

# Breaking the Biological Barriers to Cellulosic Ethanol: A Joint Research Agenda

## *A Research Roadmap Resulting from the Biomass to Biofuels Workshop Sponsored by the U.S. Department of Energy*

December 7–9, 2005, Rockville, Maryland

DOE/SC-0095, Publication Date: June 2006

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Office of Energy Efficiency and Renewable Energy, Office of the Biomass Program

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# Appendix A. Provisions for Biofuels and Biobased Products in the Energy Policy Act of 2005

On July 29, 2005, Congress passed the Energy Policy Act of 2005,<sup>1</sup> and President George Bush signed it into law on August 8, 2005. The \$14 billion national energy plan includes provisions that promote energy efficiency and conservation, modernize the domestic energy infrastructure, and provide incentives for both traditional energy sources and renewable alternatives. The following sections of the Energy Policy Act relate to biofuels and biobased products.

## Title IX—Research and Development

### Section 932. Bioenergy Program.

Research, development, demonstration, and commercial application activities under this program will address biopower, biofuels, bioproducts, integrated biorefineries, crosscutting research and development in feedstocks; and economic analysis. Goals for DOE biofuel and bioproduct programs include partnering with industrial and academic institutions to develop: “(1) advanced biochemical and thermochemical conversion technologies capable of making fuels from lignocellulosic feedstocks that are price-competitive with gasoline or diesel in either internal combustion engines or fuel cell-powered vehicles; (2) advanced biotechnology processes capable of making biofuels and bioproducts, with emphasis on development of biorefinery technologies using enzyme-based processing systems; (3) advanced biotechnology processes capable of increasing energy production from lignocellulosic feedstocks, with emphasis on reducing the dependence of industry on fossil fuels in manufacturing facilities; and (4) other advanced processes that will enable the development of cost-effective bioproducts, including biofuels.” Through Integrated Biorefinery Demonstration Projects, DOE will demonstrate the commercial application of integrated biorefineries that use a wide variety of lignocellulosic feedstocks to produce liquid transportation fuels, high-value biobased chemicals, electricity, substitutes for petroleum-based feedstocks, and useful heat.

<sup>1</sup>U.S. Congress. 2005. Energy Policy Act of 2005, Pub. L. 109-58 ([www.epa.gov/OUST/fedlaws/publ\\_109-058.pdf](http://www.epa.gov/OUST/fedlaws/publ_109-058.pdf)).

### Section 941. Amendments to the Biomass Research and Development Act of 2000.

This section presents several changes in the wording of the Biomass Research and Development Act of 2000. Some important changes include redefining the objectives of the Biomass Research and Development Initiative to state that the initiative will develop “(1) technologies and processes necessary for abundant commercial production of biobased fuels at prices competitive with fossil fuels; (2) high-value biobased products... to enhance the economic viability of biobased fuels and power... and [serve] as substitutes for petroleum-based feedstocks and products; and (3) a diversity of sustainable domestic sources of biomass for conversion to biobased fuels and biobased products.” Another important amendment introduces four technical areas that the initiative will address in its research and development activities: (1) develop crops and systems that improve feedstock production and processing, (2) convert recalcitrant cellulosic biomass into intermediates that can be used to produce biobased fuels and products, (3) develop technologies that yield a wide range of biobased products that increase the feasibility of fuel production in a biorefinery, and (4) analyze biomass technologies for their impact on sustainability and environmental quality, security, and rural economic development.

### Section 942. Production Incentives for Cellulosic Biofuels.

This section calls for the establishment of a program that provides production incentives on a per-gallon basis for cellulosic biofuels. The purpose of the incentive program is to ensure that 1 billion gallons in annual cellulosic biofuel production are achieved by 2015; cellulosic biofuels are cost-competitive with gasoline and diesel; and small feedstock producers and rural small businesses are full participants in the cellulosic biofuel industry.

### Section 977. Systems Biology Program.

This section provides for the establishment of a research program in microbial and plant systems biology, protein science, and computational biology to support DOE energy, national security, and environmental missions. Funds will be available for projects to plan, construct, or operate special instrumentation or facilities for

researchers in systems biology and proteomics and associated biological disciplines. Biomedical research on human cells or human subjects is prohibited.

## **Title XV—Ethanol and Motor Fuels**

### **Section 1501. Renewable Content of Gasoline (Renewable Fuels Standard).**

This section amends Section 211 of the Clean Air Act. An important amendment is the establishment of the renewable fuel program. In this program, gasoline sold in the United States is required to be mixed with increasing amounts of renewable fuel (usually ethanol) on an annual average basis. In 2006, 4 billion gallons of renewable fuels are to be mixed with gasoline, and this requirement increases annually to 7.5 billion gallons of renewable fuel by 2012. For 2013 and beyond, the required volume of renewable fuel will include a minimum of 250 million gallons of cellulosic ethanol.

### **Section 1505. Public Health and Environmental Impacts of Fuels and Fuel Additives.**

This section amends Section 211(b) of the Clean Air Act by requiring study of the impacts of increased use of fuel additives (e.g., ethanol and other chemicals) on public health, air quality, and water resources.

### **Section 1506. Analysis of Motor Vehicle Fuel Changes.**

This section amends Section 211 of the Clean Air Act by requiring study of the effects of ethanol-gasoline mixes on permeation of fuel molecules into plastic and rubber components of fuel systems and the evaporative emissions resulting from this permeation.

### **Section 1511. Renewable Fuel.**

This section amends the Clean Air Act by adding a section that allows funds to cover loan guarantees for no more than four projects commercially demonstrating the feasibility of producing cellulosic ethanol. Each project is expected to produce 30 million gallons of cellulosic ethanol annually. Funds also have been authorized for a resource center that further develops bioconversion technologies for ethanol production.

### **Section 1512. Conversion Assistance for Cellulosic Biomass, Waste-Derived Ethanol, Approved Renewable Fuels.**

This section amends Section 211 of the Clean Air Act by authorizing DOE to provide grants for building

production facilities to producers of cellulosic ethanol and other approved renewable fuels.

### **Section 1514. Advanced Biofuel Technologies Program.**

This section authorizes the EPA Administrator to establish a program to demonstrate advanced technologies for the production of alternative transportation fuels. Priority is given to projects that increase the geographic distribution of alternative fuel production and make use of underutilized biomass feedstocks.

### **Section 1516. Sugar Ethanol Loan-Guarantee Program.**

This section authorizes DOE to issue loan guarantees to projects that demonstrate the feasibility of producing ethanol from sugar cane or sugar cane by-products.

## **Title II—Renewable Energy**

### **Section 208. Sugar Cane Ethanol Program.**

The Environmental Protection Agency is to establish a \$36 million program to study sugar cane, production of ethanol from sugar cane, and sugar cane by-products. The project will be limited to sugar and ethanol producers in Florida, Louisiana, Texas, and Hawaii. Information will be gathered on how to scale up production once the sugar cane industry is ready to locate sites for and construct ethanol-production facilities.

### **Section 210. Grants to Improve the Commercial Value of Forest Biomass for Electric Energy, Useful Heat, Transportation Fuels, and Other Commercial Purposes.**

The Secretary of Agriculture or the Secretary of the Interior may provide grants to any person in a preferred community (e.g., Indian tribe, town or unit of local government with fewer than 50,000 individuals, or one that has been determined to pose a fire, disease, or insect-infestation hazard to federal or Indian land). Owners of facilities that use biomass to produce electricity, useful heat, or transportation fuels may receive grants of up to \$20 per green ton of biomass delivered to offset the cost of raw material. Grants of up to \$500,000 may be awarded to offset the costs of developing research opportunities that improve the use of or add value to biomass. For each fiscal year from 2006 through 2016, \$50 million is authorized to be appropriated to carry out this section.