

South Dakota State University SGI/DOE Regional Biomass Feedstock Partnership Competitive Grants



20-23 May 2013



DOE Bioenergy Technologies Office Project Peer Review
Feedstock Supply and Logistics

Vance Owens, Interim Director
NC Regional Sun Grant Center
South Dakota State University

Goal Statement

- Utilization of the congressionally directed DOE project at South Dakota State University and the North Central Regional Sun Grant's Competitive Grant program to address key issues and research gaps identified via the Sun Grant/DOE Regional Biomass Feedstock Partnership
- Researchable topics germane to the sustainable production, harvest, transport and delivery of cost-competitive, domestically grown biomass

Quad Chart Overview

Timeline

- Project start date: 6-1-2008
- Project end date: 9-31-2013
- Percent complete: 70%

Budget

- Funding for FY11: \$0
- Funding for FY12: \$0
- Funding for FY13: \$0
- Years the project has been funded/average annual funding: 5 years @ \$2,098,400/year

Barriers

- Barriers addressed
 - Ft-B Sustainable Production
 - Ft-K Biomass Physical State Alteration
 - Ft-L: Biomass Material Handling and Transportation

Partners

- Land-Grant Universities
- Industry Partners
- Project management
 - South Dakota State University

Project Overview

- South Dakota State University agreed to employ the North Central Regional Sun Grant Center to administer a competitive grant program supporting the Regional Biomass Feedstock Partnership utilizing the Sun Grant's authorization as a guide.

1 - Approach

- Sun Grant Authorization
 - Build local expertise and strength at the regional Sun Grant Centers (up to 25%)
 - Regional Competitive Grants (75%)
 - Integrate Federal and Regional Priorities
 - Regional Advisory Council and listening sessions
 - Federal Road Maps/Program Priorities
 - At least 30% for
 - Technology development
 - Technology implementation

1 - Approach

- 2008 Request for Applications
 - Priority: Biomass feedstock logistics: biomass harvesting, handling (field operations), transportation, storage (including degradation & transformations), and densification.
 - 42 pre-proposals submitted
 - 20 invitations to submit full proposals
 - 8 selected for funding
- 3 internal projects selected for funding

1 - Approach

- 2009 Request for Applications
 - Priority: Sustainable biomass feedstock production systems for the North Central Sun Grant Region including biomass crop development, production, and systems/life-cycle analysis.
 - 77 pre-proposals submitted
 - 19 invitations to submit full proposals
 - 6 selected for funding
- 4 internal projects selected for funding

1 - Approach

- 2010 Request for Applications
 - Priority: Biomass production systems that optimize biomass feedstock yield and economic return across a diverse landscape in the North Central Sun Grant Region while minimizing negative effects on the environment and food/feed production.
 - 27 pre-proposals submitted
 - 14 invitations to submit full proposals
 - 4 selected for funding
- 2 internal projects selected for funding

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: Evaluation of In-field Corn Stover Densification and Interaction with Storage Quality, Logistics, and Production Costs; Matthew Darr, Iowa State Univ.
 - In-field bale production costs of \$12 per ton.
 - Found a 20% improvement in bale collection efficiency when using an intelligent bale staging system.
 - Tarped stacks offered best balance of cost and quality.
 - Road quality a key criterion in selecting a satellite storage location
 - Tube wrapping a viable preservation option for early season, high moisture corn stover.
 - Dry matter loss the most influential economic driver to storage methods
 - DuPont Danisco Cellulosic Ethanol involved in this project

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: In-Field Cubing of Cellulosic Biomass; Kevin Shinnars, University of Wisconsin
 - Most important variables for successful formation of biomass cubes were, in order of importance: low moisture content (< 16% w.b.); die block temperature at or below ~ 50°C; addition of lime at ~1% of DM as a binding amendment; steam conditioning
 - Durability of biomass cubes was often well below the target of 75%
 - If the physical form of cubes is not required, then baling would be less costly per ton than in-field cubing

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: The Logistics of Herbaceous Crop Residue-Based Ethanol Production under Uncertainty; David Lambert, Kansas State University
 - Results indicated HCR-based cellulosic ethanol production is profitable under the cost, price, and technical assumptions used to model plant investment decisions
 - Local cropping patterns influence likely locations of pretreatment and refinery operations
 - Potential crop residue-based ethanol plants favor the more productive agricultural areas of the three states (MN, SD, ND)
 - Ammonium Fiber Expansion pretreatment (AFEX) yields feedstock for ethanol production yet also can provide high value cattle feed for local feedlots

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: Strategies for Concurrent Wet Storage and Pretreatment of Corn Stover; Yebo Li, The Ohio State University
 - Adding NaOH significantly enhanced the enzymatic degradability of corn stover by 2-3 fold after 90-d wet storage
 - Feasible to apply fungal treatment concurrently with on-farm wet storage for ethanol production
 - Using lab-scale results, the cost of ethanol production from corn stover may be 5-13% less by eliminating the pretreatment and conditioning steps in the biorefining plants

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: Improving Handling Characteristics of Herbaceous Biomass; Vance Morey, University of Minnesota
 - Optimum tub-grinding and roll press compaction variables were obtained to produce compacted biomass materials with a bulk density of at least 240 kg/m³ (15 lb/ft³)
 - Roll press compacts could be handled in belt conveyors without significant dust formation
 - Estimates show that as a fuel for heat and power applications, coarse ground/roll compacted corn stover reduced life-cycle GHG emissions by factors of approximately 7 and 11 compared to natural gas and coal, respectively
 - Industry partners: Kolbeck, Inc.; Bepex International LLC

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: Optimizing the Logistics of a Mobile Fast Pyrolysis System for Sustainable Bio-crude Oil Production; Sergio Capareda, Texas A&M University
 - A mobile fast pyrolysis system was developed and tested for biofuel production from corn stover, sorghum, and switchgrass
 - GIS analyses revealed that railroads and pipelines were generally not useful in optimizing feedstock logistics in the NC Region. Instead, roads and highways were the preferred means of transportation
 - Bio-char incorporation negatively affected major plant nutrient availability, and caused changes in soil pH and soil salinity
 - Bio-chars must be incorporated properly to prevent derogatory soil environment
 - Probability of greatest economic success (defined as a Net Present Value greater than zero) occurred when the mobile pyrolysis machine was stationary
 - One provisional patent issued

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: Transforming and Densifying Biomass in Regional Biomass Processing Centers; K. Muthukumarappan, South Dakota State University
 - Develop integrated pretreatment (AFEX) and densification (ComPAKco) system = PAKS
 - Evaluate handling and storage of PAKS
 - Evaluate conversion efficiency of fresh versus stored PAKS
 - Economic and energy analysis of PAKS process

2 - Technical Accomplishments/ Progress/Results

- 2008 Funded Project: Prioritizing Corn Harvest and Biomass Collection Activities; Cole Gustafson, North Dakota State University
 - Corn grain only option—Farmers are able to complete harvesting corn grain and achieve profit maximization in a fairly short amount of time with existing combine harvest capacity
 - Corn grain and cob one-pass option—grain harvest capacity diminishes due to the attachment of cob harvester to the back of combine which results in harvest slowdown
 - Corn grain and stover two-pass option—Time allocation will be the main challenge when farmers consider this system especially as farm size increases



2 - Technical Accomplishments/ Progress/Results

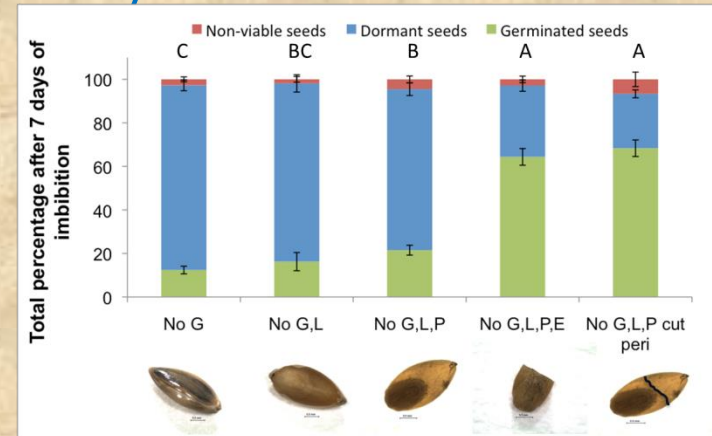
- 2008 Internally Funded Project: Landscape Scale Biomass Production, Economics, and Environmental Quality; Carter Johnson, SDSU
 - Demonstrated effective methods of renovating CRP land to native grass/forb mixtures
 - Biomass production varied by species, mixture, and landscape position
 - Perennial grass production provided year round cover to all parts of the landscape thus minimizing erosion and sedimentation
 - Perennial grasses can slowly improve the soil over time; significant improvement was seen in wet aggregate stability, a key indicator of management impacts on soil quality
 - Economics: Input costs of grass farming were about one-third the costs of conventional farms; however, grass farm income and profits were considerably lower than those of comparable corn-soybean farms

2 - Technical Accomplishments/ Progress/Results

- 2008 Internally Funded Project: Interactions of Biochar/Bio-ash Source/Properties Impacts on Soil Properties, C Sequestration Potential, and Crop Management; Doug Malo, SDSU
 - Addition of biochar to the soil (10%) reduced plant available N and increased P and K
 - Biochar additions from the optimal production conditions significantly increased soil salinity
 - Biochar pH values varied greatly depending on processing temperature and residence time; highest pH at 650°C and >16 minute residence time, lowest pH at 550°C. These differences impact biochar suitability as a soil amendment.
- Led to USDA-NIFA successful grant application

2 - Technical Accomplishments/ Progress/Results

- 2009 Funded Project: Seed Technologies to Secure Rapid and Complete Switchgrass Establishment; Brian Baldwin, Mississippi State University
 - Seed dormancy in these switchgrass cultivars lies primarily with permeability of the pericarp, and to a lesser extent the inner glumes
 - Seed safeners improved switchgrass seedling establishment and resulted in greater crop yields
 - The use of the herbicide metolachlor in controlling weeds for the first months of establishment may enable a harvest in the establishment year



2 - Technical Accomplishments/ Progress/Results

- 2009 Funded Project: Sustainable Biomass Production on Marginal Lands using a Novel Legume/Grass Mixture; Vance Owens, South Dakota State University
 - Determine N fertilizer replacement value of kura clover in a prairie cordgrass-kura clover mixed sward compared to monoculture prairie cordgrass.
 - Determine fermentable cell wall fractions, N content, mineral composition, and sward composition of prairie cordgrass-kura clover mixtures and prairie cordgrass monocultures over time

2 - Technical Accomplishments/ Progress/Results

- 2009 Funded Project: Do Nurse Crops Make Miscanthus x giganteus Establishment More Sustainable?; Emily Heaton, Iowa State University
 - Identify nurse crops that a) facilitate M. x giganteus establishment and b) improve soil quality and function.
 - Raise awareness of M. x giganteus production potential and best management through outreach activities with stakeholders.

2 - Technical Accomplishments/ Progress/Results

- 2009 Funded Project: Optimization of biomass productivity and environmental sustainability for cellulosic feedstocks: Land capability and life cycle analysis; Sylvie Brouder, Purdue University
 - Quantify productivity potentials and environmental impacts of *M. giganteus*, switchgrass, native prairie, maize and sorghum by land capability
 - Compare agronomic performance of seed- versus rhizome-derived miscanthus
 - LCAs to evaluate environmental sustainability of bioenergy crops as compared to liquid petroleum

2 - Technical Accomplishments/ Progress/Results

- 2009 Funded Project: Barley Straw Fructanolic Ethanol for On-Farm Biofuel Production; Victoria Blake, Montana State University
 - Evaluation of straw yield and composition from high-fructan barley lines
 - Utilization of recombinant inbred barley lines to improve grain and straw yield characteristics in high straw fructan barley lines

2 - Technical Accomplishments/ Progress/Results

- 2009 Funded Project: Evaluation of Bioenergy Crop Production on Marginal Land in Wisconsin; Stephen Ventura, University of Wisconsin-Madison
 - Quantify ecosystem services associated with bioenergy cropping systems on environmentally sensitive land.
 - Construct spatially specific estimates of both economic returns and ecological services for bioenergy crop alternatives
 - Provide guidance on safe and sustainable production of bioenergy crops on sensitive landscapes

2 - Technical Accomplishments/ Progress/Results

- 2010 Funded Project: Using Second-Generation Biofuel Feedstocks to Improve the Carbon Economy of US Agriculture; Evan DeLucia, Univ. of Illinois
 - Quantify above- and below-ground production and changes in SOC for replicate plots of miscanthus and switchgrass at locations across the central and eastern US
 - Utilize these data to parameterize and validate three specialized process-based models to extrapolate the yield data in space and time, to examine the effect of land use and management change on the SOC stocks and GHG balance for the central and eastern US, and to examine the economic incentives and feedbacks stemming from the wide-scale deployment of low input, perennial biofuel feedstocks on the landscape

2 - Technical Accomplishments/ Progress/Results

- 2010 Funded Project: Improving production, resilience, and biodiversity of perennial grass mixtures and monocultures as biofuel feedstocks across environmentally heterogeneous landscapes; Carter Johnson, South Dakota State Univ.
 - Determine biomass production and species performance in fields of warm-season grasses and forbs planted 1-3 years ago
 - Determine, by pairing numerous combinations of native prairie species, which grow best together and benefit switchgrass plantings the most across a range of soils and topography

2 - Technical Accomplishments/ Progress/Results

- 2010 Funded Project: Production and Economics of Perennial-based Woody and Herbaceous Biomass Crops under Alley-Cropping Systems; Gregg Johnson, University of Minnesota
 - Determine productivity of woody and herbaceous biomass species in an alley cropping configuration as well as evaluate cover crops to control erosion and improve diversity
 - Aggregate production data and refine enterprise budgets for alley-cropping and other perennial-based biomass cropping systems
 - Integrate production and economic data into a decision support tool

2 - Technical Accomplishments/ Progress/Results

- 2010 Funded Project: Intensifying the corn-soybean rotation with the use of winter rye grown for biomass energy production; Peter Sexton, South Dakota State Univ.
 - Evaluate potential of winter rye as a biomass crop established after corn varying in maturity and followed by soybean
 - Determine the effects of this practice on corn and soybean production
 - Estimate the breakeven price for this practice based on biomass production as well as corn and soybean yields and prices

2 - Technical Accomplishments/ Progress/Results

- 2013 Internal Proof of Concept Projects
- Project Requirements
 - 20% cash cost share from a source other than federal, state, or SDSU funds
 - Must advance economic development through commercialization of an invention discovered through SDSU research
 - Six month duration
 - Industry partner highly encouraged
- Three proposals funded—total cost around \$100k

3 - Relevance

- A portfolio of projects supporting the Sun Grant/DOE Regional Biomass Feedstock Partnership and addressing four technical barriers to producing a sustainable, cost-competitive supply of biomass feedstock
 - Ft-B. Sustainable Production
 - Ft-H. Biomass Storage Systems
 - Ft-K. Biomass Physical State Alteration
 - Ft-L. Biomass Material Handling and Transportation

4 - Critical Success Factors

- Timely reporting and completion of funded research projects
- Successful dissemination of research results and outcomes to scientific community and general public
- Demonstrated impact to BETO program goals
- Development and commercialization of new technologies

Future Work

- Work to obtain no-cost extension in order for completion of in-progress projects
- Continue to monitor progress on funded projects.
 - Quarterly reports
 - Annual progress presentation
- Several 2008 projects will end
 - Work with researcher to submit a comprehensive final report
 - Facilitate research/outreach publications

ID	Task Name	Start	Finish	2013				2014				2015			
				tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr
1	Complete no-cost extension request	2/1/13	5/15/13	[Bar]											
2	Quarterly reports from project Pis	6/17/13	7/15/13				[Dot]								
3	Quarterly reports from project Pis	9/16/13	10/15/13												
4	Quarterly reports from project Pis	12/16/13	1/15/14												
5	Final reports from Pis	5/1/13	1/15/14	[Bar]											
6	Project continuation pending approved no-cost extension	10/1/13	9/30/15												



Summary

- Funding from a congressionally directed project at South Dakota State University is being utilized to support a complete grant program through the North Central Sun Grant Center to address technical barriers identified through the Regional Feedstock partnership.
- Key barriers addressed:
 - Sustainable feedstock production systems on marginal land
 - Technologies to densify biomass to improve transportation and storage

Additional Slides

Responses to Previous Reviewers' Comments

- What is the process for selecting the projects to be funded from those that were submitted?
 - Answer: The request for proposals for each of the solicitations was constructed with input from the Regional Biomass Feedstock Partnership stakeholders via our annual meeting and the research priorities for the Sun Grant Initiative. The solicitation requested pre-proposals to be submitted for fit to the solicitation and research priorities described in the request. The top rated pre-proposals were invited to submit full proposals to be considered for funding utilizing a scientific merit/peer review process. Since the funding for the competitive program was a single congressionally directed project to South Dakota State University, one of the criteria was that the research had to pertain to feedstock production systems in the North Central Region. However the research PI did not have to be at an institution within the North Central Region. This provided a broader research base given the national scope of the Regional Biomass Feedstock Partnership. If each of the five Regional Sun Grant Centers received similar congressionally directed projects, each would have focused within their respective region.
- How were the SDSU projects selected?
 - The SDSU only projects (25%) were chosen using an internal selection process utilizing SDSU college deans and directors.

Publications, Presentations, and Commercialization

- **Peer reviewed publications**

- Medic, D., M. Darr, A. Shah, B. Potter and J. Zimmerman. 2012. Effects of torrefaction process parameters on biomass feedstock upgrading. *Fuel*. 91: 147-154.
- Shah, A., M. Darr, D. Medic, R. Anex, S. Khanal and D. Maski. 2012. Techno-economic analysis of a production-scale torrefaction system for cellulosic biomass upgrading. *Biofuels Bioproducts & Biorefining*. 6: 45-57.
- Shah, A., M. Darr, K. Webster and C. Hoffman. 2011. Outdoor storage characteristics of single-pass large square corn stover bales in Iowa. *Energies*. 4: 1687-1695.
- Thoreson, C. and M. Darr. 2011. Durability analysis of large corn stover briquettes. *Applied Engineering in Agriculture*.
- Lambert, David K. and Jason Middleton. “Logistical Design of a Regional Herbaceous Crop Residue-Based Ethanol Production Complex,” *Biomass and Bioenergy* 34(2010): 91-100.
- Hoffman, T. J. 2011. Design and Performance Evaluation of an In-Field Cuber. Master of Science Thesis – Department of Biological Systems Engineering – University of Wisconsin.
- Cui, Z. F., Wan, C. X., Sykes, R., Li, Y. B. 2012. Enzymatic digestibility of corn stover fractions in response to fungal pretreatment. *Industrial & Engineering Chemistry Research*. Under revision.
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- Wan, C. X., Li, Y. B. 2011. Effect of hot water extraction and liquid hot water pretreatment on the fungal degradation of biomass feedstocks. *Bioresource Technology* 102: 9788-9793.
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Publications, Presentations, and Commercialization

- **Peer reviewed publications**

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- Wan, C. X., Li, Y. B. 2010. Microbial pretreatment of corn stover with *Ceriporiopsis subvermispota* for enzymatic hydrolysis and ethanol production. *Bioresource Technology*. 101:6398-6403.
- Wan, C. X., Li, Y. B. 2010. Microbial delignification of corn stover by *Ceriporiopsis subvermispota* for improving cellulose digestibility. *Enzyme and Microbial Technology*. 47: 31–36.
- Morey, R.V., N. Kaliyan, D.G. Tiffany, and D. R. Schmidt. 2010. A corn stover supply logistics system. *Applied Engineering in Agriculture* 26(3): 455-461.
- Kaliyan, N., D.R. Schmidt, R.V. Morey, and D.G. Tiffany. 2012. Commercial scale tub grinding of corn stover and perennial grasses. *Applied Engineering in Agriculture* 28(1): 79-85.
- Capunitan, J.A. and S.C. Capareda. 2012. Assessing the Potential for Biofuel Production of Corn Stover Pyrolysis Using a Pressurized Batch reactor. *Fuel*, Volume 95 (2012) 563-572. Elsevier Science Ltd., UK. England.
- Kane, E. S., Hockaday, W. C., Turetsky, M. R., Masiello, C. A., Valentine, D. W., Finney, B. P., & Baldock, J. A. 2010. Topographic controls on black carbon accumulation in Alaskan black spruce forest soils: implications for organic matter dynamics. *Biogeochemistry*, 100(1-3), 39–56. doi:10.1007/s10533-009-9403-z
- Kinney, T. J., Masiello, C.A., Dugan, B., Hockaday, W.C., Dean, M.R., Zygourakis S.K., & Barnes, R.T. 2012. Hydrologic properties of biochars produced at different temperatures. *Biomass and Bioenergy*, 1–10. doi:10.1016/j.biombioe.2012.01.033
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Publications, Presentations, and Commercialization

- **Peer reviewed publications**

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Publications, Presentations, and Commercialization

- **Presentations**

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- Webster, K., M. Darr and K. Peyton. 2012. Analysis of the effects of grain logistics on single-pass harvesting productivity. To be presented in ASABE Annual International Meeting 2012, July 29-August 1, Dallas, TX.
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- Thorseson, C., M. Darr and K. Webster. 2010. Corn stover densification methods and their impacts on large scale biomass production preliminary analysis. ASABE Annual International Meeting 2010, June 20-23, Pittsburgh, PA.
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- Shinnars, K.J. 2009. Harvesting, transporting and processing biomass on Wisconsin's farms. 49th Annual Wisconsin Public Service Farm Show. April 1st, 2009. Oshkosh, WI.
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Publications, Presentations, and Commercialization

- **Presentations**

- Lambert, David K. "Ethanol Markets and the Development of a Cellulosic Ethanol Industry." Presentation at 2010 Risk & Profit Conference. Manhattan, KS. August 20, 2010.
- Lambert, David K. "The Logistics of Herbaceous Crop Residue-Based Ethanol Production under Uncertainty." Project update. 2010 North Central Sun Grant Regional research conference. Reno, NV. January, 2010.
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Publications, Presentations, and Commercialization

- **Presentations**

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- Morey, R.V. 2012. Improving handling characteristics of herbaceous biomass. Presentation at North Central Region Sun Grant Annual Meeting. Indianapolis, Indiana, January 10-11, 2012.
- Capunitan, J.A. and S.C.Capareda. 2010. Corn Stover Pyrolysis in a High- Pressure/High-Temperature Batch Reactor: Evaluation of Product Yields and Conversion Efficiencies. Paper presented at the 2010 American Society of Agricultural and Biological Engineering (ASABE) Annual Meeting. ASABE Paper #100-9881. ASABE, St. Joseph, MI.
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- Hockaday W.C., S. Kim, P.G. Hatcher, and C.A. Masiello. 2010. Comparing the Molecular Structures of Black Carbon in Soil and Water to Constrain Processes of Formation and Decomposition. American Chemical Society National Meeting, San Francisco, March 21-25, 2010.
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Publications, Presentations, and Commercialization

- **Presentations**

- Husmoen, D., T. Provin, C. Munster, J. Wise, and M. Keough. 2011. Biochar effects on switchgrass establishment and runoff loss of nutrients. ASA-CSSA-SSSA Ann. Meetings. Oct. 16-19, 2011. 205-20.
- Keough, M., T. Provin, D. Vietor, C. Munster, and S. Capareda. 2011. Post removal of oil/tar materials from biochar and subsequent impact on weathering. ASA-CSSA-SSSA Int. Ann. Meetings. Oct. 16-19, 2011. 137-13.57
- Masiello C.A., W.C. Hockaday, K. Zygourakis, B. Dugan, J.A. Rudgers, P.J.J. Alvarez, T.W. Boutton, L.A. Pyle, T.J. Kinney, H. Sun, and D. Li. 2010. Biochar Research at Rice University: An Overview. Geological Society of America, Denver, CO, 2010.
- Palma, M.A., Richardson, J., Roberson, B., Ribera, L., Outlaw, J., and C. Munster. 2011. "Economic Feasibility of a Mobile Fast Pyrolysis System for Sustainable Bio-crude Oil Production" Paper presented at the International Food and Agribusiness Management Association meeting. June 14, 2011. Frankfurt, Germany.
- Pyle L.A., W.C. Hockaday, C.A. Masiello, T.W. Boutton, and C. LeCroy. 2010. Production and Isotopic Composition of Black Nitrogen Following Experimental Charring of Plant Materials. Fall American Geophysical Union Meeting, San Francisco, Dec. 13-18, 2010.
- Schnell, R.W., S. Capareda, T.L. Provin, C.L. Munster, D. Husmoen, J. Wise, and D.M. Vietor. 2010. Cycling biochar affects crop production and water quality. Paper 166-1, Division A05, Annual ASA Meeting, Long Beach, CA.
- Sun H., W.C. Hockaday, C.A. Masiello, K. Zygourakis. 2010. Physical and Chemical Structure Analysis of Biochars Produced from Different Feedstocks and Under a Variety of Pyrolysis Conditions. American Institute of Chemical Engineers Annual Meeting (AiChE), Salt Lake City, Nov 7-12, 2010.
- Vietor, D.M., S. Capareda, J. Wise, D. Husmoen, R. Schnell, B. Santos, J. Capunitan, T. Provin, C. Munster, and W. Rooney. 2010. Biochar yield and composition from sorghum pyrolysis at varied temperature. Annual Meeting of Northeastern Branch of Agronomy, Crop, and Soil Societies. Ithaca, NY, June 28-30.

Publications, Presentations, and Commercialization

- **Presentations**

- Wise J, Provin T, Vietor D, Munster C, Capareda S, Boateng A. 2011. Nutrient Recovery from Pyrolysis Systems. Presented at the TC Biomass 2011 International Conference on Thermochemical Conversion Sciences. Chicago, Illinois. September 29. (Placed 2nd in the graduate student competition).
- Wise J, Provin T, Vietor D, Munster C, Capareda S, Boateng A. 2011. Nutrient Recovery from Pyrolysis Systems. Presented at the 2011 ASA-CSSA-SSSA Annual Meetings. San Antonio, Texas. October 16-19.
- Wise J, Provin T, Vietor D, Munster C, Capareda S, Husmoen D, Schnell R. 2010. Mineral Nutrient Recovery in Pyrolysis Systems for Varied Feedstocks. Presented at the 2010 ASA-CSSA-SSSA Annual Meetings. Long Beach, California. October 31-November 3.
- Wise, J., D. Vietor, T. Provin, D. Husmoen, M. Keough, S. Capareda, C. Munster, and A. Boateng. 2011. Mineral nutrient recovery from pyrolysis systems. ASACSSA- SSSA Int. Ann. Meetings. Oct. 16-19, 2011. 127-30.58
- Wise, J., T. Provin, D. Vietor, D. Husmoen*, C. Munster, M. Keough, S. Capareda, A. Boateng. Nutrient Recovery from Pyrolysis Systems. Poster presented at: TC Biomass 2011. The International Conference on Thermochemical Conversion Science; 2011 Sept 27; Chicago, Illinois.
- Wise, J., T.L. Provin, D. Husmoen, R.W. Schnell, D.M. Vietor, S. Capareda, and C.L. Munster. 2010. Mineral nutrient recovery in co-products of pyrolysis for varied biomass feedstocks. Paper 56-17, Poster 731, Div. A10, Annual ASA Meetings, Long Beach, CA.
- Bumguardner, M., M. Ha, and C. Munster. 2011. Result of a GIS model developed to optimize feedstock logistics for production of bio-oil using mobile pyrolysis units. Poster presentation at the Energy Forum 2011: Energy Security and Sustainability –Global Challenges. Feb. 1 – 2, 2011. College Station, TX.
- Wise J, Provin T, Vietor D, Munster C, Capareda S, Husmoen D, Schnell R. Mineral Nutrient Recovery in Pyrolysis Systems for Varied Feedstocks. Presented at the 2011 Hispanic Leaders in Agriculture and the Environment (HLAE) South Texas Symposium. Corpus Christi, TX. March 16.

Publications, Presentations, and Commercialization

- **Presentations**

- Wise J, Provin T, Vietor D, Munster C, Capareda S, Rooney B. Relationship of Feedstock Composition and Pyrolysis Temperature to Bio-Char Yield. Presented at the 2010 AgriLife Conference. College Station, Texas. January 11-15.
- Wise J, Provin T, Vietor D, Munster C, Capareda S, Rooney B. Relationship of Feedstock Composition and Pyrolysis Temperature to Bio-Char Yield. Presented at the 2010 Hispanic Leaders in Agriculture and the Environment (HLAE) Orientation. College Station, Texas. August 26.
- Duclos V.D., D. T. Ray, A. G. Taylor. 2009. Understanding the physiology and mechanisms of seed dormancy in Switchgrass (*Panicum virgatum* L.). Association of the Advancement for Industrial Crops 21st Annual Meeting, Chillán, Chile. p 30.
- Taylor, A. G. 2011. Challenges in seed germination and dormancy for new industrial crops. 23rd Annual meeting of the Association for the Advancement of Industrial Crops. Fargo, ND, Sep. 12, 2011. p 22.
- Rushing, J.B., B. Baldwin and A. Taylor. 2010. Seed safening for use in switchgrass establishment. Seventh Eastern Native Grass Symp. Knoxville, TN. Oct 5-8.
- Rushing, B., B. Baldwin, A. Taylor. 2010. Seed safening for use in switchgrass establishment. MSU Biofuels Conference. Jackson, MS. 11-13 Aug.
- Review of annual trends of atmospheric thermal inversions in South Dakota utilizing NWS radiosonde and WRAN data. South Dakota Academy of Science Annual Meeting, Vermillion, SD 14 April 2012, South Dakota Academy of Science.
- South Dakota WRAN Update, South Dakota Wind Energy Association Annual Meeting, Mitchell, SD, 30 November 2010. South Dakota Wind Energy Association.
- Krack, K., Clay, S., Hansen, S., Clay, D., and Olson, M. 2009. Switchgrass biochar influence on soil properties and atrazine sorption (published abstract). Weed Science Society of American Annual Meetings. Denver, CO (Feb 2010). <https://srm.conference-services.net/reports/template/onetextabstract.xml?xsl=template/onetextabstract.xsl&conferenceID=1756&abstractID=344140> (verified Jan 24. 2010).

Publications, Presentations, and Commercialization

- **Presentations**

- Malo D.D. and Clay, S.A. (project leaders), Schumacher, T.E., Woodard, H.J., Clay, D.E., Gelderman, R.H., Lei, H. and Julson, J.L. 2010. Interactions of Biochar Source/Properties Impacts on Soil Properties, C Sequestration Potential, and Crop Management (annual report). Sun Grant Initiative – North Central Center at South Dakota State University Annual Meeting. Jan 2010. Reno, Nevada.
http://ncsungrant.sdstate.org/upload/Microsoft-PowerPoint-SDSU-biochar-projects-Presentation-reno_2010-Compatibility-Mode.pdf (verified Jan 24, 2010).
- Lei, H., S. Ren, and J. Julson. 2009. The effects of reaction temperature and time and particle size of corn stover on microwave pyrolysis. *Energy and Fuels*. 23, 3254–3261.
- Malo D.D. and Clay, S.A. (project leaders), Schumacher, T.E., Woodard, H.J., Clay, D.E., Gelderman, R.H., Julson, J.L., and Wei, L. 2011. Interactions of Biochar Source/Properties Impacts on Soil Properties, C Sequestration Potential, and Crop Management (annual report). Sun Grant Initiative – North Central Center at South Dakota State University Annual Meeting. Jan 2011. Orlando, Florida (verified Jan 24, 2011).
- Clay, S.A. and D.D. Malo. 2011. The Influence of Biochar Production on Herbicide Sorption Characteristics. Chapter in *Herbicides/Book 3*. ed. M.N. Hasaneen. Intech Rijeka, Croatia. ISBN 9790953-307-729-0 (accepted for publication/in press).
- “Researchers Evaluate Grass Farming’s Potential” in *Hay and Forage Grower* magazine (written by Loretta Sorenson based on interview with C. Johnson). (2012)
- “Remaking Prairie, Re-Greening Agriculture: Creating a Working Farm Growing Native Grass” in *Prairie Fire, The Progressive Voice of the Great Plains* (written by Peter Carrels; centerfold article describes research and demonstration work on the Prairie Farm)(2011)
- “Taking Grass to the Next Level: Prairie Farm Rooted in Desire to Sustain Land” in *Sioux Falls Argus Leader Newspaper* (front page) (written by Cody Winchester) (2011)
- “They’re Farming a Sea of Grass: Four Ph.D.s Out to Prove Tall-Grass Farming can be Profitable” in *Brookings Register* (front page) (written by Ryan Woodard) (2011)

Publications, Presentations, and Commercialization

- **Presentations**

- “Second Civitas (Honors) Lecture Features Ecologist” in the Augustana College Mirror (front page) (Promoting lecture by C. Johnson as part of Civitas lecture series) (2011)
- “South Dakota’s Best Prairies” in South Dakota Magazine (written by Jerry Wilson) (Prairie Farm project featured) (2011)
- Program Review Presentation (C. Johnson), “Landscape-Scale Biomass Production, Economics, and Environmental Quality,” North Central Sun Grant Research Center, Indianapolis, IN (2012)
- Contributed Paper (C. Johnson), “South Dakota’s Prairie Farm: An Experiment in Ecological and Economic Sustainability,” Conference on America’s Grasslands: Status, Threats, and Opportunities, Sioux Falls, SD (2011)
- Invited Keynote Address (C. Johnson), “Dakota Grasslands, Wetlands, and Climate Change: Last Nail or Silver Lining?” Annual Meeting of the South Dakota Academy of Science, Oacoma, SD (2011)
- Invited Lecture (C. Johnson), “South Dakota’s Prairie Farm, An Experiment in Ecological and Economic Sustainability,” Inaugural Civitas (Honors) Lecture Series, Augustana College, Sioux Falls, SD (2011)
- Program Review Presentation (C. Johnson), “Production of Biomass Across Heterogeneous Landscapes,” North Central Sun Grant Research Center, Orlando, FL (2011)
- Seminar (C. Johnson), “Biofuel Feedstock Production at the Prairie Farm,” NRCS Plant Materials Center, Bismarck, ND (2011)
- Invited Lecture (A. Boe), “South Dakota’s Prairie Farm Project—An Experiment in Grassland Farming,” Brookings, SD (2011)
- Invited seminar (C. Johnson), “South Dakota’s Prairie Farm: An Experiment in Economic and Ecological Sustainability,” University of Northern Iowa (sponsored by UNI Tallgrass Prairie Center and the College of Natural Sciences/Humanities and Fine Arts. (2010)

Publications, Presentations, and Commercialization

- **Presentations**

- Invited speaker (C. Johnson), “The Prairie Farm Concept and South Dakota’s Alternative Energy Future,” Annual Conference of the SD Association of Conservation Districts, Pierre, SD (Alternative Energies Session). (2010)
- Invited banquet speaker (C. Johnson), “Prairie Farm Research,” Annual Meeting of the Eastern Dakota Water Districts, Brookings, SD (2010)
- Presenter (C. Johnson), “Research Progress in Biofuel Feedstocks,” North Central Sun Grant Research Center 5 X 10 meeting, Brookings, SD (2010)
- Program Review Presentation (C. Johnson), Landscape Scale Lignocellulosic Biomass Production, Economics and Environmental Quality,” North Central Sun Grant Research Center, Reno, NV (2010)
- Invited seminar (C. Johnson), “South Dakota’s Prairie Farm,” Iowa State University Sustainable Agriculture Colloquium, Ames. (2009)
- Invited seminar (C. Johnson), “South Dakota’s Prairie Farm,” Ecology and Environmental Biology Seminar Series, SDSU, Brookings. (2009)
- Invited seminar (C. Johnson), “South Dakota’s Prairie Farm,” Plant Science/NCARL Seminar Series, Brookings, SD (2008)

Internal Proof of Concept Awards

- Electrophoretic deposition of biochar nanoparticle based films for energy storage; Q. Fan
 - Objective: Verify the ability of our proprietary electrophoretic deposition scheme to deposit biochar nanoparticle based films
- Developing gas stripping - adsorption/desorption separation processes based on porous carbon adsorbents for biofuel purification from bioreactors; Z. Gu
 - Objective: Develop a highly efficient and selective gas stripping-adsorption/desorption separation platform for purifying advanced biofuels and chemicals from biochemical processing streams
- Catalytic fast pyrolysis conversion of corn stover to drop-in quality hydrocarbons; L. Wei
 - Objectives: 1. Eliminate air entering the reactor through the biomass feed port, 2. Insert catalysts into the CFP reactor, 3. Evaluate the effect of the catalysts in the CFP reactor on the HDO catalysts functional life and conversion efficiency, and 4. Complete a chemical and physical analysis of the most promising hydrocarbon products to determine compatibility for insertion into existing petroleum refineries or directly blend with liquid fuels for direct use as transportation fuel

Internal Projects Funded at SDSU

- Interaction of Biochar/ash Source, Properties impacts on Soil Properties, C Sequestration Potential & Crop Management, Doug Malo
- Cordgrass Establishment, Carter Johnson
- Integration of Weather Station with Wind Resources Assessment Network (WRSAN), Dennis Todey
- Biofuel Crops in Eastern South Dakota: Establishment, Productivity, Biotic Impact, and Multiple Use Potential
- Pyrolysis of Forest Residue, Lin Wei
- Cup Plant as a Potential New Biomass Crop, Arvid Boe
- Beneficial plant microbe interactions and their potential to increase biomass production and environmental sustainability of prairie cordgrass, Heike Bücking
- Develop Solid-stem Triticale as a Feedstock for Biofuel Production, Wanlong Li

The logo features a stylized orange sun with rays on the left, followed by the text "SunGrant" in a large, green, serif font. Below "SunGrant" is the word "INITIATIVE" in a smaller, green, all-caps, serif font.

SunGrant *INITIATIVE*

Grow renewable energy and biobased industries that revitalize rural communities by harnessing science and technological capacities of Land-Grant University research, education, and Extension programs

**Vance Owens, Interim Director
North Central Sun Grant Center
South Dakota State University**



Concept...

- A national network of land-grant universities and federal agencies partnering to build a biobased economy.
- Land-grant institutions will broaden their responsibilities beyond traditional agriculture & forestry issues.
- SGI Centers will be charged with making significant advances in biobased industries for the benefit of America's independent farmers, rural communities, and public at large.

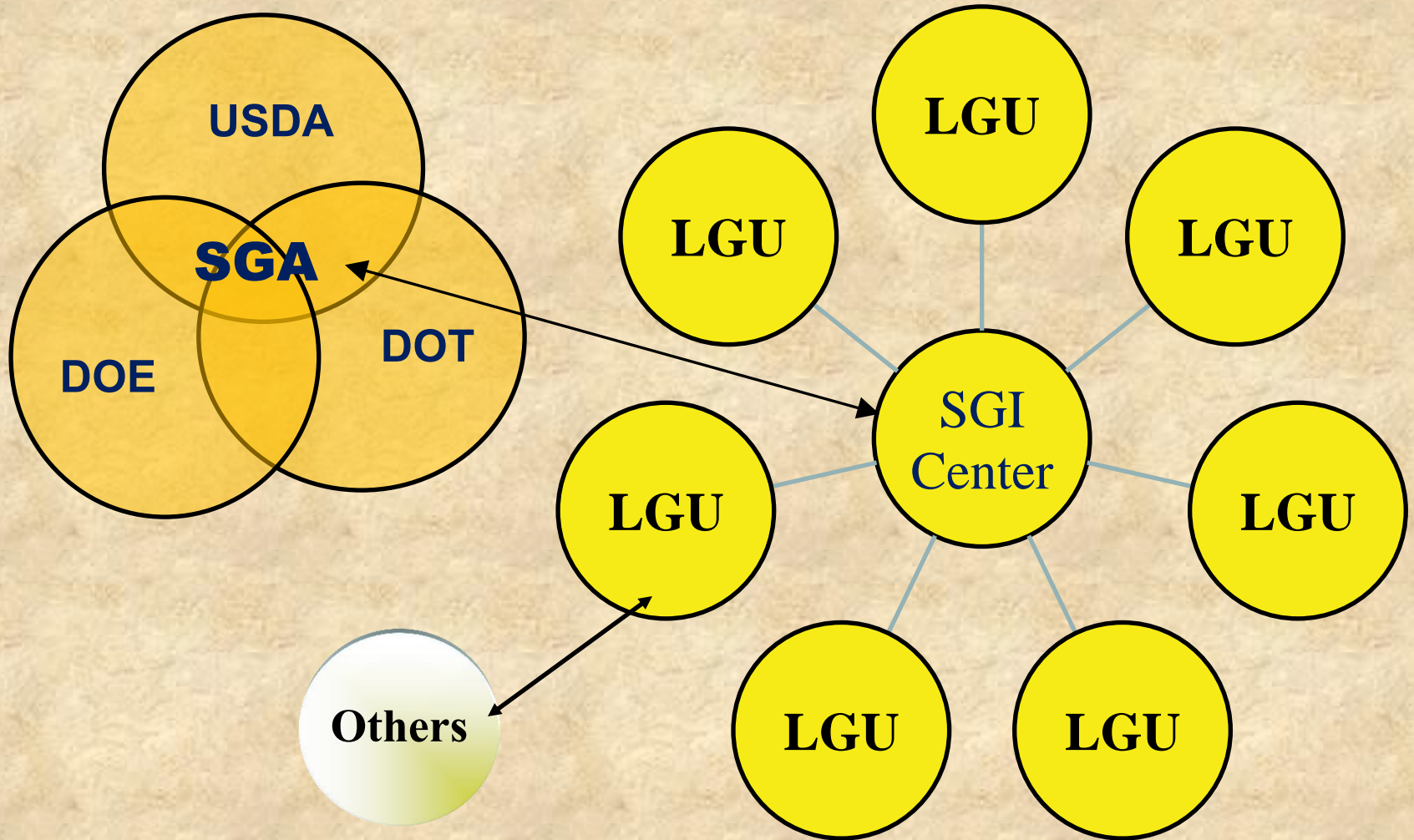


- Mission
 - Enhance America's national energy security through development, distribution and implementation of biobased energy technologies.
 - Promote diversification and environmental sustainability of America's agriculture
 - Promote opportunities for biobased economic diversification in America's rural communities.



- Five Regional University Centers
 - South Dakota State, U of Tennessee, Oregon State, Oklahoma State, Cornell University
 - Coordinate activities within SGI Region and SGA
 - Administer Regional grant program
- Sun Grant Association (SGA)
 - Non-profit entity
 - Membership from Regional SGI Centers
 - Facilitates/Integrates activities of 5 SGI regions
 - Facilitates coordination and communication with agency and private partners

- **Interaction of SGA with SGI Centers,**
- **federal agencies and others**





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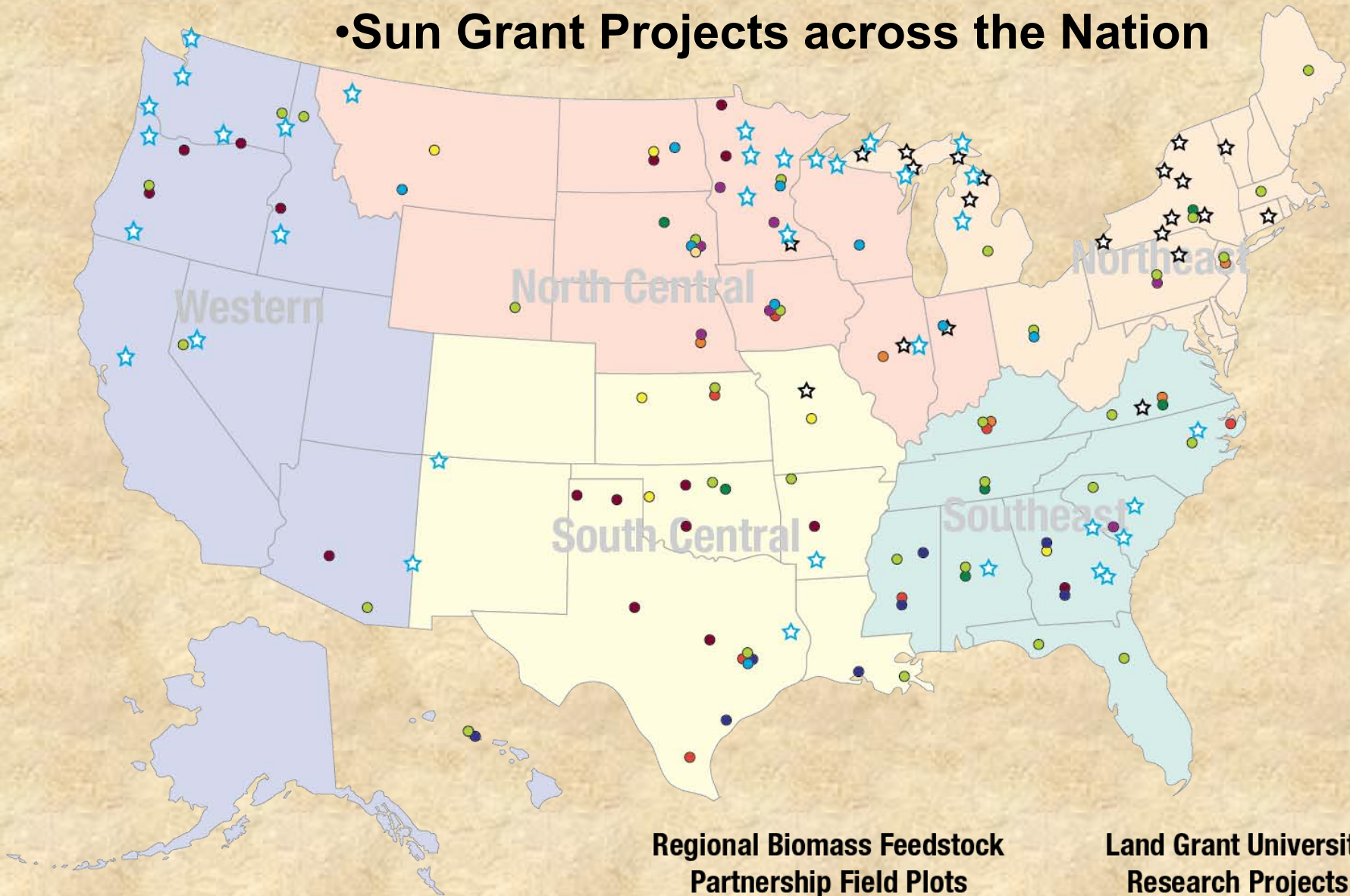
•**Sun Grant Initiative Regions and Regional Centers**



Authorized and Funded

- USDA
 - Authorized in the 2008 Farm Bill at \$75M
 - \$5.5 M
- DOE
 - Biomass Program project funding
 - \$11.2 M
 - Regional Feedstock Partnership
 - \$18.9 M
- DOT
 - Authorized and funded in the 2005 Highway Bill (SAFETEA-LU)
 - \$43.9 M
- Total = \$75.6 M \$92.7 with cost-share

•Sun Grant Projects across the Nation



Regional Biomass Feedstock Partnership Field Plots

- CRP
- Energycane
- Corn Residue
- Miscanthus
- Sorghum
- Switchgrass
- Cereal Residues
- Willow
- ★ Poplar

Land Grant University Research Projects

- DOT Funded
- DOE Funded
- USDA Funded