

Annual Report to Congress
on the
Biomass Research and Development
Initiative

Submitted Jointly by

The U.S. Department of Agriculture
&
The U.S. Department of Energy

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I. INTRODUCTION

This Annual Report to Congress is submitted in accordance with section 309 of the Biomass Research and Development Act of 2000 (the Biomass Act), 7 U.S.C. 7624 note. For each fiscal year (FY) in which funds are appropriated to carry out this title, the Secretary of Agriculture and the Secretary of Energy must jointly submit a report to Congress that details the status of activities carried out under the Biomass Research and Development Initiative (Initiative). FY 2002 was the first fiscal year in which funds were made available to the Initiative as Congress, through section 9008 of the Farm Security and Rural Investment Act of 2002 (Farm Bill) (P.L. 101-171), amended section 310 of the Biomass Act to provide \$5 million to the United States Department of Agriculture for the purpose of carrying out activities under the Biomass Act.

This first annual report on the Initiative details activities that the Departments of Agriculture and Energy conducted during the 2001 and 2002 calendar years. The activities highlighted in this report include activities that are not directly funded through the Biomass Act, but contribute to the advancement of biomass research and development. Specifically, this report does the following:

- Describes the current general status and progress of the Initiative;
- Describes the current general status of cooperation and research and development efforts carried out at both the Department of Agriculture (USDA) and the Department of Energy (DOE); and
- Details the Biomass Research and Development Technical Advisory Committee's assessment of projects funded under the Initiative.

II. A Report from the Secretaries of Agriculture and Energy

Over the past year, USDA and DOE have continued to forge a strong working relationship to fulfill the requirements of the Biomass Act and to improve coordination and integration of Federal biomass research and development activities.

Several specific accomplishments made during 2002 include:

- Joint facilitation by USDA and DOE on the development of a *Vision for Bioenergy and Biobased Products in the United States* which was completed by the Biomass Research and Development Technical Advisory Committee (Committee) in October 2002; and a *Roadmap for Biomass Technologies* which was completed by the Committee in November 2002. The development of these documents is a significant accomplishment. They were requested of the Committee by the Secretaries of Agriculture and Energy in June 2002 and were completed in less than six months. They will form the basis for future Committee evaluation of Federal biomass research and development activities.
- Interagency meetings between USDA and DOE to identify opportunities for collaboration between our respective programs.
- A successful meeting of the Biomass Research and Development Board (Board), and the proposed addition of a new board member, the Office of the Federal Environmental Executive.

The achievements of 2002 have set the stage for even more effective coordination between USDA and DOE as well as the other agencies of the Board for 2003. For example, USDA and DOE are working together to develop an interagency database of biomass research and development programs, which will enable the Committee to better review and provide guidance on the research being performed throughout the Federal Government.

USDA and DOE are also working closely together in the implementation of relevant energy sections of the Farm Bill. To date, USDA and DOE collaboration on implementing section 9008 of the Farm Bill has resulted in the successful selection of two projects (see section III. C. page 5). However, the agencies intend to re-evaluate the process for future competitive solicitations in order to accommodate the recommendations offered by the Committee. Opportunities for enabling the Committee to review the merit review process will be explored.

In summary, the past year has been one of great progress in identifying goals and objectives, and Federal program integration and coordination continues to improve.

III. Status and Progress of the Biomass Initiative

Since the establishment of the Initiative in June of 2000, USDA and DOE have been working in conjunction to ensure that their designated biomass research and development programs are carried out in accordance with the Biomass Act. Coordination and collaboration between the two agencies has been steadily increasing and is currently strong.

Acting on behalf of their respective Secretaries, the points of contact for each agency have been working closely together to coordinate their agencies' activities, as well as the activities of the Board and the Committee.

Efforts to increase cooperation between the two agencies are led by the National Biomass Coordination Office, which is co-directed by staff from both agencies. To date, the increased coordination between the agencies has resulted in a number of joint projects and activities contained within this document.

A. Biomass Research and Development Board

The Board held its first meeting under the current Administration in September 2002. The Board is co-chaired by the points of contact from USDA and DOE. Board members are senior officers from the Department of the Interior (DOI), the Environmental Protection Agency (EPA), the National Science Foundation (NSF), and the Office of Science and Technology Policy (OSTP). The Board met to discuss the current status of the Initiative and to develop a plan for future activities. The plan includes the creation of an interagency matrix of biomass activities and programs that will provide an overview of the Federal investment in biomass. The Board will continue to meet on a quarterly basis, and membership in 2003 will be expanded to include the Office of the Federal Environmental Executive.

Members of the Biomass Research and Development Board

Co-Chairs

Mark Rey, Under Secretary, Natural Resources and Environment, USDA

David K. Garman, Assistant Secretary, Energy Efficiency and Renewable Energy, DOE

Members

Bruce Hamilton, Director, Bioengineering and Environmental Systems Division, NSF

Jean-Mari Peltier, Counselor to the Administrator, EPA

Jim Tate, Science Advisor, DOI

Kathie Olsen, Associate Director for Science, OSTP

B. Biomass Research and Development Technical Advisory Committee

The Committee is now ending its second year of activities. During its 2002 work-year, the Committee consisted of 26 individuals from industry, academia, non-profit organizations, and the agricultural and forestry sectors that are experts in their respective fields. In 2001, the Committee prepared recommendations to the Secretaries of Agriculture and Energy for research

and development and other activities necessary for advancing goals and challenges for biofuels, biobased products, and biopower.

In June 2002, the Secretaries of Agriculture and Energy requested that the Committee develop vision and roadmap documents to guide future biomass research and development activities. The documents would serve as a resource for the agencies in planning their biomass research and development portfolios. The Committee worked over the course of several months to develop these documents. The *Vision for Bioenergy and Biobased Products in the United States* was released in October 2002 and sets far-reaching goals for the role of biomass in future energy and product markets. The corresponding *Roadmap for Biomass Technologies* will be released in January 2003. In 2003, the Committee will use these documents as a baseline to develop recommendations for Federal agencies on biomass research and development.

2002 Members of the Biomass Research and Development Technical Advisory Committee

Co-chairs

Glenn English, National Rural Electric Cooperative Association
Thomas Ewing, Davis & Harman LLP

Members

Roger Beachy, Donald Danforth Plant Science Center
Robert Boeding, National Corn Growers Association
Dale Bryk, Natural Resources Defense Council
Robert Dorsch, E.I. du Pont de Nemours & Co., Inc.
Carolyn Fritz, Dow Chemical Company
Stephen Gatto, Bionol Corporation
Brian Griffin, Oklahoma Secretary of Environment
Patrick Gruber, Cargill Dow LLC
William Guyker, Life Fellow - IEEE
John Hickman, Deere & Company
Walter Hill, Tuskegee University
William Horan, Horan Brothers Agricultural Enterprises
Jack Huttner, Genencor International, Inc.
F. Terry Jaffoni, Cargill, Inc.
Michael Ladisch, Purdue University
David Morris, Institute for Local Self Reliance
William Nicholson, Potlatch Corporation- Retired
Edan Prabhu, Flex Energy
William Richards, Richards Farms, Inc.
Philip Shane, Illinois Corn Marketing Board
Larry Walker, Cornell University
John Wootten, Peabody Energy
Michael Yost, Yost Farm, Inc.
Holly Youngbear-Tibbetts, College of Menominee Nation

C. Cooperative Efforts Relating to FY 2002 Funding to the Initiative

The \$5 million made available to the Initiative through section 9008 of the Farm Bill was used in accordance with the priorities, criteria, and procedures outlined in the Biomass Act. The funds provided the first opportunity for USDA and DOE to work together to implement the Initiative with funds specifically allocated to the legislation. Future year funding for the Initiative committed under the 2002 Farm Bill will continue to enhance these interagency cooperative efforts.

In accordance with the Biomass Act, the points of contact, in consultation with the Board, are charged with establishing a priority in grants, contracts, and assistance that demonstrates potential significant advances in biomass processing; demonstrates potential to substantially further scale-sensitive national objectives, such as sustainable resource supplies, reduced greenhouse gas emissions, healthier rural economies, and improved strategic security and trade balances; and improves knowledge of important biomass processing systems that demonstrate potential for commercial applications.

USDA's Natural Resources Conservation Service received the \$5 million FY 2002 apportionment from the Office of Management and Budget. At the request of the points of contact, USDA and DOE agreed to collaborate by using an existing DOE solicitation, which was consistent with provisions of the Biomass Act, to identify potential projects for funding from the FY 2002 monies. A USDA inter-mission area working group developed a process to screen the available applications from the DOE solicitation and made final recommendations to the Board on proposals suitable for consideration. This process resulted in a successful and competitive merit review of proposals that responded to the Biomass Act.

In accordance with the results of the merit review and in consultation with the Biomass Research and Development Board, two projects were selected for funding.

- ***Value Added Products from Hemicellulose Utilization in Dry Mill Ethanol Plants*** - The Iowa Corn Promotion Board received funding for its plan to integrate enzymatic hydrolysis, fermentation, and aqueous phase catalysis to produce high-value components from hemicellulose.
- ***Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis*** - The Iowa Corn Promotion Board received funding to develop a process to convert sorbitol, from corn wet milling operations, to isosorbide.

IV. Other USDA and DOE Biomass Efforts

A. Interagency Coordination and Cooperation

USDA and DOE collaborate on a number of biomass activities that do not receive funding under the Initiative. USDA and DOE are jointly funding a Digester/Turbine project in Beltsville, Maryland. The project is a distributed energy system that will provide power for an on-site lighting system for both the farm feedlot and the micro-turbine. This system can be used by dairy, poultry, or swine farmers to offset electricity costs and will improve the efficiency of the electricity infrastructure by helping to reduce and manage peak energy loads.

USDA's Forest Service and DOE are collaborating to demonstrate small modular systems in conjunction with the Forest Service's forest health/fire mitigation strategy by using the thinnings and underbrush as fuels for power production. USDA and DOE are also working with EPA in an interagency organization called the Buy Bio Program Interagency Work Group. The mission of this Group is to use the purchasing and leveraging power of Federal agencies to encourage preferential procurement of biobased products. All Federal agencies have an opportunity to lead the way by example. The State and private sector will also be encouraged to increase their purchase of biobased products.

Both USDA and DOE conduct a number of research and development activities funded without Initiative dollars that contribute to the advancement of biomass research and development. A summary of each agency's activities follows.

B. U.S. Department of Agriculture

Biomass research and development activities cut widely across a broad range of mission areas within USDA. In order to ensure that the various biomass research and development activities across USDA are carried out in an effective approach, USDA has established a Biobased Products and Bioenergy Coordination Council (BBCC) to provide a forum through which USDA agencies coordinate, facilitate, and promote research, development, transfer of technology, commercialization, and marketing of biobased products and bioenergy using renewable, domestic agricultural and forestry materials.

The agencies within USDA that carry out biomass research and development activities and a summary of their activities are as follows:

- The Agricultural Research Service is the in-house agricultural research arm of USDA, conducting fundamental and applied research to develop solutions to agricultural problems of high national priority. Research related to biobased products focuses on developing industrial products that expand markets for farm products, replace imports and petroleum-based products and offer an opportunity to meet environmental needs. Activities include development of technologies for biobased degradable plastics, adsorbents and absorbents, improved and lower cost fuel additives, biopesticides, composites, cotton-based fabrics with versatile new and improved properties, encapsulating agents, fiber crops for specialized uses, polymers and polymer blends, soy

ink, functional fluids (lubricants, hydraulic fluids), specialty chemicals, coatings, health-care products, and new crops to meet niche market opportunities.

- The Commodity Credit Corporation's Bioenergy Program reimburses eligible producers of bioenergy (commercial fuel grade ethanol and biodiesel) for part of their input costs of eligible commodities used to increase bioenergy production over the previous fiscal year. The Farm Bill extended this program through FY 2006.
- The Cooperative State Research, Education and Extension Service (CSREES) is USDA's principal link to academia and participates in a nationwide agricultural research planning and coordination system that includes State land-grant universities and the agricultural industry. CSREES promotes research and development for biobased industrial products and bioenergy primarily through its Agricultural Materials Program, National Research Initiative (NRI), and Small Business Innovation Research Program (SBIR). The Agricultural Materials Program provides non-competitive funding to land grant institutions through formula funding and special research grants to support a range of basic and applied research topics. Competitive funding is provided through the NRI and the SBIR. The NRI program provides a bridge between basic research and near-term development, and SBIR supports pre-commercialization activities.

Additional activities under Title IX of the Farm Bill for CSREES include competitive grants for research on carbon fluxes and exchange of greenhouse gases from agriculture.

- The National Resource Conservation Service (NRCS) provides technical assistance to farmers and ranchers to help ensure that the production of feedstocks for bioenergy and bioproducts are produced in an environmentally acceptable manner. The agency has focused increasing attention on helping producers use animal waste in energy production, especially to address greenhouse gas problems. Through USDA's Resource Conservation and Development program, NRCS works at the community or area-wide level to help develop enterprises to produce and market bioenergy and bioproducts.
- The Forest Service has had an active Research and Development program for almost 90 years in the growth and management of timber resources, and forest products development. Biobased products research is directed toward development of cost-effective feedstock systems for wood fiber that are competitive with non-renewable resources and new technologies to provide low-cost and environmentally acceptable processing and manufacturing of wood-based products.
- The Office of the Chief Economist includes the Office of Energy Policy and New Uses (OEPNU), which provides leadership, oversight, coordination, and evaluation for all USDA energy and energy-related activities with the exception of those delegated to USDA's Assistant Secretary for Administration. OEPNU analyzes existing and proposed energy policies, strategies, and regulations concerning or potentially affecting agriculture. It also evaluates the feasibility of new uses for agricultural products.

Additional activities under Title IX of the Farm Bill for OEPNU include:

- A program to promote the purchase of biobased products by Federal agencies;
 - A competitive grant program to educate governmental and private entities with vehicle fleets and the public about the benefits of biodiesel; and
 - A memorandum of understanding between USDA and DOE regarding collaboration to disseminate information on hydrogen and fuel cell technology to agricultural producers and rural communities.
- Under Departmental Administration, the Office of Procurement and Property Management funds a portion of the salary of a staff person that works on the alternative fuels program in support of the Energy Policy Act of 1992 requirements and Executive Order 13149, Greening the Government Through Federal Fleet and Transportation Efficiency. The focus of this program is to increase the acquisition of alternative fuel vehicles and use of alternative fuels in USDA fleet vehicles nationwide.
 - The Rural Development mission area works to make sure that rural citizens can participate fully in the global economy--with technical assistance and programs that help rural Americans build strong economies to improve their quality of life. Rural Development is running a comprehensive program of research to determine how the cooperative form of business can be adapted to increase domestic fuel supplies, both traditional and alternative, while increasing returns to farmers.

Additional activities under Title IX of the Farm Bill for Rural Development include:

- A competitive grant program to support the development of biorefineries to convert biomass into multiple products, such as fuels, chemicals, and electricity;
- A competitive grant program for entities to administer energy audits and renewable energy development assessments for farmers, ranchers, and rural small businesses; and
- A loan, loan guarantee, and grant program to assist eligible farmers, ranchers, and rural small businesses in purchasing renewable energy systems and making energy efficiency improvements.

C. Department of Energy

In 2002, DOE's Office of Energy Efficiency and Renewable Energy (EERE) integrated its biomass research areas that were spread throughout the Office of Industrial Technologies, the Office of Power Technologies, and the Office of Transportation Technologies. This new integrated program is the Office of the Biomass Program (Biomass Program). The Biomass Program is focusing its research and development on several areas, primarily gasification, cellulosic ethanol, and biobased products. The mission of the Biomass Program is to partner with U.S. industry to foster research and development of advanced technologies to transform our Nation's abundant biomass resources into clean, affordable, and domestically produced biofuels, biopower, and high-value bioproducts for improving economic development and enhancing U.S. energy supply options.

Research Focus

Gasification - Gasification research and development will be focused on the feasibility of producing biomass-derived fuels, power, chemicals, and other products as well as developing a catalytic gasification technology that will allow recovery of energy from wet biomass.

Cellulosic Conversion - Currently, ethanol is not being produced commercially from cellulose or hemicellulose, the fibrous sugar polymers that make up the bulk of plant material. The Biomass Program is strongly pursuing cellulosic ethanol technology in hopes of supplementing the corn ethanol that is currently on the market. The Biomass Program will focus its research and development on integrating cellulosic conversion processes with existing starch-based commercial facilities. A major goal for the program is to work with an ethanol producer to demonstrate the feasibility of the commercial production of ethanol and co-products from the corn fiber stream.

Integrated Biorefinery - Research and development of biobased products offers the opportunity to create high value products that will establish biomass conversion facilities broadly and assist with the development of other components of an integrated industrial biorefinery. The Biomass Program is conducting biobased product research and development to produce value-added chemicals, biobased engine oils and solvents, biobased plastics, and improved enzymes. A major success for the program is its partnership with Cargill Dow, LLC's polylactic acid (PLA) plastic manufacturing operation in Blair, Nebraska. Using sugar from cornstarch as a feedstock, the sugar is fermented to lactic acid, which is converted to PLA polymer. The PLA is used to produce plastic and fibers, which are then used to produce soda bottles, clothing, and other products.

To ensure continued success, the Biomass Program relies strongly on competitive solicitations to identify projects that support its program focus areas. In April 2002, an Integrated Biomass Solicitation was issued seeking proposals focused on research and development in cellulosic conversion for the production of fuels, power, and biobased products. From the 190 proposals that were received, the following six projects were selected for \$80 million of funding over four years.

- ***Second Generation Dry Mill Biorefinery*** - Broin and Associates, Inc., of South Dakota received funding for its four-year project to develop a "Second Generation Dry Mill Biorefinery." The project's goal is to enhance the economics of existing ethanol dry mills by increasing ethanol yields and creating additional co-products. Broin estimates that its process will increase ethanol output at existing plants by approximately 10 to 20 percent by 2006.
- ***A New Biorefinery Platform Intermediate*** - Cargill, Inc., of Minnesota received funding for its three-year project for developing a biobased technology to produce a wide variety of products based on 3-hydroxypropionic acid (3-hp), which is produced by the fermentation of carbohydrates.

- ***Integrated Corn-based Bio Refinery (ICBR) Project*** - Delaware's E.I. du Pont de Nemours & Co., Inc. (DuPont), received funding for its proposal to build a biobased production facility that will convert corn and stover into fermentable sugars for production of value-added chemicals.
- ***Making Industrial Bio-refining Happen*** - Based in Minnesota, Cargill Dow, LLC received funding for its project that focuses on process and fermentation technologies to develop and validate process technology and sustainable agricultural systems that will economically produce sugars and chemicals such as lactic acid and ethanol. Cargill Dow also plans to give growers and grower organizations the first opportunity to participate in the commercial development of this technology.
- ***Advanced Biorefining of Distiller's Grain and Corn Stover Blends: Pre-Commercialization of a Biomass-Derived Process Technology*** - High Plains Corporation, with plants in Kansas, Nebraska, and New Mexico, received funding for their project that focuses on developing a novel biomass-derived process technology. This process technology will utilize advanced biorefined distiller's grain and corn stover blends to achieve significantly higher ethanol yields while maintaining the protein feed value.
- ***Separation of Corn Fiber and Conversion to Fuels and Chemicals Phase II: Pilot-scale Operation*** - The National Corn Growers Association, based in Missouri, received funding for its proposed development of a technically and economically feasible integrated process for recovery of the hemicellulose, protein, and oil components from corn fiber. These materials will subsequently be converted into value-added products.

V. Report of the Biomass Research and Development Technical Advisory Committee

As required by section 309 of the Biomass Act, the Committee is submitting this report to assess whether or not funds appropriated for the Initiative are being used in a manner that is consistent with the Biomass Act.

A. Process Used to Select Projects

For the \$5 million dollars that were made available to the Initiative for FY 2002, the points of contact for the Initiative decided that a collaborative effort would be the best course of action for selecting projects. It was decided that a USDA Working Group would develop a process to select projects for funding from an existing DOE solicitation. The Working Group selected two projects, and the Board reviewed their selection and approved funding.

B. Projects Selected

The following is a review of the grants that received funding from the Initiative:

1. **Project Title:** Value Added Products from Hemicellulose Utilization in Dry Mill Ethanol Plants.

Partners: The Iowa Corn Promotion Board, the Minnesota Corn Research and Promotion Council, the Ohio Corn Marketing Program, the Pacific Northwest National Laboratory, and the Idaho National Engineering and Environmental Laboratory.

Objectives: Aimed at integrating enzymatic hydrolysis, fermentation, and aqueous phase catalysis to produce high value components from hemicellulose in the corn dry milling process.

2. **Project Title:** Continuous Isosorbide Production from Sorbital Using Solid Acid Catalysis.

Partners: The Iowa Corn Promotion Board, the Pacific Northwest National Laboratory, and Archer Daniels Midland.

Objectives: Research is focused on developing an economically viable process that converts sorbitol, from corn wet milling operations, to isosorbide. Researchers will be exploring how isosorbide could replace petroleum-derived polyethyleneterephthalate, both in terms of economic values and environmental benefits.

C. Committee's Evaluation of the Project Selection Process

While the Committee did not participate in the process used to select these projects, the Committee understands the circumstances under which USDA chose to use this process for FY 2002 funding. The Committee strongly recommends that the process used to select these two

projects not be used for future funding. To better fulfill their duties to advise the Secretaries of Agriculture and Energy, the Committee will investigate opportunities to increase their involvement regarding procedures for reviewing and evaluating proposals under the Initiative. Further, due to constraints regarding the release of information on the FY 2002 project selection process, the Committee did not believe it was provided with adequate information to affirm the process by which the projects were selected.

D. Committee's Evaluation of the Projects Selected

In reviewing the grants that received funding from the Initiative in FY 2002, the Committee believes that the technical focus of the projects is consistent with the goals of the Initiative.

The project titled, “**Value Added Products from Hemicellulose Utilization in Dry Mill Ethanol Plants,**” satisfies the qualifications under the Biomass Act by focusing on technology that will diversify the range of products that can be efficiently and cost-competitively produced from biomass. This project also satisfies the recommendations of the Committee by helping to further the biorefinery concept and by increasing the value of agricultural products.

The project titled, “**Continuous Isosorbide Production from Sorbital Using Solid Acid Catalysis,**” satisfies the qualifications under the Biomass Act by focusing on the research priorities of developing biobased industrial products that can compete in performance and cost with fossil-based products; accurate measurement and analysis of greenhouse gas emissions in relation to the life cycle of biobased industrial products with respect to other alternatives; analyzing the economic viability of a biobased industrial product; and evaluating the cost of the required process technology and interactions between an emergent biomass refining industry and the petrochemical-refining infrastructure. This project also satisfies the recommendations of the Committee by helping to further the biorefinery concept and by increasing the value of agricultural products.