



Through Oklahoma's 100-year history, the state has endured and overcome disasters and obstacles, from depression and dust bowl days to oil booms and busts. Today's challenges are no less daunting and require the combination of innovative people, technology, research, political vision and unwavering dedication. Our country's energy needs are a prime example of how Oklahoma can help solve one of the toughest problems facing America today. Following President Bush signing the new energy law that mandates annual production of 36 billion gallons of renewable fuel by 2022, Oklahoma is well positioned to play a leading role in the national effort to produce biofuels to power the country's economy.

Our state legislators should be commended for their foresight and leadership in creating the Oklahoma Bioenergy Center to focus research efforts on the development of cellulosic ethanol. It is natural for Oklahoma to combine its energy and agriculture industries in this very important effort. The Oklahoma Bioenergy Center was proposed by Gov. Brad Henry in 2006 and funded by the Oklahoma Legislature in 2007, with the promise of continuing support over the next four years. The partners in the Oklahoma Bioenergy Center are the University of Oklahoma, Oklahoma State University and the Noble Foundation, who are collaborating on the development of cellulosic ethanol from crops like switchgrass, sweet sorghum and milo, and the development of technologies to convert biomass to transportation fuel. The focus is on crops that are viable on marginally productive lands, that produce more energy per unit of input than corn, and that do not compete with human food and animal feed markets.

We're proud to be part of the research and economic development collaboration that's working to make our state a leader in America's quest to reduce its dependence on foreign oil, to reduce greenhouse gas emissions and to redirect investment into rural America. This is a critical time for Oklahoma. We once again have an opportunity to serve as an energy leader, both in research and production, for our nation and for the world.

*V. Burns Hargis*  
 Burns Hargis  
 President, Oklahoma State University

*Michael A. Cawley*  
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 President, University of Oklahoma

*David Fleischaker*  
 David Fleischaker  
 Secretary of Energy, State of Oklahoma

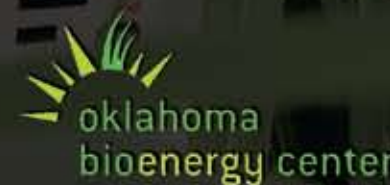
## Oklahoma Bioenergy Center 2007 Annual Report

Cultivating the Future of Oklahoma's Renewable Energy Industry



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# The Oklahoma Bioenergy Center is a research and economic development collaboration focused on making Oklahoma a leader in the United States' quest for a renewable, economically viable and environmentally conscious energy source.

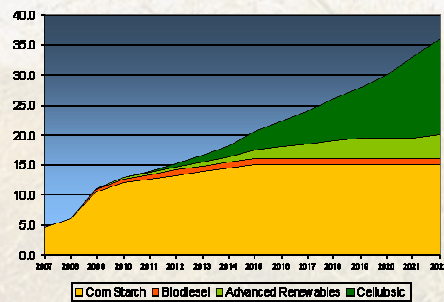
The Oklahoma Bioenergy Center is a collaboration of the University of Oklahoma, Oklahoma State University and the Noble Foundation. Working together, these world-class institutions are coordinating the conduct of research and the delivery of outcomes to:

- Achieve the competitive and sustainable production of liquid biofuels in Oklahoma; and
- Contribute to the national research effort to achieve federally mandated levels of biofuel production and reduce the United States' dependence on foreign oil.

## New challenges bring new opportunities

In December 2007, the Energy Independence and Security Act became law, mandating the production of 36 billion gallons of biofuels annually by 2022 with at least 16 billion gallons taking the form of cellulosic ethanol.

## Current Alternate Fuel Mandates



Today, the United States maintains the capacity to produce in excess of 8 billion gallons of ethanol annually. This ethanol is produced exclusively from grain, such as corn or milo.

In only 15 years, the United States will be required to develop a cellulosic ethanol industry and increase the production

volume of starch ethanol to achieve these mandated standards.

## The Oklahoma Bioenergy Center approach

To produce the required volume of biofuels each year, every geographic region within the United States will have the opportunity to contribute. The manner and level to which each region contributes will likely be a local and unique event due to native (or introduced) crops or forests; soil type, rainfall and other environmental factors; and even historical production patterns.

## What is cellulosic ethanol?

Cellulosic ethanol is ethanol made from cellulose, or plant fiber. Sources of cellulose are abundant and include corn stalks, wheat straw, alfalfa stems, wood, forestry residues and switchgrass. In contrast, starch ethanol is made from grain, such as corn or milo. Cellulosic and starch ethanol are chemically identical. In 2006, more than 50 percent of the gasoline used in the United States contained ethanol.

In Oklahoma, agricultural history has shown that corn and wheat are only economically productive in certain regions of the state. Forests occupy the southeastern extremes of the state, and native and introduced pastures are found across the central and western portions of the state. All of these "crops" may eventually contribute to Oklahoma's role as a bioenergy leader.

With such diversity and a desire to make a timely impact, the scientists and

researchers representing the Oklahoma Bioenergy Center took a practical approach to establishing the Center's initial research priorities. They answered the question: What will best benefit Oklahoma and its agricultural producers?

Unlike other state or national biofuels research initiatives, the Oklahoma Bioenergy Center has focused and is coordinating its research effort to address the entire spectrum of the bioenergy process "from the field to the biorefinery." The Center capitalizes on the strengths of the contributing institutions, taking a "whole-system" approach – moving and integrating the discoveries and innovations of one research program to the next research program to enable the delivery of an integrated solution for Oklahoma and its agricultural producers.

The Oklahoma Bioenergy Center divided this integrated system into four primary research areas:

1. Crop Development – evaluating, identifying and improving the best plant materials to increase yield, sustainability, conversion efficiency and biofuel output
2. Crop Production – developing establishment and management tools and procedures for dedicated energy crops
3. Harvest, Collection and Transport – designing new solutions to harvest, process, collect and move high-yielding, commercial bioenergy crops
4. Conversion – formulating the most effective and economical way to transform new feedstocks – like switchgrass – into biofuels that burn efficiently, reduce greenhouse gases and are compatible with today's engines and fuel pumps.

In addition to this critical research, the Oklahoma Bioenergy Center will establish production-scale demonstration fields – totaling more than 1,300 acres – for cellulosic energy crops, including sorghum and switchgrass. The Oklahoma Dedicated Energy Crop Demonstration Fields will be the first of their size

**The value [of the Oklahoma Bioenergy Center] to the cellulosic ethanol industry cannot be overstated; the early and aggressive establishment of 1,000 acres of switchgrass will provide researchers, scientists, agricultural producers and industry – not only in Oklahoma, but across the nation – with important information that will help establish the emerging cellulosic ethanol industry.**

Gerson Santos-Leon  
Executive Vice President  
Abengoa Bioenergy  
New Technologies

in the world. These fields will provide academia and industry a unique "living laboratory" to understand the production and long-term impact of bioenergy crops, as well as experiment with new production techniques and critical harvest, collection and transport methods. These demonstration fields will also serve as a "living classroom" where agricultural producers, policymakers and the general public can see and experience these crops which will play a key role in the United States' energy future.

The 1,300 acres are expected to be planted in late spring 2008 and will comprise acreage near Chickasha (sorghum), Maysville (switchgrass) and Guymon (switchgrass). The critical piece of this effort is a 1,000-acre stand of switchgrass near Guymon. This location leverages the extensive agricultural infrastructure and farming expertise located in Oklahoma's Panhandle. Moreover, the switchgrass grown at this location will have a marketable endpoint – a cellulosic biorefinery

currently being constructed in Hugoton, Kan., will be less than 35 miles from Guymon. The Abengoa Bioenergy facility is expected to be operational in 2010.

## Beyond switchgrass and cellulosic ethanol

While the initial research focus of the Oklahoma Bioenergy Center is cellulosic ethanol produced from switchgrass, secondary research of the Center includes:

- Oilseed feedstock production (for biodiesel production)
- Winter canola production (for biodiesel production)
- Sweet sorghum processing for on-farm production of ethanol
- Alfalfa improvement (as a "bridge" crop for cellulosic ethanol production)
- Forage sorghum demonstration (for cellulosic ethanol production)
- Enhanced oil extraction and other processing for oilseed feedstocks (for biodiesel production).

## External Contributors to the Oklahoma Dedicated Energy Crop Demonstration Fields

### ABENGOA BIOENERGY

Abengoa Bioenergy is Europe's largest ethanol producer and fifth largest in the United States. To complement its current U.S. production capabilities, Abengoa Bioenergy USA, based in St. Louis, Mo., is building a biorefinery 10 miles from the Oklahoma-Kansas border.

The proposed Hugoton biorefinery, set for completion in late 2010, will occupy about 400 acres west of Hugoton. This facility is expected to produce about 13 million gallons of cellulosic ethanol a year, using 930 tons per day of cellulosic material, and another 88 million gallons of starch ethanol. The cellulosic feedstock will be comprised of crop residues (e.g., corn and milo stover, and wheat straw) and switchgrass.



Idaho National Laboratory (INL), based in Idaho Falls, Idaho, is the lead feedstock supply and logistics laboratory for the

Department of Energy's Office of Biomass Programs. INL has conducted considerable work in the area of feedstock gathering and processing for crop residues (wheat straw).



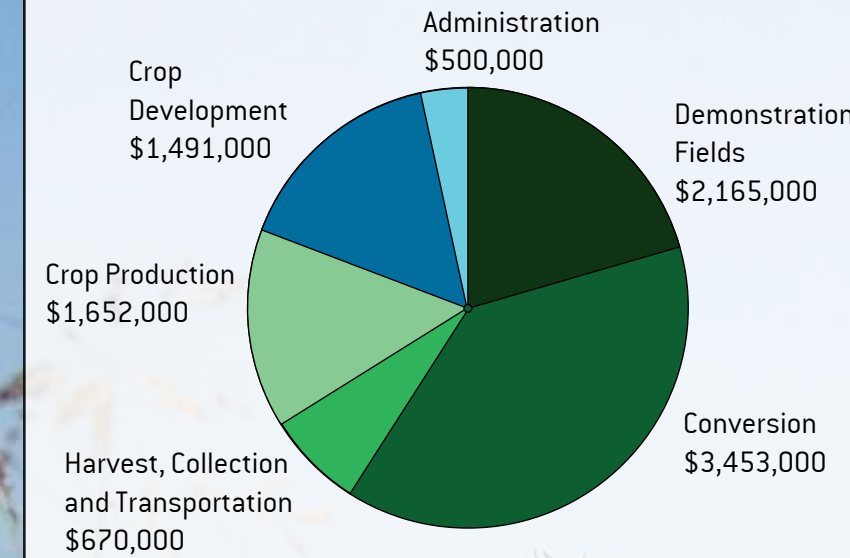
Ceres, Inc., based in Thousand Oaks, Calif., is a leading developer of high-yielding, dedicated energy crops that can be planted as feedstocks for cellulosic ethanol production. Its development efforts cover switchgrass, sorghum, miscanthus, energycane and woody crops.



Hitch Enterprises, Inc., based in Guymon, Okla., is a family-owned and -managed agricultural company. Founded more than 115 years ago, Hitch Enterprises conducts extensive cattle feeding, cattle production, pork production and agricultural operations primarily near Guymon. Through its agricultural operations, Hitch Enterprises produces corn, milo, sunflowers, wheat (hard red and white), introduced grasses and alfalfa.

## Allocation of Oklahoma Bioenergy Center Resources: 2007-2009

(based on allocated research dollars)



## Institutional Cost Sharing Contributions

(based on contribution of indirect costs)

Oklahoma State University	\$1,157,904 (on \$3,200,000 in direct cost)
Noble Foundation	\$1,132,296 (on \$3,030,740 in direct cost)
University of Oklahoma	\$1,130,506 (on \$3,200,000 in direct cost)

## Oklahoma Bioenergy Center Board of Directors

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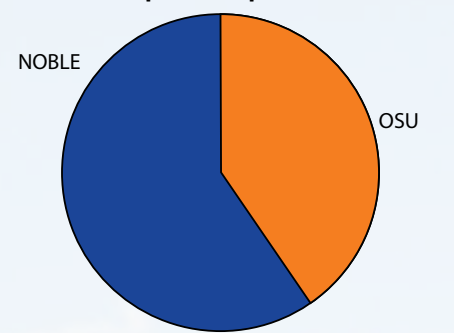
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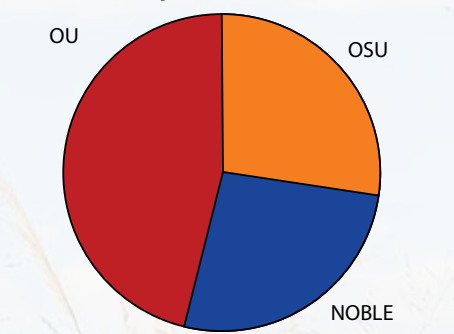
## Institutional Contributions to Center's Research

(based on allocated research dollars)

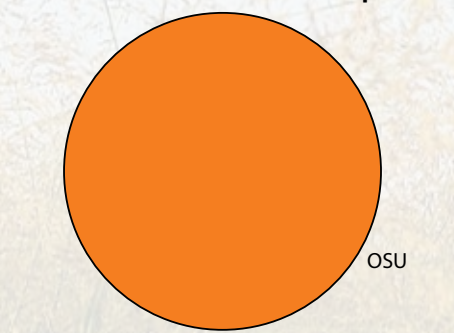
### Crop Development



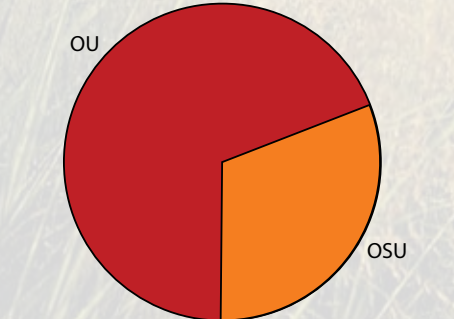
### Crop Production



### Harvest, Collection and Transport\*



### Conversion



\*Additional contributions to this research will be made by the external contributors to the Oklahoma Dedicated Energy Crop Demonstration Fields (see information box in this annual report).