

Testimony submitted to the

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Committee on Agriculture
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by

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On behalf of South Dakota State University, I wish to thank Chairman Peterson for the opportunity to address the House Committee on Agriculture. As the Congress evaluates the current Farm Bill, the nation continues to be at a critical juncture in terms of its energy security. Our future economic and strategic security is eroding because of our nation's excessive dependence on imported petroleum. This has led to much debate and speculation about the role renewable fuels can and should play in our effort to eliminate our dependence on foreign oil, and whether or not the agricultural industry can produce the necessary food, energy, and social services that will be demanded by a world with 9 billion people. I think that as Americans we can agree that the continued use of fossil energy merely passes on our current challenges to future generations, including environmental concerns and the issue of long-term energy supply. American agriculture represents an important part of the solution toward reversing these concerns. American farmers, agribusinesses, and agricultural scientists can lead the world in development of renewable agriculture-based energy sources; however, the Congress must enact policies, programs, and funding that empower these sectors.

Through the Farm Bill, the House Committee on Agriculture has profound influence on higher education and public research in the United States. Title VII (i.e. the Research Title) delivers essential authorizations by which the Land-Grant community carries out their mission. The foundational programs in Title VII make the nation's Land-Grant institutions an international powerhouse. Because of the Farm Bill authorizations, Land-Grant institutions communicate with each other, generate intellectual synergy, leverage resources and expertise, and have a track record of solving problems for agricultural producers and rural communities.

USDA-REE Reorganization

The 2008 Farm Bill is reinvigorating agricultural research and the Land-Grant community. Section 7511 creates the National Institute of Food and Agriculture (NIFA). Under this section, NIFA is to replace the Cooperative State Research, Education, and Extension Service (CSREES). The reinvigoration will result from elevating scientific rigor and establishing a national institute on par with the National Institutes of Health and the National Science Foundation. Additionally, NIFA is to be directed by an agricultural or food science scholar of national renown.

USDA - Research, Education and Economics (USDA-REE) has made progress toward establishing NIFA as directed in the Farm Bill. I have received input from Land-Grant college deans and administrative heads indicating that they are cautiously optimistic about the progress to date. It is clear that NIFA is established as a new administrative entity and that the CSREES structure is being transferred. Last autumn, Dr. Roger Beachy was confirmed as the first NIFA

director and I appreciate how he has implemented NIFA programs. As a hallmark for the new agency, NIFA has established the Agricultural and Food Research Initiative (AFRI) to replace the former CSREES National Research Initiative.

The AFRI has been implemented to meet the nation's most urgent issues in agriculture, food, and human nutrition. The AFRI is a competitive program with broad eligibility to Land-Grant institutions, federal agencies (e.g. USDA-ARS), and other entities (e.g. non Land-Grants and private corporations). The breadth of eligibility stands to redefine public agricultural research.

The AFRI will establish Coordinated Agricultural Projects with relatively high funding levels of \$5 million per year and five-year durations. These large grants will be comprised of multi-institutional teams that integrate research, Extension, and education. The current priority issue areas include:

- Childhood Obesity Prevention (\$25 million with FY 2010 funds)
- Global Food Security (\$19 million with FY 2010 funds)
- Food Safety (\$20 million with FY 2010 funds)
- Climate Change (\$55 million with FY 2010 funds)
- Sustainable Bioenergy (\$40 million with FY 2010 funds)

Implementation of AFRI is currently under way and eligible institutions are actively developing teams, research plans, and proposals. I feel that NIFA has introduced AFRI effectively and that meaningful results are forthcoming.

The 2008 Farm Bill also supports the Land-Grant community through continued support of the capacity programs. These programs include the Hatch, Evans-Allen, Smith-Lever, and McIntire-Stennis funds that serve as the foundation of state agricultural experiment stations, and state Cooperative Extension Services. These authorizations and corresponding appropriations are the heart of what makes the Land-Grant system unique in the world by linking state scientists with stakeholders, industry, and federal agencies to address problems and opportunities at local and regional scales. Perhaps most important, higher education and public outreach are linked through the Land-Grant system so that research and education are mutually beneficial. The Land-Grant institutions are charged with addressing national problems at a local level and on behalf of local stakeholders. The long-term capacity that is provided by the capacity funds positions the institutions to be immediately responsive to problems. Even in the current budgetary restraints faced by each state, the agricultural experiment stations continue to be supported and federal appropriations are leveraged several fold with non-federal funds.

These components of today's NIFA are critical elements of the nation's agricultural research capacity. The several authorizations provided by Title VII, such as ARFI competitive funds, capacity funds, and specialized programs such as SARE and Sun Grant, represent a balanced portfolio of diverse research resources. Diversity is an essential key element of sustainability.

Sun Grant Program

The Sun Grant Program was first authorized in January 2004 in section 9011 as an amendment to Title IX of the Farm Security and Rural Investment Act of 2002 (7 USC 8109). The program was reauthorized in the 2008 Farm Bill as section 7526 with annual appropriations limits of \$75 million. Additionally, Sun Grant is authorized as section 5201(m) under provisions of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users of

2005 [SAFETEA-LU (23 USC 118)]. These authorizations culminated planning and development since 2001 by Land-Grant universities and the Congress.

The mission of the Sun Grant Program is to:

- Enhance national energy security through the development, distribution, and implementation of biobased energy technologies;
- Promote diversification in, and the environmental sustainability of agricultural production in the United States through biobased energy and product technologies;
- Promote economic diversification in rural areas of the United States through biobased energy and product technologies; and
- Enhance the efficiency of bioenergy and biomass research and development programs through improved coordination and collaboration between the Department of Agriculture and the Department of Energy, and the Land-Grant colleges and universities.

Five Land-Grant universities serve as regional Sun Grant centers, including South Dakota State University, Oklahoma State University, the University of Tennessee, Oregon State University, and Cornell University. The regional centers emphasize research, Extension, and educational programs on renewable energy technologies while promoting biobased industries in rural communities. Each center is authorized to receive base federal funding to establish them as leading research, Extension, and higher education institutions for the biobased economy. Each center is guided by stakeholder input through their regional advisory councils.

Other key guidelines define how the regional Sun Grant centers function:

- Appropriations are to be allocated evenly among the five regions
- No more than 25% of regional funds will be used directly for a center's programs
- The remaining 75% of regional funds are to be allocated within a region to Land-Grant institutions through competitive processes.
- Research, Extension, and educational programs on bioenergy and biobased products will include activities aimed at technology development and technology implementation.

Since passage of the authorization, the Sun Grant Program has developed collaborative working relations and projects with the U.S. Department of Transportation (DOT), U.S. Department of Energy (DOE), and USDA. The Farm Bill authorization has attracted agencies to the Sun Grant Program as a means of facilitating their own goals toward developing renewable energy. For example, funding for the Sun Grant Program is included in the President's FY 2011 Budget Request in DOE's Office of the Biomass Program (OBP) to support the DOE Regional Feedstock Partnership. The regional centers already facilitate ongoing and proposed federal-funded research, Extension and education programs in their respective regions. These programs embrace the multi-state, multi-function, multi-disciplinary integrated approach that is at the heart of how Land-Grants address national problems. The Sun Grant centers have developed rigorous competitive regional programs to identify excellent projects. Today, the Sun Grant Program has implemented 123 competitively awarded regional research projects in 37 states (Figure 1) and has implemented 110 field trials in 36 states through the DOE Regional Feedstock Partnership (Figure 2).

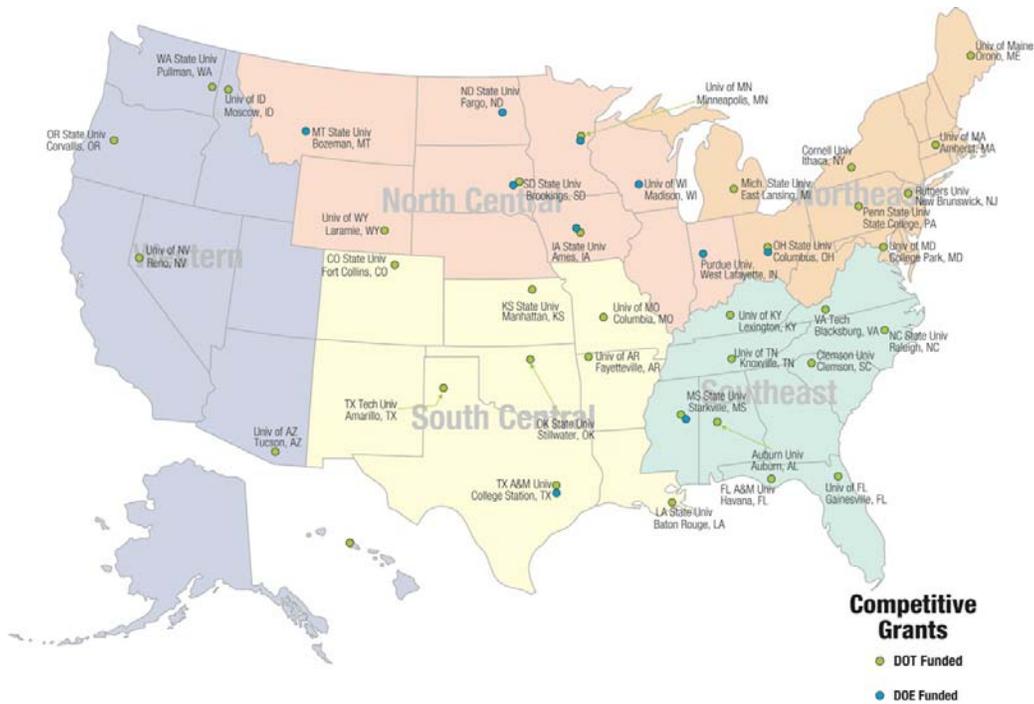


Figure 1. Sun Grant research projects awarded through regional competition. The projects are funded through DOT or DOE funds.

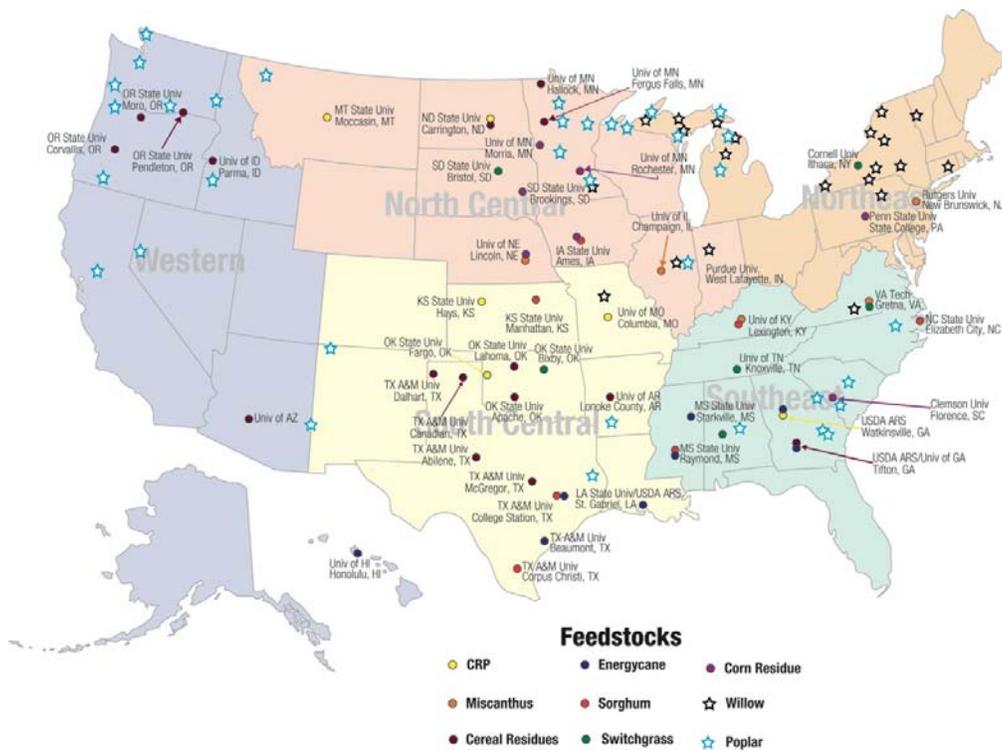


Figure 2. Field trials implemented by the DOE-Sun Grant Regional Feedstock Partnership. Feedstock species were identified by DOE as models to determine sustainability measures and production supply curves.

The scope of Sun Grant research is very broad. Feedstock development includes camelina, palm, eutropha, hazelnut, sorghum, switchgrass, prairie cordgrass, cup plant and many other species. Development of conversion processes includes new pretreatments and organisms for fermentation and includes improved processes for biodiesel, gasification, and pyrolysis. One project is using nanotechnology to recover enzymes so that ethanol production costs can be reduced. Sun Grant-funded work has examined state-based policies in Western states and has developed GIS models to site biorefineries in the Southeastern U.S.

Some examples of outcomes of Sun Grant-supported research include:

Western Regional Sun Grant Center at Oregon State University

- Washington State University is developing a pyrolysis based biorefinery that will process forest residues and will permit production of pyrolysis oils, lipids, or anhydro-sugars that can be fermented to ethanol.
- The University of Nevada – Reno is developing salt basin algae for biofuels production and carbon sequestration. Halophytic algae are an ideal renewable energy resource because they grow on marginal lands with brackish or saline water and have been shown to be 30 times more productive than terrestrial feedstocks. The team is evaluating algae strains and mutants for high production of triacylglycerols under different growing conditions and identify genes related to oil production by microarray analysis. Ultimately, this project will provide an assessment of the potential of algae as a biodiesel feedstock. The lipid and starch contents of 19 halophytic green algal strains of the genus *Dunaliella* were determined for their suitability for use as feedstocks for biofuels.
- Oregon State University is developing camelina as a low-input oilseed crop for the Pacific Northwest. They have determined correct planting dates in environments in which camelina yield performance is likely to be best, but these windows will vary by environment. Fall-planted camelina can withstand cold winter temperatures with little snow cover as well as the combination of cold and wet soil conditions in the region. They found that residual herbicides and slug predation create challenges for camelina survival in the Willamette Valley. Broadcast and drilled seedings showed similar performance levels.

North Central Regional Sun Grant Center at South Dakota State University

- South Dakota State University has plant breeding and genetics projects to identify native perennial plants, such as prairie cordgrass, that can produce lignocellulosic feedstock on marginal land (wet & salty) in amounts equal to or greater than switchgrass on prime farmland in the North Central Region.
- The University of Wyoming has developed nano-technology to recover and reuse enzymes necessary for converting lignocellulosic feedstocks into second-generation biofuel. Laboratory –scale results indicate the enzymes can be recovered, cleaned and reused several times with limited reduction in enzymatic activity saving the cost of new enzymes which can be up to 25% of the cost of biofuel production.
- The University of Minnesota is developing microwave technology to design, engineer, and test a low capital cost, mobile pyrolysis unit to convert lignocellulosic biomass into bio-oil which can be refined into a drop-in transportation fuel.

South Central Regional Sun Grant Center at Oklahoma State University

- Texas A&M University has developed sorghum lines that optimize the endosperm for ethanol conversion and distiller's grain feed for low rain-fed Texas environments. These lines represented advanced lines that have a wild-type endosperm, the high amylopectin waxy grain trait or the high protein digestible/ high lysine grain trait. The combination of these two modified endosperm traits into a single sorghum hybrid will be the optimal endosperm architecture for low energy and high ethanol yield.
- Oklahoma State University has developed a unique downdraft gasifier optimized for low bulk density biomass feedstocks, such as switchgrass, to generate synthesis gas high in carbon monoxide and hydrogen concentrations and low in tar and particulate contents. This gasifier has been demonstrated to potential industries for commercialization.
- Texas A&M University has finalized the design and development of a skid-mounted fluidized bed gasifier that can be relocated using a mobile trailer. Various feedstocks have been gasified including sorghum biomass, animal manure (dairy and poultry litter), switchgrass, wood chips and straw. A patent has been filed and numerous companies have shown interest in commercialization.

Northeast Regional Sun Grant Center at Cornell University

- The University of Massachusetts has collected twenty hyperthermophile bacteria from a geothermal vent off the coast of Washington and Oregon. The bacteria that grow at 200 degrees Fahrenheit and have been observed to convert cellulose to hydrogen and grew on cellulose at a rate approximately 30% faster than any other microbe previously reported. These microorganisms have great potential for industrial applications.
- Rutgers University is developing hazelnut as a potential new oil-producing crop for the Northeastern U.S. The Rutgers team has identified some promising cultivars that have resistance to Eastern Filbert Blight, a disease that makes hazelnut production difficult in the Northeast. Initial results suggest hazelnut trees could produce almost twice as much oil per acre as soybeans.
- Cornell University is evaluating the potential performance of a broad range of grasses and production methods for ethanol production capacity to help plant breeders select the best bioenergy grass cultivars. Lignocellulosic ethanol can be produced from sugars in the cell walls of grasses, but not all sugars are the same. The Cornell University research team is evaluating ethanol production capacity in grasses by examining the types of sugars stored in cell walls. Compositional analysis revealed that the grasses could be clustered into two different groups - one with more useful (fermentable) sugars (cellulose, xylose and arabinose) in the cell walls, and a second group with sugars that are not as readily fermentable (rhamnose, fucose and mannose).

Southeast Regional Sun Grant Center at the University of Tennessee

- The University of Tennessee has developed an innovative biomass site assessment tool, known as BioSAT (www.biosat.net). As the only model incorporating biomass from both agricultural and forest sectors in the analysis, it covers the 33 eastern states and offers convenient web access for clients. The investment has been leveraged with support from the U.S. Forest Service and other partners to establish a broad-based program addressing the unique information needs presented by bioenergy issues.

- The University of Tennessee has advanced the use of ionic liquids to pretreat woody biomass for greater enzyme access to cellulose. After a 3-day exposure to ionic liquid, 95 percent conversion of cellulose was achieved in 8 hours, while the untreated wood released less than 10 percent of sugars even after 72 hours. The dramatic improvement was attributed to both physical (loss of crystalline structure) and chemical changes in the biomass.
- The University of Kentucky is developing *Clostridium thermocellum*, an anaerobic bacterium that can directly convert cellulose into ethanol. Their work has shown that *C. thermocellum* at elevated pressure (7.0 MPa, and 13.0 MPa) increased the ethanol:acetate ratio by more than 100-fold compared to that under atmospheric pressure. In revealing the ability to control product selectivity by environmentally manipulating carbon and electron flows, a novel approach to directing microbial metabolism is being exploited.

Recent Developments from the Administration

The Obama Administration is also working on strategies to address the daunting challenges of agriculture. For example, the White House released a plan last January entitled “Growing America’s Fuel: An Innovation Approach to Achieving the President’s Biofuel Target.” The plan identifies key segments of the bioenergy supply chain and identifies federal agencies to lead research, development, and policy efforts. The supply chain/agency assignments include:

<u>Supply Chain Segment</u>	<u>Lead Agency</u>
1. Discovery Science	DOE Office of Science
2. Feedstock Development	USDA REE and Forest Service (FS)
3. Feedstock Production Systems	USDA REE and FS
4. Pilot Scale Conversion and Biorefinery Facilities	USDA REE and FS
5. Full-scale and Widespread Deployment of Commercial Facilities	USDA-Rural Development (RD) and FS
6. Regulatory Compliance	Environmental Protection Agency (EPA) and USDA
7. Sustainability	EPA and USDA
8. Policy Support	All
9. Dissemination of Best Practices and Technical Assistance	USDA-NIFA
10. Feedstock Supply Chain Workforce Development	USDA-REE, FS, RD and Universities

The plan calls for setting biofuels production targets, then implementing federal programs designed to meet the targets. It also identifies a full complement of feasibility measures to provide guidance on program evolution. There is support for the Administration’s *Growing America’s Fuel* plan; however, it misses the mark on at least two issues. First, the role of EPA in the sustainability segment must be weighed carefully. Environmental issues are only one component of sustainability and agencies such as USDA or DOE would be better leads because of their research capacities. Secondly, the President’s FY 2011 budget proposes to allocate \$10 million to establish five Regional Feedstock Centers within the USDA-Agricultural Research Service (ARS). The USDA-ARS centers are to plan and develop regional supply chain systems that link feedstock development, production, logistics, conversion, co-product

production and distribution. Additionally, the proposed USDA-ARS centers are to “coordinate with DOE to enhance work underway through DOE’s Regional Feedstock Partnerships and the Bioenergy Research Centers.” The proposed USDA-ARS centers duplicate the Sun Grant Program. The Congress has already established five regional Sun Grant centers that serve the same purpose described in the White House report. Moreover, the DOE Office of Biomass Programs contacted the leadership of the Sun Grant Program in 2006 to establish the Regional Feedstock Partnership. The Sun Grant centers have been coordinating the Regional Feedstock Partnership since that time and have included participation of USDA-ARS and private industry scientists.

Return on the Public Investment

Title VII of the 2008 Farm Bill is critical for the nation’s future. The authorizations and associated appropriations enable critical research and development that will advance agriculture, feed the world’s growing population, sustain the environment, support global commerce, and benefit world peace. These are not exaggerated goals and an analysis of past public investment will likely support these claims. Indeed, economists at the University of Nebraska recently studied the internal rates of return to public investment in agricultural research. During the period of 1949 to 1991, the mean social rate of return was 27% and the mean own-state return was 17%. The average rates of return during this period for the S&P500 and NASDAQ were 9% and 12%, respectively. The public investment in agricultural research is critical for future social and economic benefits to the nation.

Perhaps more important, the Farm Bill truly impacts higher education. Each year, the month of May brings celebrations at university commencement events across America. Graduate students at the nation’s Land-Grant institutions are being recognized for their accomplishments in original research. Title VII of the Farm Bill has a profoundly positive influence on the work of practically every student in agriculture and related fields. The research mission is at the heart of the Land-Grant system. Research provides for an advanced curriculum for future generations of students. It assures us that we will have a highly educated workforce and a vast nation of leaders. Research supports continuous education long after students leave their alma maters.

Thank you for the opportunity to visit with you today. Thank you for your hard work and commitment to bringing a better future to the United States through a balanced research portfolio.

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