



Iowa State to manage waste conversion projects as part of new Manufacturing USA Institute

A pyrolysis and anaerobic digestion project were part of the proposal that won DOE approval.

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Conversion Technologies

Iowa State's Robert C. Brown, left, explains new pyrolysis technology to Karen Fletcher, leader of the RAPID Institute for manufacturing; and Mark Gaalswyk, leader of Easy Energy Systems in Emmetsburg; during a recent tour of the BioCentury Research Farm. Larger photo. (Photo by Christopher Gannon.)

Iowa State University, based in Ames, Iowa, will bring its expertise in biorenewable technologies and pilot plant operations to the country's 10th Manufacturing USA Institute.

The recently announced advanced manufacturing institute is dedicated to improving the productivity and efficiency of chemical manufacturing. Those improvements could include combining processes such as mixing, reacting and separating into single steps.

Such process intensification could boost manufacturing productivity while cutting costs and reducing waste. That could save the chemical industry more than \$9 billion

annually, according to the U.S. Department of Energy's announcement of the institute.

The new institute will be known as RAPID, the Rapid Advancement in Process Intensification Deployment Institute. The American Institute of Chemical Engineers in New York City will lead the effort, which was developed in collaboration with the U.S. Department of Energy's Savannah River National Laboratory in South Carolina and the Georgia Institute of Technology in Atlanta. Additional information about the RAPID Institute and its objectives can be found at www.processintensification.org.

On Dec. 9, the U.S. Department of Energy announced it would support the institute with \$70 million over five years, subject to federal appropriations. Another \$70 million is expected from RAPID's partners, including companies, universities, laboratories and other organizations.

"This institute is intended to take technologies – ideas that are well beyond basic research – and translate them into workable processes that can be demonstrated in the field," says Robert C. Brown, the director of Iowa State's Bioeconomy Institute, an Anson Marston Distinguished Professor in Engineering and the leader of RAPID's Distributed Biorefinery program.

Iowa State researchers are managing the project's biorefinery efforts because they are "an extremely talented and well-known team that's highly regarded in the industry," says Karen Fletcher, RAPID's chief executive officer, speaking during a recent tour of Iowa State's BioCentury Research Farm.

In addition, she said the Iowa State team has already pulled in multiple partners willing to help commercialize distributed biorefineries.

"We can make big leaps with shared funding instead of small steps with individual projects," Fletcher says. "We're very focused on the commercial value of this work, and Iowa State gets that."

The proposal that won the Department of Energy's approval includes \$8 million to support development and testing of biorefineries that feature modular design and construction for ease of manufacturing and mass production. Two possible projects highlighted in the application include:

- Pyrolysis-based Modular Energy Production Systems for conversion of wastes and biomass into fuels, chemicals and other products, with \$3.2 million from the energy department and additional support from Easy Energy Systems of Emmetsburg; the State of Iowa; Stine Seed Co. of Adel; and the Iowa Energy Center. Pyrolysis as traditionally practiced involves quickly heating biomass without oxygen to produce a biochar for fertilizer and a liquid bio-oil for energy. Iowa State researchers have improved the process by adding a small amount of air to the reaction, partially

burning some of the biomass as a source of heat for the reactor. The so-called autothermal process dramatically increases the rate that biomass can be converted to products, allowing construction of smaller and simpler reactors suitable for modular systems. The new process produces sugars that can be fermented to biofuels and a solid fuel suitable as a coal substitute. The big idea is to develop small, efficient biorefineries that can process local biomass, saving the cost and trouble of transporting and storing biomass from a larger region.

- Anaerobic digestion of grassy biomass and wet wastes to convert waste biomass into carbon-neutral fuels and chemicals, with \$4 million from the energy department and additional support from Earth Energy Renewables of Bryan, Texas; Roeslein Alternative Energy of St. Louis; the State of Iowa; the Iowa Energy Center; and Iowa State. The project will build on technology developed by Mark Holtzapple of Texas A&M University to efficiently ferment biomass for production of carboxylic acids. The acids can be converted into valuable industrial chemicals and fuels, all the way up to gasoline.

Brown said both projects and the dollars associated with them are still subject to final contract negotiations between the Department of Energy and the leaders of RAPID. But he says they're good candidates to move ahead.

"We believe these projects fit the institute well and can very quickly advance," Brown said. "These are also projects that will be developed at a scale that addresses the commercially significant issues."

As for the entire RAPID effort, the Department of Energy sees the new manufacturing institute as a problem-solver for America's chemical industry.

"Our investment in this cross-cutting technology is an investment in the future of U.S. manufacturing," said David Friedman, acting assistant secretary of the Department of Energy's Office of Energy Efficiency and Renewable Energy, in a statement announcing the institute. "As we expand the Manufacturing USA network, we provide greater opportunities for businesses of all sizes to solve their toughest technology challenges and unleash major savings in energy-intensive sectors like oil and gas, pulp and paper-making and other industries."