



FOCUS ON...

Biobased Products and Bioenergy Initiative: Grants and Contracts to Advance Biofuels Technology and Market Entry

The U.S. Department of Energy (DOE) has been reaching out to U.S. industries, universities, and trade associations to help meet the goals of a vital Presidential initiative. In recent months, DOE has issued numerous financial assistance awards and subcontracts in support of the President's Biobased Products and Bioenergy Initiative (see the article on the new National Bioenergy Center on page 4). These cooperative projects seek to improve key aspects of technology for developing valuable fuels and chemicals from domestic biomass resources. All could play important roles in helping reach the central goal of the Initiative—to triple U.S. use of biobased products and bioenergy by 2010.

Four major cost-shared Biobased Products and Bioenergy Technology awards, totaling \$4.3 million, are described in more detail in the center pages of this newsletter. These awards were jointly funded by the DOE Offices of Power Technologies and Transportation

Technologies. In addition, Arthur D. Little Company won a competitive contract for a key bioenergy study. The consulting company will analyze the biomass resources and technologies available for meeting the Initiative's goal of tripling biomass use. It will also examine the economic and environmental impacts of an expanded bioenergy role, barriers to achieving the goal, and policy changes necessary to meet the goal.

In September, the DOE Office of Fuels Development awarded cost-shared financial assistance totaling about \$1.5 million (\$1.0 million DOE share) for research and development to improve ethanol-from-biomass technology. These seven 1-year awards went to five universities [Dartmouth (2), Colorado, Auburn, Florida, Iowa State] and the Masada Resources Group. Subjects included basic research on hydrolysis (the breakdown of cellulosic material), genetic engineering of microorganisms that produce enzymes, the fermentation of additional biomass-derived sugars, and the development of a corn stover harvesting system.

The DOE Office of Industrial Technologies (OIT) recently committed \$8 million to initiate six major cost-shared-award research and development projects and six grants to universities to support biobased product graduate school programs. The research and development projects, sponsored by OIT's Agricultural Industry

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Animation of cellulase enzyme attached to cellulose. Successfully reducing the cost of enzymes that break cellulose down to fermentable sugars is key to cutting the cost of producing biomass ethanol and other biobased fermentation products. The DOE Biofuels Program issued a major (\$17 million total for three years) subcontract to Genencor International (see Spring/Summer 2000 issue of Biofuels News <http://www.ott.doe.gov/biofuels/pdfs/summer00.pdf>) to develop less expensive enzymes and expects to issue a second contract soon.



of the Future Program, are for generating biomass-derived chemical building blocks or other industrial processes leading to production of chemical products from biomass:

- Eastman Chemical Company will extract cellulose from biomass to produce plastics for uses such as fibers for clothing and filters.
- The Iowa Corn Promotion Board will produce an intermediate chemical from corn syrup to use for making a variety of products.
- Pittsburg State University will make plastics from vegetable oils.
- The National Corn Growers Association will produce plastic from glucose for clothing fiber and other materials.
- Amalgamated Research, Inc. will separate out individual monomers (building blocks for plastics, such as those made in the other processes) from mixtures of monomers or other biomass materials.
- Cargill Dow LLC will use yeast to ferment an additional biomass sugar to lactic acid. This will enhance their process for making plastic from biomass (see article on page 3).

Another \$675,000 from the Office of Power Technologies' Biomass Power Program funded five grants to allow universities to research cofiring of biomass with coal in their own heating plants.

Both the Biofuels Program and the Agricultural Industry of the Future Program plan on issuing new solicitations for engineering development projects in the near future and OIT plans another education solicitation. Watch for announcements at <http://www.eren.doe.gov/solicitations.html> or in the *Federal Register*.

In addition, the U.S. Department of Agriculture just announced two new programs to promote bioenergy. Information about these programs can be found at <http://www.fsa.usda.gov/daco/bioenergy/bioenergy.htm>. Under a 2-year, \$150 million per year program, the Commodity Credit Corporation will make cash payments to compensate for a portion of increased biomass feedstock purchases to bioethanol and biodiesel producers based on their increased production. The other program provides for up to six 10-year-long pilot projects for the harvesting of biomass from Conservation Reserve Program lands for use in energy production. State Farm Service Agencies will accept applications for the pilot projects until December 19, 2000.



Biobased Products and Bioenergy Technology Awards:

Warren Gretz, NREL/PX 00082



National Corn Growers / Archer Daniels Midland

One of the four cost-shared financial-assistance Bioenergy projects awarded in June (see page 1) is to the National Corn Growers Association (NCGA) and Archer Daniels Midland (ADM). This 2-year, \$2.5 million (\$1.7 million DOE contribution) project seeks to prove the concept for an industrial process to produce valuable products by separating corn fiber from wet-mill ethanol plants into component parts. The project is based on largely existing technology and combines laboratory-scale work with process engineering and economic analyses.

The proposed industrial process takes advantage of the fact that at one point in the wet-mill ethanol process, the corn fiber is already "clean," with protein, oil, and most sugar already separated. This process would break the fiber down into sugars in several different streams of varying composition. Certain streams would be processed chemically to make products such as glycols for antifreeze. Other streams would be fermented to ethanol. Corn-fiber oil (not to be confused with corn oil separated in an earlier step) and ferulic acid would also

be separated out. While both are present in very small quantities, they could contribute substantially to process economics as a source for synthesis of high-value "nutraceuticals"—food-derived specialty products such as vitamins and vanillin.

NCGA, which is funding its share of the project with member contributions, will manage the project and provide economic analysis. DOE's Pacific Northwest National Laboratory (PNNL) and ADM will carry out the project research cooperatively. ADM will also contribute their expertise in the nutraceutical production area, and provide key "real world" guidance for the project. In addition to conducting the research, PNNL will provide its chemical analysis capabilities and the technology for producing glycols. Also, the National Renewable Energy Laboratories is planning on contributing pretreatment expertise.

Warren Gretz, NREL/PX 02001



Louisiana Pacific Corporation/ Ensyn Technologies

Another of the June Bioenergy cost-shared awards went to Louisiana Pacific Corporation and Ensyn Technologies for development of technology for substituting wood bark-derived pyrolysis oil for petroleum-derived phenol in adhesives used to make oriented-strand board

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(OSB, also known as flake board) and plywood. This 2-year, \$2 million (\$1.4 million DOE share), project will include commercial-scale adhesive production, manufacture of OSB and plywood in a commercial mill, testing of the structural panels produced, and environmental assessment of the technology.

Fast pyrolysis (chemical breakdown by heat) of wood bark produces a phenolics-rich oil that can be mixed with conventional phenol to produce the phenol-formaldehyde (PF) adhesive used in making OSB and plywood. This would also allow less formaldehyde to be used in making the adhesive. The byproducts from the fast pyrolysis will be used as fuel for the production process, but the project will also investigate the possibility of using the char to make activated carbon for air and water purification systems.

Ensyn will use its own patented fluidized-bed-reactor system for the fast pyrolysis. Adhesive production will be contracted to one or more of the largest commercial resin producers in North America. Louisiana Pacific, which is the world's largest consumer of PF adhesive, will make the OSB and plywood in one or more of its own mills. The National Renewable Energy Laboratory, which has done considerable work in this area, will provide consulting and analysis support. OSB is the fastest growing structural panel material, already capturing about half of the market. About 4 billion pounds per year of petroleum-derived phenol is now used to make PF adhesive. With this technology, as much as one-third of that phenol could be replaced by biobased product.

multi-year project to overcome several challenges to making the lactic acid from corn fiber or stover instead of starch. Success will allow Cargill Dow to use lower cost feedstock, thereby allowing expansion of the market for PLA and perhaps make it possible to create ethanol or other chemical products in conjunction with PLA production.

The PLA can be used in a wide range of applications, but initial markets include clothing fiber, alone or as a blend, and packaging materials such as films and biodegradable food and beverage containers. While other companies have produced biobased plastics for niche uses such as biodegradable medical implants, this is the first mass-market production.

Gas Technology Institute

The smallest of the four June Bioenergy Initiative awards went to the Gas Technology Institute (GTI) to evaluate the possibility of using anaerobic-



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digestion to convert swine manure to methane fuel and fertilizer. This 1-year, \$337,000 (\$264,000 DOE share) award addresses an increasingly troublesome environmental problem with a possible bioenergy solution. Unlike other animal manure, swine manure is highly liquid and high in soluble nitrates. When applied to cropland as fertilizer, much of the nitrate can leach through the soil and contaminate groundwater.

GTI was formed by a recent merger of the Gas Research Institute, which served the natural gas industry, and the Institute of Gas Technology, a not-for-profit research organization. GTI has developed several anaerobic digestion technologies for use in sewage treatment systems. Anaerobic digestion uses naturally occurring microorganisms to process sewage or other biomass material in closed, pressurized tanks. GTI believes that anaerobic digestion can convert swine manure into a methane-rich fuel gas and an effective fertilizer that is largely free of pathogens, leachable nitrates or other soluble organics—and odor.

In this project, GTI researchers will test various anaerobic digestion systems for processing swine manure, together with a methane-enrichment technology for making the gas produced more valuable. Alliance Consultants will quantify the test results and make economic projections. Preliminary investigations indicate that the technology could be used by the majority of hog farms. They also suggest that the digesters could pay for themselves quickly with the value of the fuel gas and with the increased value of the fertilizer compared to raw manure. ☺

Cargill Dow

The 1-year, \$2.2 million (\$1.1 million DOE share) award to Cargill Dow LLC will help this company prepare to use cellulosic material such as corn fiber or

corn stover as feedstock for its new biobased polylactic acid (PLA) plastic. Cargill Dow LLC is a 50:50 joint venture between Cargill Incorporated and the Dow Chemical Company, established to produce biobased products such as PLA. Cargill Dow is already producing and marketing PLA under the trade name NatureWorks™.

Cargill Dow plans to open a 140,000 metric-ton-per-year capacity biobased-plastic production plant in Blair, Nebraska, in late 2001. This award will assist Cargill Dow's plans to produce the lactic acid—from which they make the plastic—from cellulosic biomass rather than from corn starch.

The Bioenergy award funds just the first year of a



Cargill Dow/PIX 096339



IN THE SPOTLIGHT

National Bioenergy Center Created

On October 31, Secretary of Energy Bill Richardson announced the creation of a National Bioenergy Center to serve as a focal point for the Department of Energy's (DOE's) efforts to develop technology and information about biobased products and bioenergy in the United States. The center will be based at the National Renewable Energy Laboratory (NREL) and be lead by NREL and Oak Ridge National Laboratory (ORNL). In addition, the center will incorporate work conducted at other DOE laboratories. Secretary Richardson describes this organizational structure as an "inclusive center without walls." The new center will also coordinate with bioenergy work at the U.S. Department of Agriculture and other federal agencies, as well as working cooperatively with industrial partners. The new center will help carry out President Clinton's 1999 Initiative and subsequent Congressional authorization. More information about the Biobased Products and Bioenergy Initiative is available from DOE (http://www.eren.doe.gov/bioenergy_initiative/) and interagency (<http://www.bioproducts-bioenergy.gov/about.html>) Web sites.

The core components of the National Bioenergy Center will be the current Biotechnology for Fuels and Chemicals and Chemistry for Bioenergy Systems Centers at NREL (\$33 million per year total budget) and the Biomass Feedstock Development Program at ORNL (\$6 million). ORNL also carries out other bioenergy efforts, as do Argonne National Laboratory, Pacific Northwest National Laboratory, and other DOE facilities. DOE, NREL, and ORNL will conduct a national search for hiring a director for the new center.

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DID YOU KNOW?

Upcoming Conferences Biofuels News on the Web

Researchers and producers—don't miss the:

23rd Symposium on Biotechnology for Fuels and Chemicals

May 6-9, 2001, Breckenridge, CO
http://www.nrel.gov/biotech_symposium

Abstracts accepted until February 15, 2001:

The Fifth Biomass Conference of the Americas

Sept. 17-21, 2001, Orlando, Florida
<http://www.nrel.gov/bioam/>

FOR OTHER UPCOMING CALENDAR EVENTS SEE:

[http://www.afdc.doe.gov/](http://www.afdc.doe.gov/cgi-bin/comingevents/events.cgi?biofuel)

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DOE/GO-102000-1149 Past issues and other related information are available on the Biofuels Program Web site <http://www.ott.doe.gov/biofuels/>



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