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DOE and USDA Award $17 Million via Joint Biomass Research and Development Initiative

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The U.S. Departments of Energy and Agriculture selected 17 projects to receive total funding of approximately $17.5 million from the agencies under the Biomass Research and Development Initiative. Cost-sharing by private sector partners increases the total value to over $27 million. More than 300 applications were received in response to the solicitation, with each proposal reviewed for technical merit by teams from industry, laboratories, and federal agencies. The funds will be used for biomass research, development and demonstration projects.

The Biomass R&D Act of 2000, the 2002 Farm Bill and the Energy Policy Act of 2005 set the framework for interagency cooperation and joint solicitations. The President's Advanced Energy Initiative, announced in 2006, will incorporate advancements from this research in its ongoing work towards energy independence, including displacement of petroleum with domestically produced biofuels.

Increased demand for ethanol will support traditional agricultural crops such as corn, as well as create new cash crops for America's farmers and foresters, while a new bioindustry will encourage better use of agricultural and forestry residues. Furthermore, new processing facilities resulting from this increased demand will help improve rural communities and economies.

Following is a list of the 17 selected projects and the dollar amount funded.

2006 BIOMASS RESEARCH AND DEVELOPMENT INITIATIVE PROJECTS

U.S. Department of Energy Projects

Edenspace Systems Corporation - Energy Corn Consortium - $1,926,970.00

By 2009, the Consortium will introduce new corn varieties for production of cellulosic ethanol in existing grain ethanol facilities. This work will include: identification and testing of improved enzymes for conversion of lignocellulose; speed up development of corn feedstocks specifically bred for cellulosic ethanol production from stover; and continuous control for lowest cost solutions using current ethanol production facilities, such as solutions for concurrent processing of various feedstocks. Project technology will also be applicable to crops such as switchgrass, and will provide high-performance enzymes for processes such as dilute acid and ammonia fiber explosion pre-treatments, as well as applications in textile, paper, and other industries.

Lucigen Corporation - Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol - $1,259,000.00

This work seeks to overcome the recalcitrance of cellulosic biomass by developing enzymes capable of breaking down the carbohydrates in defatted soybean meal (DSM) into a fermentable substrate suitable for biobased alcohol production; this is expected to increase fuel ethanol production by as much as two billion gallons. The project will clone, express, and characterize thermostable bacterial enzymes capable of degrading less than 70 percent of the carbohydrates in DSM into monosaccharides and disaccharides fermentable by yeast. The goal is to develop a product and process which does not require separation of soybean protein from carbohydrate nor require harsh pretreatment of the soybean meal, and which retains the protein value of the meal. This conversion to ethanol could increase the value of the soybean

crop by over $4 billion because the feed value of the protein would be retained in the fermentation residue.

Center for Technology Transfer, Inc. - Value Prior to Pulping - $1,521,763.00

This work seeks to produce fuel ethanol from hemicelluloses extracted from wood chips prior to paper production. The project will combine approaches, addressing the recalcitrance of woody biomass for conversion with enzymes, acids, and other additives for hemicellulose sugar extraction, as well as high-yield conversion of a complex mixture of pentose and hexose sugars and fermentation to produce ethanol and acetic acid as a co-product.

U.S. Department of Agriculture Projects

SUNY College of Environmental Science and Forestry - Overcoming Barriers to Facilitate the Commercialization of Willow Biomass Crops as a Feedstock for Biofuels, Bioenergy and Bioproducts - $813,450.00

Domestication and deployment of fast-growing perennial plants as dedicated energy crops can provide a long-term, sustainable replacement for fossil fuels. Perennial woody and herbaceous crops will annually provide up to 377 million dry tons of biomass by 2030. Shrub willows, grown as short-rotation woody crops (SRWC), can serve as a dedicated and custom feedstock for bioproducts and bioenergy, promote rural development, and provide positive environmental benefits. This project will seek to increase willow yield through genetic improvement. In addition, reduction of planting density should reduce the cost of planting establishment. Work will combine these efforts with a push to expand harvesting timeframes for willow biomass crops, and provide a user-friendly model of willow production and conversion economics.

Ceres, Inc. - Biotechnological Improvement of Switchgrass - $1,572,460.00

The goal of this project is to double switchgrass yield from the current 7 tons per acre to 14 tons per acre by the year 2020, thereby greatly promoting the adoption of cellulosic ethanol as a source of fuel. Switchgrass yields are relatively high; and costs, pesticide requirements, and planting effort is lower than corn. The rate of yield improvement for switchgrass through traditional breeding methods is very slow. Biotechnological (transgenic) approaches such as the mis-expression of certain plant genes could result in rapid and dramatic improvement of traits desirable in energy crops. Ceres can use its innovative and proprietary biotechnological tools to make dramatic improvement in agronomic traits of switchgrass.

Drexel University - Moisture Management in Polylactide and Polylactide Copolymers - $1,312,389.00

This project seeks to improve the moisture barrier properties of PLA (polylactide or polylactic acid) using chemical modification, copolymerization, and composite approaches while maintaining thermal, mechanical, degradation, and optical properties of pure PLA. Cooperative work with industrial partner NatureWorks LLC combines fundamental and applied research that will lead to both improvements in performance of bio-based polymers, and fundamental knowledge about moisture transport in bio-based polymers. In turn, this will lead to more efficient and environmentally benign production of bio-based polymeric products with enhanced properties and performance to compete with or displace petroleum-based polymers in the marketplace.

Virent Energy Systems, Inc. - High-Value Chemical Production from Biodiesel-Derived Glycerol - $2,000,000.00

The process for biodiesel production is relatively simple, but deriving value from co-produced glycerol remains a challenge. This project will convert crude glycerol to propylene glycol, a high-value chemical, using patented aqueous-phase reforming (APR) technology. The goal is to complete research of this

application, and prove its technical and economic feasibility. Work will include development and testing of conversion system prototypes up to commercial scale.

The Pennsylvania State University - Lignin Conversion to Value-Added Materials - $579,340.00

This project seeks to produce high-value saleable products from hardwood lignin. Work includes process technology for conversion of hardwood feedstocks into fuel ethanol, and conversion of co-produced lignin into higher-value chemicals or fuel components. Depolymerization using methanol with a base as a catalyst could produce a high-octane gasoline additive, and chemical production of phenol from toluene. PSU will work with partners SWAN Biomass Company and Axion Analytical Laboratories to find the most commercially viable pathway.

Iowa Corn Promotion Board - Adding Value to Commercial Polymers through the Incorporation of Biomass Derived Chemistries - $1,762,157.44

This project builds on past polymer research conducted with various industrial and federal partners, including the Pacific Northwest National Laboratory, New Jersey Institute of Technology, and Mid-Atlantic Technology, Research, and Innovation Center. Work will define the cost-performance of isosorbide derived compounds which improves the performance characteristics of thermoplastic and thermosetting polymer systems. Prior inventions and concepts include isosorbide based chain modifiers, monomers, and crosslinking agents. This work seeks to develop a process which can be scaled to at least 500,000 pounds per year. Process modeling and economic studies will be performed to provide direction to the project. A pilot plant will assist in demonstration and larger-scale production for commercial-scale engineering and economic data.

Louisiana State University Agricultural Center - Thermoplastics Composites Reinforced with Natural Fibers and Inorganic Nano-Particles - $791,865.00

This project combines natural wood fibers with recycled plastics to make biocomposites, providing a practical use for biomass. This research will use the latest technology in composite development and interface analysis to combat the predominant challenges of incompatibility and composite brittleness. Technical development will focus on new coupling agents and forms for commingled plastics, composite strengthening through nanoparticles, and advanced extrusion technology. Enhanced manufacturing capability should result, leading to improved energy efficiency, rural development, and environmental benefits.

Ceres, Inc. - A Plant-Based Production System for Methacrylate - $1,523,530.00

This project seeks to utilize the metabolic pathways which already exist in plants to genetically engineer methacrylate production into a cellulosic ethanol biomass crop such as switchgrass. Methacrylate as a co-product will generate additional revenue from the biorefinery, thus further enhancing the economics and efficiency of the biomass crop and biorefinery operations, as well as increasing possible petroleum displacement. Ceres will collaborate with industry partner Rohm & Haas, one of the world's leaders in methyl methacrylate production, ensuring technical suitability for downstream processes.

Argonne National Laboratory - Enhancing Animal Feed Values in Corn Dry Mills with Biobased Solvents - $400,000.00

Corn dry grind mills are the technology of choice for expanding U.S. ethanol production. In these mills, distiller's grains and solubles (DGS) are co-produced and sold as animal feed, primarily to ruminants. If immediate markets are not available, the material is dried to produce dried DGS (DDGS), an expensive and energy-intensive process. This project will use renewable biobased solvents derived from corn and soybeans to extract and concentrate the protein content in DGS. The goal is to produce a high-nutritional animal feed which is suitable for a wide range of animals, with value based on protein and oil content.

This work will aid rural development, reduce energy waste in ethanol production, and develop additional markets for the ethanol co-product. In addition, the project should enable production of "captured" cellulosic sugars from the corn fiber in residues, making them available for fermentation.

Western Governors' Association - Strategic Development of Biomass in the Western States - $290,246.32

The WGA seeks to continue work begun with strategic analysis of clean energy in the Western States. The next step is to examine the implementation of proposed policy measures conducive to biomass development, and enabling continued and progressive additions of new bioenergy resources and technologies in the next decade. Information is used by the governors, both collectively and individually, to make well informed decisions. Planned analysis includes: augmentation of supply resource database and feedstock transportation functions; completion of the conversion technology database; spatial analysis and supply curve development; resource/technology development scenarios and policy interactions; and cost/benefits analysis.

Southern Illinois University - Technical Area 4; Expansion of Ethanol Ethanol Production: Evaluation of Costs and Benefits to Rural Communities in the Upper Mississippi River Basin - $676,722.00

The project will simultaneously assess the impacts of corn-based ethanol production on crop prices, cropping patterns, water quality, and regional economic indicators for a major region of U.S. agricultural production, within an explicit spatial framework. Work will include development of economic models, spatial models, energy displacement accounting, and a soil and water assessment tool model. Data will be mapped to estimate the economic and environmental impacts of potential future growth of ethanol production in the region.

Clarkson University - Analysis for Strategic Guidance Demonstrating the Value of Waste Biomass Feedstocks for Fuel Ethanol Production from Energy Policy Perspectives - $250,001.00

This project will develop an analysis framework to compare the benefits of various ethanol feedstocks based on national energy policy perspectives. The framework will focus on both dedicated feedstocks and waste materials, and metrics will be developed for assessment using three national energy policy perspectives: increased energy security, energy resource conservation, and sustainable development of energy resources and systems. Work will aid decision makers in understanding tradeoffs between developing different ethanol supply systems.

Michigan State University - Life Cycle Assessment to Improve the Sustainability and Competitive Position of Biobased Chemicals - 376,616.00

This project will build locally (county-level) life cycle inventory databases for biomass production and biorefinery systems up to platform chemicals to: determine effects of farming locations and practices on the environmental performance of biobased chemical production systems; identify the most important environmentally sensitive areas within the system boundaries for future improvements; evaluate the environmental impacts of potential or proposed improvements in crop production and biorefinery systems; and estimate the eco-efficiencies of biobased chemical production systems. Information will be collected for corn and soybean agriculture in approximately 40 counties in 9 Corn Belt states: Iowa, Illinois, Indiana, Michigan, Minnesota, Nebraska, Ohio, South Dakota, and North Dakota. Also, data on platform chemical production in wet/dry milling plants and soybean crushing plants will be collected.

North Carolina State University - Strategic Positioning of Biofuels in the Economic Context of Agriculture, Crude Oil, and Auto-Manufacturing. - $435,997.00

This project will concentrate on evaluation of the major participants in biofuel commercialization, and development of constructive interaction strategies. The major participants are government, agriculture,

the petroleum industry, and automobile manufacturers. To minimize confusion and promote efficient interaction, a formalized methodology of examination and strategy or policy development must be created. Work will involve research of participants' goals, actions, collaborations, and responses, and creation of a model for effective interaction. This project will utilize review panels consisting of representative members from agriculture, industry, business, and government, who will in turn review the progress of this research effort by offering detailed recommendations, insights, and perspectives.