gallon.”

The potential to cut costs has one large producer of ethanol and food-grade alcohol interested in the research project, van Leeuwen said.

Koziel said the researchers are using two purification technologies: they’re bubbling ozone gas through the fuel to remove impurities and they are filtering the fuel through granular activated carbon to absorb impurities. A patent for the process is pending.

Underpinning the research is sophisticated chemical and sensory analysis of the raw fuel and the purified alcohol. Koziel will use a technology called solid phase microextraction to collect samples of the compounds in the alcohols. He will also use a technology called gas chromatography-mass spectrometry to identify and quantify all the compounds in the samples. And he will use his lab’s olfactometry equipment to separate and analyze the smells created by the various compounds.

“If this is viable,” Koziel said, “we are looking at adding a lot of value to relatively cheap fuel-grade ethanol.”

Grants & Contracts
