

The Sun Grant Initiative



**Raw
Materials**



**Land Grant
Universities**



Partners



**Finished
Products**

South Central Region

South Central Sun Grant Initiative Report

D.C. Coston

Associate Director

Oklahoma Agricultural Experiment Station
Oklahoma State University

Raymond L. Huhnke

Professor

Biosystems and Agricultural Engineering
Oklahoma State University



Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, sex, age, religion, disability, or status as a veteran in any of its policies, practices or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

This report of the Oklahoma Agricultural Experiment Station is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of \$4,184.26 for 1,500 copies.

Table of Contents

Introduction	1
Rationale	2
Assets and Challenges	6
Vision	8
Goals and Activities	10
Administrative principles	11



South Central Sun Grant Initiative Report

D.C. Coston
Raymond L. Huhnke¹

The founding principles of the Sun Grant Initiative are to develop biobased products, many of them with industrial applications, and concurrently stimulate renewed economic activity particularly in rural areas.

Introduction

Agricultural and forestry production and other natural resource based enterprises have been, and will continue to be, the source of food, feed, and fiber for our nation. In coming years, agricultural and other natural resource commodities will provide primary building blocks for energy, materials, and chemicals. These biobased products will include liquid fuels, lubricants, plastics, building materials, nutraceuticals, pharmaceuticals, industrial enzymes, monomers, polymers, and many other items. Advances in biological sciences, combined with continuing developments in process engineering, will make this possible.

As the science and technology developments move forward, new entrepreneurial industries will emerge and prosper in an environmentally sound manner. Additionally, existing companies will develop new business ventures. Significant employment opportunities will arise.

Currently, many raw materials for industrial production are derived from petroleum. The biobased economy will not supplant the petroleum industry, but will complement and augment it.

The Sun Grant Initiative is an activity that will enlist the resources of the nation's Land Grant Universities in helping push the biobased economy to reality. Partnerships with private sector entities; foundations; other educational institutions; local, state, and federal government; and other organizations will be essential.

The Sun Grant Initiative was proposed to be established in five regions, with coordination in each of the regions through a designated Land Grant university. The South Central Region was defined as Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, and Texas. Oklahoma State University was asked to serve as the coordinating institution for the consortium. Coordinating institutions for the other four regions are South Dakota State University, Cornell University, University of Tennessee, and Oregon State University.

¹ Associate Director, Oklahoma Agricultural Experiment Station; and Professor, Biosystems and Agricultural Engineering, respectively, Oklahoma State University.

Through a special Federal appropriation, funding was provided for planning purposes in federal FY02. These funds are being used to convene regional planning sessions. Leadership of the Land Grant Universities in the South Central Region met for an initial orientation and planning session on April 23, 2002. Concepts of the Sun Grant Initiative were reviewed. Kevin Kephart from South Dakota State, leader of the Initiative, participated in the meeting. The group discussed the appropriate planning process for the South Central Region portion of the Initiative. This included convening of a stakeholder meeting on June 26 and 27, 2002. The first day of the June session included stakeholders from both within universities and external to universities. The second day involved just those from the universities to utilize the input that had been garnered the previous day in further planning. Drawing upon the information generated from this two-day stakeholder meeting, D.C. Coston and Ray Huhnke, Oklahoma State University, developed a draft concept report, which was circulated to all participants, who were involved in the process for their comments and input. A small group of internal stakeholders, most having volunteered at the close of the June meeting, convened September 10-11, 2002, to take the comments and input and then finalize the document.

Rationale

There is a number of strong, interdependent forces driving the search for alternate ways to address America's energy needs and development of a biobased economy for the United States. Most important are the following in a non-prioritized list.

- **Concerns regarding the amount of world petroleum reserves.**

As noted previously, petroleum has been (and will continue to be) a primary source of fuels and the basic building blocks for many products. Estimates of the reserves vary from as little as twenty years to fifty or more years. Exploration continues and new recovery techniques are allowing extraction of petroleum from aging wells. However, regardless of how much petroleum will ultimately be extracted, development of the *biobased economy* will extend the useful life of reserves and also allow minimal disruption if petroleum is depleted. Development of biobased products represents an insurance policy against shortages and associated price increases of petroleum-based products. Some products derived from biobased technologies are available, for example ethanol through fermentation of carbohydrates, but most are not as cost





effective to produce at this stage in their development compared to their petroleum-based counterparts.

- **Energy self-sufficiency.**

Assuring continued access to proven petroleum reserves drives much of U.S. foreign policy. The United States Department of Energy (USDOE) estimates that approximately 2/3 of the world's oil is in the Persian Gulf region. The USDOE has called for accommodating increased demand through renewable sources. Development of biobased products will reduce the dependence on imported oil and positively affect the balance of payments for the United States.

- **Preservation of environmental quality.**

Many biobased products will be derived from plant materials such as crops, grasses, and forests. Production of these "raw materials" will be dependent on current photosynthesis. Carbon dioxide will be withdrawn from the atmosphere and some returned when the products are utilized (e.g. burning of fuels) resulting in equal amounts of CO₂ being withdrawn and returned to the atmosphere. Petroleum reserves were created from plant materials that grew millions of years ago. As they are used, particularly as fuels being burned, the CO₂ previously fixed by photosynthesis while those plants were growing is released. This utilization of "fossil fuels" is blamed for the majority of the increase of CO₂ (and other greenhouse gases) in the earth's atmosphere. One of the significant Federal cross-agency initiatives is "carbon sequestration." Part of the Federal government's interest in the "biobased economy" is to minimize further increases in atmospheric CO₂ concentrations. These developments should help enhance sustainability of natural resources.

- **Utilization of co-/by-products.**

In addition to biomass produced specifically for biobased products, co-/by-products from food processing, animal production, and the organic portions of garbage may serve as raw materials. Currently, many of these materials are considered wastes and often are liabilities for the organizations that produce them. There are significant costs associated with disposal and handling. If these materials can be utilized to produce marketable products, the organizations will realize additional income and will be able to create significant economic activity and associated employment.

- **Economic development in rural areas.**

Economic factors will result in the early steps of processing being done relatively close to the sites of raw material production. Otherwise, transportation of bulky, water-laden material would likely not be economically feasible. Because raw material production (biomass, animal wastes, etc.) will primarily occur in rural areas, the first steps of processing and product development will also occur there. There will also be opportunities for production of intermediate products and, in some cases, final products in rural areas. Collectively these activities – raw product production through product development - have the potential to diversify rural economies and spawn high-value enterprises and employment. Such enterprises will offer new opportunities for specialty and limited acreage farmers. Many of these businesses will be locally owned by farmers and other citizens in the local community through cooperatives and other innovative business structures. These developments will play a significant role in improving local economies and community vitality.



- **Use of underutilized productivity potential in agriculture.**
There is much land available that is currently not being utilized for production. Much of this land is subject to erosion (for example in the Conservation Reserve Program), yet is potentially quite productive. If perennial crops, which provide continuous ground cover, were developed, much land, which is idle, could be used productively while preserving it environmentally. USDOE has targeted switchgrass as a plant that meets these criteria and, through the Oak Ridge National Laboratory, has invested nearly ten years in genetic improvement and productivity research. In other areas, there is potential for biomass crops that offer enhanced income potential compared to current use.
- **Use of U.S. capabilities in biological sciences including molecular biology.**
Through Federal, state, and private investment, the U.S. has developed significant strengths in molecular biology and understandings of living systems. Application of this knowledge and these skills will be a significant factor in development of biobased products by designing plants for non-traditional products.
- **Use of technical capabilities to convert materials to products.**
U.S. technology in conversion and process engineering are world standards. The biobased economy will call on existing and developing skills to utilize new raw materials to make new products. Additionally, new technologies developed throughout the world will also be utilized.

Studies have been conducted regarding the biobased economy in recent years. To serve as resources, two important reports that emerged from the United States Department of Energy are:

- *Plant/Crop-Based Renewable Resources 2020: A Vision to Enhance U.S. Economic Security Through Renewable Plant/Crop-Based Resource Use* (DOE/GO-10098-385, January 1998).
- *The Technology Roadmap for Plant/Crop-Based Renewable Resources 2020*. (DOE/GO-10099-706, February 1999).

The National Academy of Sciences produced a report that establishes intermediate and long-term targets for biobased product development:

Biobased Industrial Products: Research and Commercialization Priorities.
National Research Council of the National Academy of Sciences. 2000.

In late 1999, President Clinton signed an executive order calling for the Departments of Energy and Agriculture to form a coordinating council and to move aggressively to initiate programs to lead to the development of the biobased economy. This Council has been formed. By all indicators, there is broad-based support for development of biobased industries that transcend government agencies, branches of government, and political parties. In addition, the new farm bill contains incentives for the production of mobile fuels from biomass.



Assets and Challenges

Among the assets identified by stakeholders that characterize the South Central Region are:

- Tremendous potential in the region, including:
 - Excellent biobased materials production capacity
 - Abundant land, infrastructure, human capital
 - Opportunities for production of many types of biomass
 - Large land areas of underutilized biomass
 - Other feedstock sources, particularly co-/by-products from animal production and processing
 - Outstanding industrial sector (petroleum and associated industries) to commercialize products
 - Environmental analytic capacity
- Rural communities across the region are seeking and anxious to embrace new economic development opportunities – particularly ones that diversify the local economy yet build on existing assets, e.g. the agricultural base.
- Land Grant universities having a great tradition of working collaboratively within the region, across the U.S., and around the world with a multitude of partners.
- Strong expertise in disciplines of importance for developing biobased products.
- Existing research at and outreach centers through Land Grant universities that have appropriate specialized equipment, facilities, and expertise.
- Broad-based agricultural industries and rural communities that are engaged with the Land Grant universities.

- Additional institutional capacities that will be vital to success including USDOE laboratories; strong agricultural and electric cooperatives; strong economic development organizations; USDA-ARS; etc.
- Strong agricultural industry associations and organizations that have improved rural community vitality as a top priority.
- State agencies that are committed to improving the rural economies in the respective states.
- Congressional delegations, state legislatures, and other government leaders who have a commitment to improving the economies in the regions they represent.

Challenges to the South Central Region include:

- Addressing the resource diversity of the region which ranges from mountains to seashore, from desert to subtropical.
 - Water availability
 - Water quality
 - Climate
 - Soils
 - Population density
 - Infrastructure, i.e. utilities, transportation, and communications
- Uncertainty of acceptance of new industries and technologies by rural citizens, organizations, and communities, i.e., they have been “burned” by promises in the past. In some areas there is a sense of futility and/or apathy about change or anything new.
- Developing and commercializing new biobased products and processes, with processing capability in rural areas.
 - Human skills enhancement – leadership and technical capacity
 - Improved capacity for sound business development
 - Capital formation
 - Scale of enterprises to be effective in marketplace
 - Development of a spectrum of enterprises that affords opportunities for agricultural producers of all sizes
 - Development of cooperative agreements to appropriately recognize intellectual property rights, licensing, and ownership beyond what exists at each land grant university
- Migration of traditional residents out of rural areas and influx of non-traditional residents into rural areas.

The Sun Grant Initiative holds great promise. Readily apparent, however, is the fact that the capacities of the Land Grant universities by themselves, even working collaboratively, will not be able to bring about a new era of biobased products. This will be for two major reasons: (1) the actual development of new industries and enterprises will occur through private sector initiatives in collaboration with the Land Grant universities, and (2) there is not currently sufficient funding for all of the final technology

development that will result in the complex systems for unique feedstocks and/or unique products. Thus, the universities must be catalysts not only for technology development, but also for bringing other players together and helping nurture relationships to fully explore opportunities.

Vision

The aspiration is to improve the regional economy with biobased products as a significant part of the industrial base. Because of the location of feedstocks and the economics of moving these materials, much of the processing development will occur in rural areas. There is also an expectation that many of these enterprises will be “high technology” in nature. These new enterprises will provide significant new employment opportunities in rural communities as well as serve as an impetus for further economic and social development supporting community sustainability.

Elements of a vision of what may be accomplished in the South Central Region five years after the beginning of the Sun Grant Initiative identified thus far include:

- Improved regional economy with:
 - Development of cost-efficient, low environmental impact biobased energy sources and other commercial products/processes
 - Distributed processing systems and enhanced local processing
 - New products vitalizing rural areas of individual states and the region as a whole
 - Creation of new, high-tech businesses
 - Established, well-defined industries
- Increased public knowledge and appreciation of biomass and bioproducts.
- New policies that encourage biobased products development.
- National leadership in biobased research and product development.
- A working partnership between industry and all land-grants in the region in an integrated multi-institution, multi-state, multi-disciplinary approach.
- Educational programs, cooperative among institutions and industry, to prepare professionals for the biobased economy.



- These developments will have occurred in ways that minimize environmental impact and in many cases will have improved environmental conditions.
- Identification of new opportunities for products or enterprises in the region based on technical and economical potential and feasibility.



These developments will occur because the Land Grant universities in the region have worked effectively together to develop the base technologies and information that are necessary to foster further development of final products. The institutions have worked with each other and with other entities to undergird the development of the industries to assure a high probability of success. Additionally, educational programs, cooperative among the institutions, will prepare future and existing professionals for the biobased economy.

Through education programs offered by the Land Grant universities, the public will have a better understanding and appreciation for biobased products. As a result, they will utilize the products because they are economically attractive and also because the products help meet other social goals such as environmental stewardship, enhanced national security, and enhanced vitality of rural areas.

The opportunities of the South Central region Sun Grant Initiative are immense. The greatest challenge for the Sun Grant Initiative will be to identify, focus, and undertake activities that will develop and transfer information with broad applicability throughout the region.

In reviewing the materials in previous sections of this document, the reports referenced above, and information from other studies, clearly there is a large number of possible feedstocks that could be used and more possible products that might be developed than the consortium can possibly support. Selecting beginning feedstocks and/or finished products that are only important in a small part of the region could result in misunderstandings and tensions within the consortium.

The technologies and systems that will arise from consortium programs will have utility for many beginning biomaterials and marketable products. The consortium will not try *a priori* to select successful finished technologies for a particular feedstock, a specific process, or a particular final product. Such selection would result in exploration by the consortium of very few technologies because of limited funding. Thus the final selection of specific feedstocks and marketable products must be made locally. Much of the final effort by a company or community will draw on the local university for additional assistance as enterprise development proceeds.

Goals and Activities

In view of the above, the South Central Consortium will concentrate on development of understandings and processes that transcend geographical borders, transcend specific final products, and can work with numerous input materials.

Thus, much of the initial Consortium activities will focus on a number of base or underlying technologies. These may, for example, include bioprocessing technologies and associated raw material production and procurement, development, and transportation systems. Such technologies will draw on existing knowledge, developing new information, and creating new systems. These enabling technologies will be applicable for development of many different marketable products from many different beginning materials. Examples of enabling technologies might include:

- Chemical hydrolysis
- Extraction
- Fermentation
- Gasification
- Microbial digestion

A parallel set of activities will focus on developing similar base and underlying information and processes for business development. Potential areas of endeavor may include evaluation of the economic viability of technologies including the identification of possible bottlenecks impeding commercialization, assessment of business organizations that have a high probability of success, and policies that may encourage new industries.

In addition, there must be some consortium activities that will produce early results. This will be essential to establish the track record of success for the consortium and to demonstrate to policy makers and supporters that the consortium can produce. Among the early activities may be implementation of existing technologies and assemblage of a database of activities and resources in the region that can contribute to successful development of biobased industries.

The nature of the types of activities in the Initiative will change as knowledge develops and opportunities arise. The consortium, in consultation with an external advisory board, will address how the Initiative can have the greatest impacts and will adjust the portfolio of activities accordingly.

The Sun Grant Initiative



Administrative principles

The administrative structure will be guided through interactions with the other four Sun Grant Initiative regions. However, the stakeholder sessions held for the South Central Region developed a number of administrative principles that will guide the process for development of the administrative structure for this region and the others. These include:

Management, review, and accountability

- There should be a small management entity located at the coordinating institution in the region, in this case Oklahoma State University. This group will have responsibility for day-to-day management of the consortium.
- There should be an oversight team consisting of representatives of the universities in the region to assure implementation of the agenda and strategies of the consortium. These activities will include setting the goals and milestones and monitoring progress.

- There shall be an advisory board of external stakeholders to provide input to assure that work is relevant and leading to ultimate industrial development. This group will also provide advocacy for the efforts and the connections to additional organizations etc. that will develop biobased enterprises. This group should meet at least annually.
- The oversight and external groups will have the responsibilities to regularly review the opportunities and challenges, as well as progress of prior efforts, to assure that consortium activities are providing maximum impact. The consortium anticipates that the scope of activities will change and evolve as new understandings develop, new technologies develop, and economic and social conditions change.
- Regular meetings of researchers will occur with external reviewers, the oversight team, and the external stakeholder advisory board to report results, exchange technical information, and to solicit input for future program direction(s).



Cooperation

- Participating institutions will work to harmonize their own policies and procedures to assure progress by the consortium.
- Various funding mechanisms should be investigated. These should support the purpose of leading to information and knowledge that will result in biobased industries. Collaboration, sharing of facilities, exchange of information, and development of human capacity will be hallmarks. It is expected that consortium members will view Sun Grant Initiative resources as “seed” funds while seeking other avenues of support.
- There should be coordination among the regions, particularly when there are activities that must transcend the geographic boundaries of the regions.
- There should be coordination with current programs, i.e., USDOE and USDA energy and biobased products activities.
- The South Central Region will work with the other regional Sun Grant Centers in establishing a central clearinghouse of the latest technologies and information regarding development of the biobased economy.

Communication

- Use of appropriate techniques (e.g. web sites, newsletters, list serves, etc.) are essential to assure timely and effective internal and external communications.
- The consortium should establish an identity early.
- Contributions of the consortium and its partners should be acknowledged through all means available.
- The consortium will operate with a high degree of transparency, making information about its activities, decisions, and outcomes accessible to all, ensuring accountability for programs, progress, and direction.



Contributors to this Report

Kamran Abdulahi	Southern University
David Anderson	Texas Cooperative Extension
Carmela Bailey	USDA/CSREES
Fuller Bazer	Texas Agricultural Experiment Station
Henry Bellmon	Oklahoma Alliance
Marvin Burns	Langston University
Marjorie Campbell	Lincoln University
Ken Caspall	MFA Oil, Missouri
Bharat Chahar	Conoco, Inc., Oklahoma
Osborn Christian	Louisiana Farmer
Forrest Chumley	Kansas State University
Mark Cochran	University of Arkansas
David Coltrain	Kansas State University
D. C. Coston	Oklahoma State University
Ellen Cull	Consultant, Washington, DC
Mike Daniels	University of Arkansas
Leroy Daugherty	New Mexico State University
Terry Detrick	Oklahoma Farmers Union
Cady Engler	Texas Agricultural Experiment Station
Roy Escoubas	Oklahoma State University
Connie Fischer	Kansas Dept of Commerce and Housing
Darwin Foster	Texas Cooperative Extension
David Frey	Kansas Wheat Commission
Luis Garcia	Colorado State University
Dennis Gardisser	Arkansas Cooperative Extension Service
John Gardner	University of Missouri
James Garner	University of Arkansas-Pine Bluff
Sebhatu Gebrelul	Southern University
Yemane Gheberiyessus	Southern University
David Gibson	Texas Corn Producers
H. L. Goodwin	University of Arkansas
Richard Griffin	Prairie View Coop Ag Research Center
Steve Hall	Louisiana State University
Phil Halstead	Kansas Polymer Research Center
Mike Harbordt	Temple-Inland, Texas
Michael Heard	Lincoln University
Jim Heird	Colorado State University
Tom Herald	Kansas State University
Tom Holtzer	Colorado State University
Ron Hooks	Southwest Indian Polytechnic Institute
Fu-Hung Hsieh	University of Missouri
Ray Huhnke	Oklahoma State University
A. J. Johannes	Oklahoma State University
Kenlon Johannes	Kansas Soybean Commission
Vernon Jones	Langston University

Curtis Kastner	Kansas State University
Kevin Kephart	South Dakota State University
Jin-Woo Kim	University of Arkansas
Brent Kisling	Oklahoma Rural Development
Ron Lacewell	Texas A&M University
Jerry Lalman	Oklahoma State University
Randy Lewis	Oklahoma State University
Carol Loopstra	Texas Agricultural Experiment Station
Steve Loring	Las Cruces Agricultural Experiment Station
Ross Love	Oklahoma State University
Dale Ludwig	Missouri Soybean Association
Ron Madl	Kansas State University
Gary Marshall	Missouri Corn Growers
Freddie Martin	Louisiana State University
Jerry Matthews	Texas Council on Environmental Technology
Calvin McCastlain	Pender, McCastlain & Ptak, P.A.
Gordon Niswender	Colorado State University
Ademola Oloko	Southern University
Al Parks	Prairie View A&M University
Keith Paustian	Colorado State University
Tom Payne	University of Missouri-Columbia
Florine P. Raitano	Colorado Rural Development Council
James Ray	Oklahoma Farmer
Calvin Roberts	Colorado Farm Bureau
Michael Saska	Louisiana State University
John Schlup	Kansas State University
Leon Schumacher	University of Missouri
Andy Seidl	Colorado State University
Todd Shupe	Louisiana State University
Terry Siebenmorgen	University of Arkansas
Lee Sommers	Colorado State University
Dave Spears	Kansas Farm Bureau
John Stencil	Rocky Mountain Farmers Union
Michael Stubblefield	Southern University
Ralph Tanner	University of Oklahoma
Clyde Todd	Louisiana Forestry Assn
Anthony Turhollow	Oak Ridge National Laboratory
Andy Vestal	Texas Cooperative Extension
Grace Wasike	Southern University
Larry Watters	Outpost Enterprises, Oklahoma
Greg Weidemann	University of Arkansas
Ewell Welch	Arkansas Farm Bureau
Robert Wood	Texas Department of Agriculture
Qinglin Wu	Louisiana State University
Jill Zimmerman	Kansas Corn Commission

Notes:



Sun Grant Initiative South Central Region

Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, and Texas



For more information on the South Central Region contact:

D.C. Coston

Associate Director

Oklahoma Agricultural Experiment Station

Oklahoma State University

405-744-5398

dcoston@okstate.edu

Raymond L. Huhnke

Professor

Biosystems and Agricultural Engineering

Oklahoma State University

405-744-5425

rhuhnke@okstate.edu