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BEFORE THE
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OVERSIGHT HEARING ON BIOFUELS RESEARCH FOR ENERGY PRODUCTION
AGRICULTURAL RESEARCH SERVICE
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Mr. Chairman and Members of the Subcommittee, I am Gale A. Buchanan, Under Secretary for Research, Education, and Economics (REE) in the United States Department of Agriculture (USDA). Thank you for the opportunity to submit written testimony to the Subcommittee today about USDA research on biofuels and how this ongoing research and development can contribute to increased production of domestic energy supplies, and help promote continued prosperity in rural America.

Recognizing that it is in the United States' interest to meet its growing energy demand with a greater share of domestic fuels, President Bush outlined the 2006 Advanced Energy Initiative. Some scientists have been heard to say that we can't hope to accomplish this with a silver bullet—we'll need silver buckshot instead. Domestic biofuels technology, at the junction between biological and energy research, is a new and particularly fertile area and can be an effective part of that mix.

Biofuels are produced from any type of biomass, which includes all plant- and animal-derived materials. In the United States today, the most common biofuel is ethanol which is produced from starch obtained from corn--or other grains--and then converted into sugar and fermented to produce alcohol. Biodiesel is produced by refining the oil obtained from soybeans and other oil crops, as well as oil derived from animal fats and used cooking grease. There are presently over 100 operating ethanol refineries, with 30 more under construction. Biodiesel is produced at 65 commercial refineries with another 50 on the way. Together, these two biofuels constitute, on a volume basis, approximately 4% of the fuels we use for transportation in this country. In fact, when you look at the numbers, you'll see that energy derived from biomass resources recently surpassed hydropower as the Nation's leading source of renewable energy.

It's time to build on that success. In 2005, the Department of Energy and USDA released a major study assessing the Nation's capacity to utilize biomass as a feedstock for bioenergy generation and related bioproducts industries. This study concluded that, with relatively modest changes to land use and agricultural and forestry practices, by 2030 the land resources of the United States could be capable of producing a sustainable supply of biomass sufficient to displace the equivalent of 30% or more of the Nation's present petroleum consumption without significantly displacing the production of food. The resources used for biofuel materials could

include crop residues, grains, animal wastes, and forest residue generated from lumbering, paper manufacturing, fuel load reduction, and other activities. Plant resources would be used as the primary raw material to produce cellulosic ethanol, which differs from starch-derived ethanol because it uses every available part of the plant—leaves, bark, stems, roots, and all—in the ethanol production process. Of course, the technology to produce cellulosic ethanol is not yet commercially viable. Through his Biofuels Initiative, part of the Advanced Energy Initiative at the Department of Energy (DOE), the President set a goal for conducting research to accelerate the date at which cellulosic could be cost-competitive with corn-based ethanol by 2012. While USDA is not directly part of this initiative, ongoing research and collaboration with DOE could contribute to its goal.

There is no perfect fuel—at least, we haven't discovered it yet. Each barrel of oil contains a huge amount of energy, which is accessed through an intricate infrastructure of production and distribution. Biofuels, too, face challenges in production and supply system, but offer us the opportunity to build on the successes we've already achieved with oil and its refined products.

To begin with, we must focus on bringing the cost of biofuel production more in line with the cost of petroleum production. While international events can result in petroleum price swings beyond our control, overall petroleum production costs are presently still lower than domestic biofuel production costs. The harvest, storage, and processing of crops for biofuel conversion is one part of the production flow where continued research will help bring production costs more in line with the costs of fossil fuel production. We will also need to make the production of biofuel energy more efficient, which will make it more economically competitive. At present, the amount of energy that can be obtained from starch or cellulose is small compared to the amount of energy that can be obtained from petroleum, on a per unit volume basis. Since we are aiming to meet a larger share of the Nation's energy needs with biofuels, we will need a significant quantity of biomass feedstock. As the biofuel learning curve continues, we will find more efficient methods of obtaining the energy in biomass resources, and we will develop more cost-effective processes and greater energy yields. As part of this effort, research is continuing on mechanisms for breaking down plant cell walls to utilize plant cellulose for its energy content, and reducing the amount of energy that is needed to produce ethanol from grain starch. Biodiesel offers some additional challenges that are presently being studied: biodiesel fuel can generate nitrogen oxide emissions and at low temperatures, biodiesel will sometimes crystallize and gel. In short, biofuels offer a promising--but challenging--research agenda.

To help the Nation meet its energy needs with renewable resources, USDA's Agricultural Research Service (ARS) conducts a Bioenergy and Agricultural Energy Systems Research Program. Work is focused on developing energy-efficient and economical energy sources, developing value-added biofuel coproducts, understanding biomass biology and characteristics to improve the production of biofuel crops, and developing better technologies for the conversion of plant material to biofuels. Some 60 ARS scientists at 14 laboratories across the Nation are conducting a wide range of research that supports the development of a more efficient and productive biofuels industry.

ARS research has produced several outstanding findings that will help biofuel crops claim a more prominent place in the Nation's energy supply. ARS scientists and partners at the University of Illinois have developed more environmentally friendly process for processing seed corn that uses new enzymes instead of toxic sulfites. The corn is processed into corn oil, high-protein feeds, and higher yields of starch, and the starch is then fermented into ethanol. The higher starch yields resulting from the use of the new enzymes have lowered ethanol's

production cost by reducing enzyme costs by 90%, and have been so successful that one of the world's largest enzyme companies is currently licensing this patented technology. ARS scientist Dr. David Johnston, who played a key role in this discovery, received the Presidential Early Career Award for Scientists and Engineers for his research.

Cost and process engineers at the ARS Eastern Regional Research Center in Wyndmoor, Pennsylvania, have developed sophisticated computer models for biofuel and grain processes that have been used by hundreds of companies and private institutions around the world, including Dupont's New Integrated Corn Biomass Refinery. Producers can use these models to determine whether new ethanol production processes are feasible before spending funds on bench-scale and pilot-scale research.

ARS scientists have discovered that several other plants show potential as sources for biofuel. Researchers identified switchgrass genes that are associated with valuable traits such as biomass yield, drought tolerance, and seed production. This new knowledge provides an enhanced understanding of switchgrass that will allow genetic modification of this plant for enhanced energy feedstock production. ARS scientists have also developed processes for turning field peas into enriched protein and starch and for fermenting the pea starch into ethanol. Ethanol yields from pea starch were found to be comparable to yields from corn starch. Work is also being conducted to create new barley varieties with higher starch content, as well as to develop new milling processes that will separate low-starch barley kernels into a starch-enriched stream for efficient ethanol production. This process will also yield a protein- and fiber-enriched fraction for making valuable food and feed co-products. Overall, this could result in production of another 1 to 2 billion gallons of ethanol per year in non-Corn Belt States on the east and west coasts and provide a new cash crop for growers.

ARS scientists are working on enzymatic processes to convert animal fats, vegetable oils, and restaurant greases into biodiesel. This research program is also helping to improve biodiesel quality and performance, including increasing its storage stability and reducing its emissions of nitrous oxides and sulfur.

Other USDA agencies also conduct research on biofuels. The Cooperative State Research, Education, and Extension Service (CSREES) provides extramural funding for 45 projects, primarily through the National Research Initiative (NRI), the Small Business Innovation Research Program (SBIR) and the Agricultural Materials Program (AMP). For FY 2005, CSREES provided an estimated $6.9M for energy-related projects, and $11.5M for biobased products that can replace petroleum-based products.

There are many fine examples of bioenergy-related projects funded by CSREES. In Indiana, researchers at Purdue are receiving NRI funding to genetically modify yeast so that it can co-ferment mixtures of cellulosic sugars into ethanol. This yeast has been licensed to Iogen Corporation, which began the world's first commercial cellulosic ethanol fuel production from straw in April 2004. This process improved the ethanol yield from straw by 30 to 40 percent.

In a similar vein, a team of researchers at the University of Florida is using NRI support to focus on the genetic engineering of novel bacterial biocatalyst for the conversion of lignocellulosic biomass into ethanol fuels. The technology has been found to be successful in converting over 50 different agricultural residues into fermentable sugars and plans are underway to build full-scale processing mills throughout the world.

At North Carolina State University, scientists are working to modify cellulose biosynthesis in trees so that they will produce more desirable cellulose and less undesirable lignin.

In Oklahoma and Mississippi a consortium, Biomass-Based Energy, is working to combine gasification and fermentation technologies that utilize perennial grasses to produce both ethanol and chemicals.

In Iowa, the Iowa Biotechnology Consortium is bringing university scientists together with industry R&D specialists to develop technologies that will recover energy, chemicals, and materials from agriculture wastes.

The National Alternative Fuels Laboratory at the University of North Dakota has developed an aviation-grade ethanol certified by the U.S. Federal Aviation Administration.

The University of Idaho is working with the Biodiesel Fuel Education Program of National Biodiesel Board, to provide public education and outreach about the benefits of using biodiesel.

CSREES is also working diligently to foster interagency and interdepartmental collaboration and cooperation. A notable example is the joint research solicitation between USDA-CSREES and the Department of Energy (DOE). Working together they jointly identified the need and opportunity for genomics-based research that can improve the use of biomass for the production of fuels such as ethanol or renewable chemical feedstocks. Jointly, USDA-CSREES and DOE have just announced the selection of nine recipient institutions that will receive $5.7 million to pursue this work.

I would also like to mention that the Economic Research Service (ERS) is playing a role in this area by collecting and analyzing information about biofuel crops and the impact they may have on the agricultural economy, as well as other energy issues of concern to producers.

In summary, USDA is excited about the opportunities that biofuels offer to this Nation as we continue to develop ways to economically increase our domestic energy supply. We will work to coordinate our work with the President's Biofuels Initiative in DOE. Working together, we believe that we can help biofuels expand their role in the domestic energy supply, and we thank you for the opportunity to share our research with you.