

# Switchgrass at The Department of Energy's Former K-25 Site

Sprouting Solutions and Harvesting  
Alternatives to America's Dependence on Foreign Oil

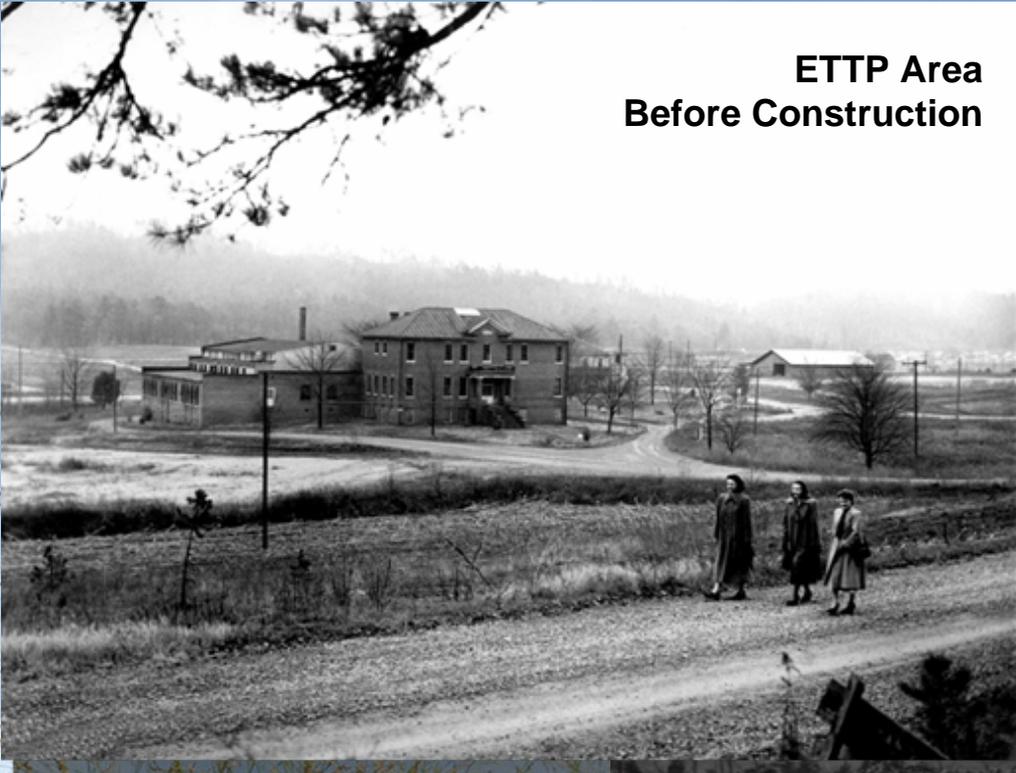
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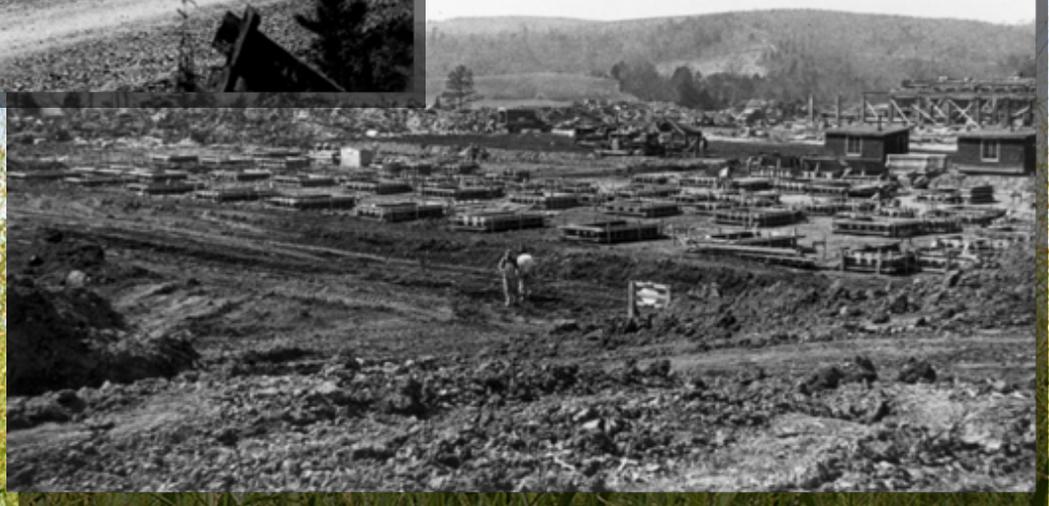
June 18, 2008



**ETTP Area  
Before Construction**



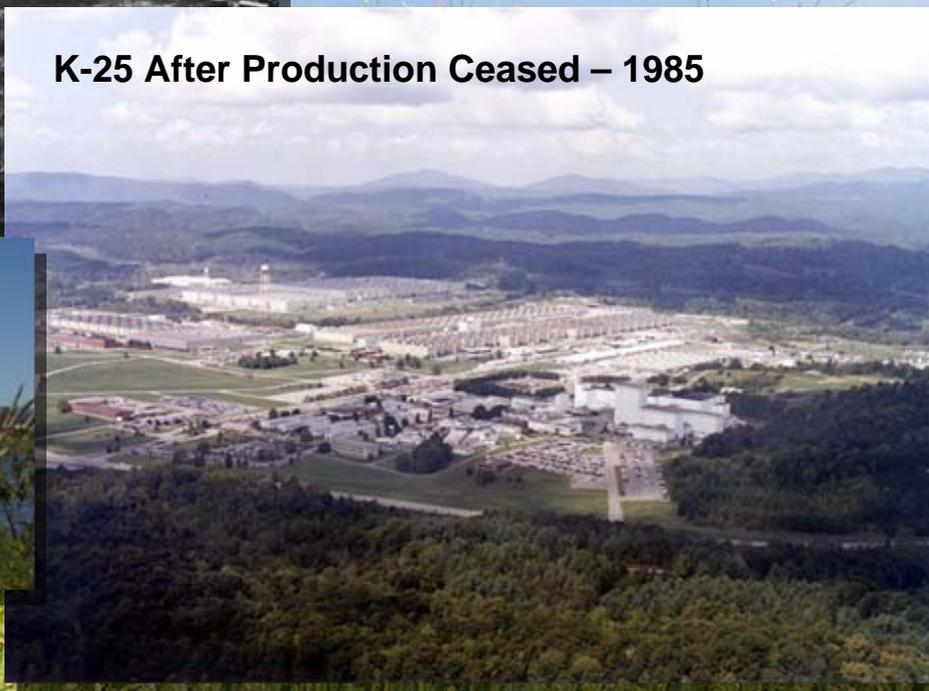
**ETTP Area  
During Construction**



## Construction of K-25 – 1943



## K-25 After Production Ceased – 1985



# Vision

By 2012, the Oak Ridge Reindustrialization Program will be recognized as the national leader in the beneficial reuse of Department of Energy assets.

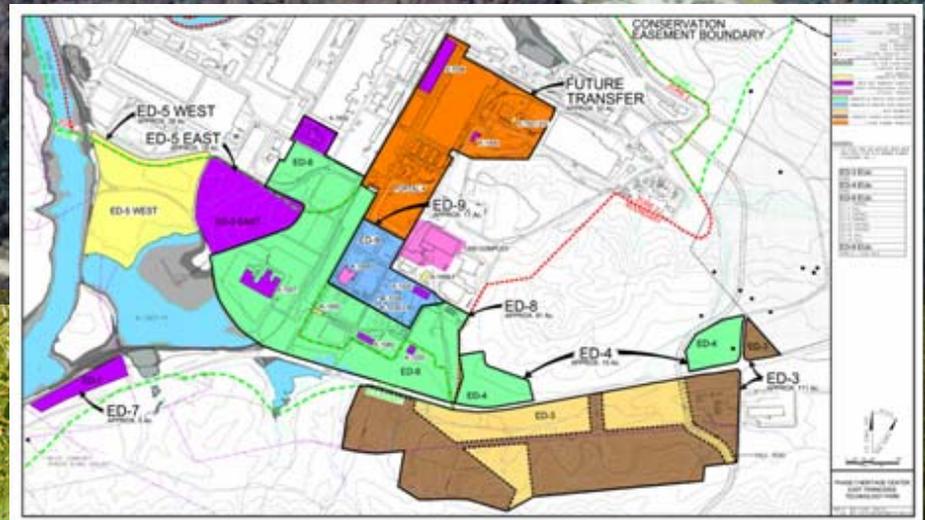
# Mission

Accelerate clean-up and promote economic development by making DOE underutilized assets (e.g., buildings, land, equipment) available to the private sector for the establishment of self sustaining businesses on the Oak Ridge Reservation.

# A Vision for a Sustainable Future



A mixed-use business and industrial park with many tracts planted in switchgrass, a “second generation” biofuel feedstock.



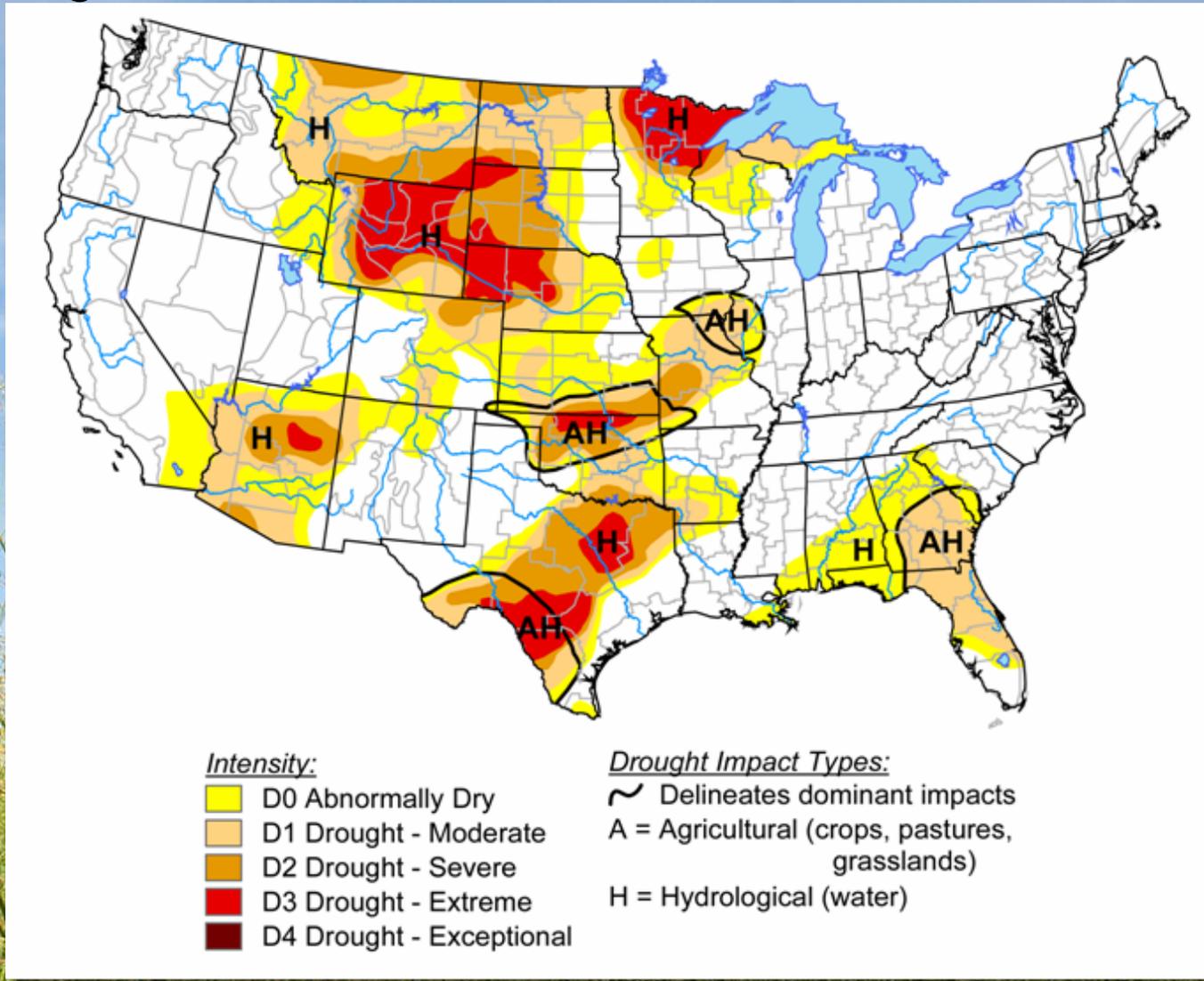
# Switchgrass is a Native Warm Season Grass

- Native warm-season grasses (NWSG) are grasses historically native to an area that grow during the warm months of the year and are otherwise dormant.
- Native warm season grass benefits include: wildlife habitat, agricultural forage, vegetation to filter sediment and pesticides from waterways, and soil erosion control.



*Panicum virgatum*

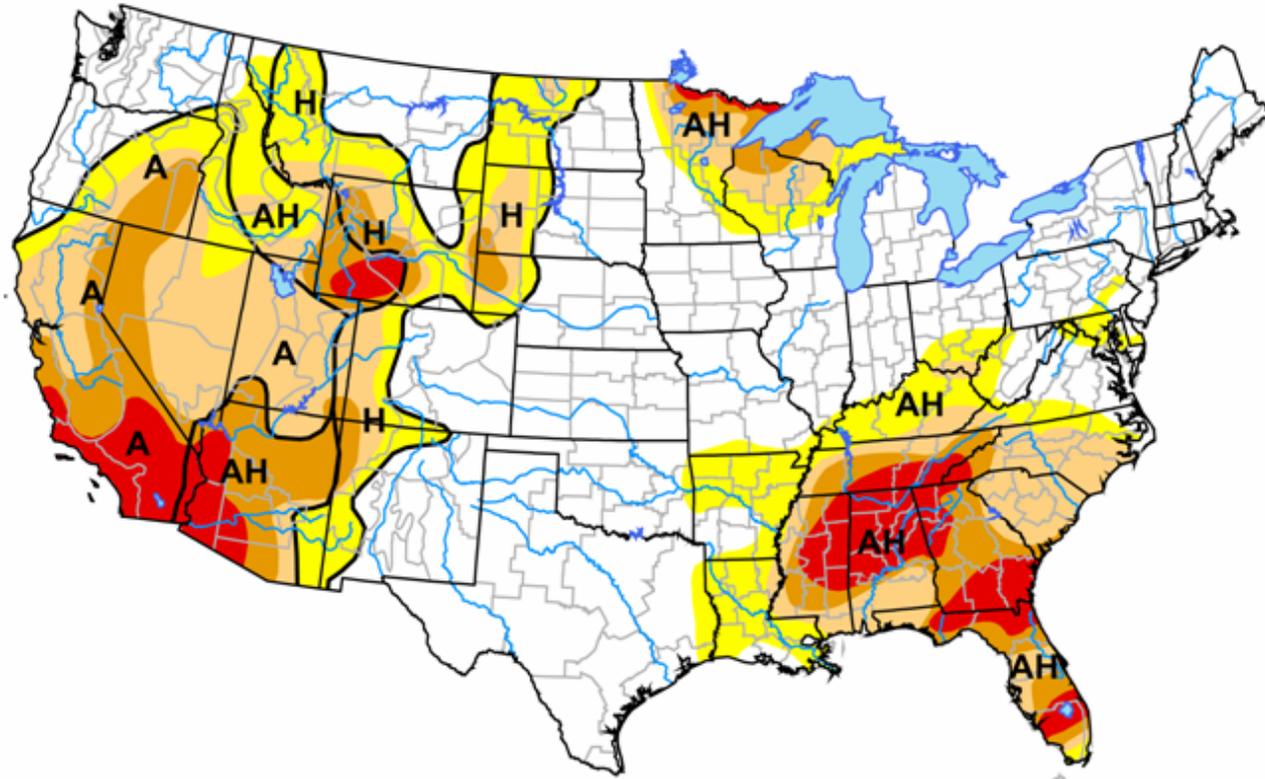
# Project Planned: November 2006



Source: National Drought Mitigation Center  
University of Nebraska-Lincoln



# Project Planted: May 2007



Intensity:

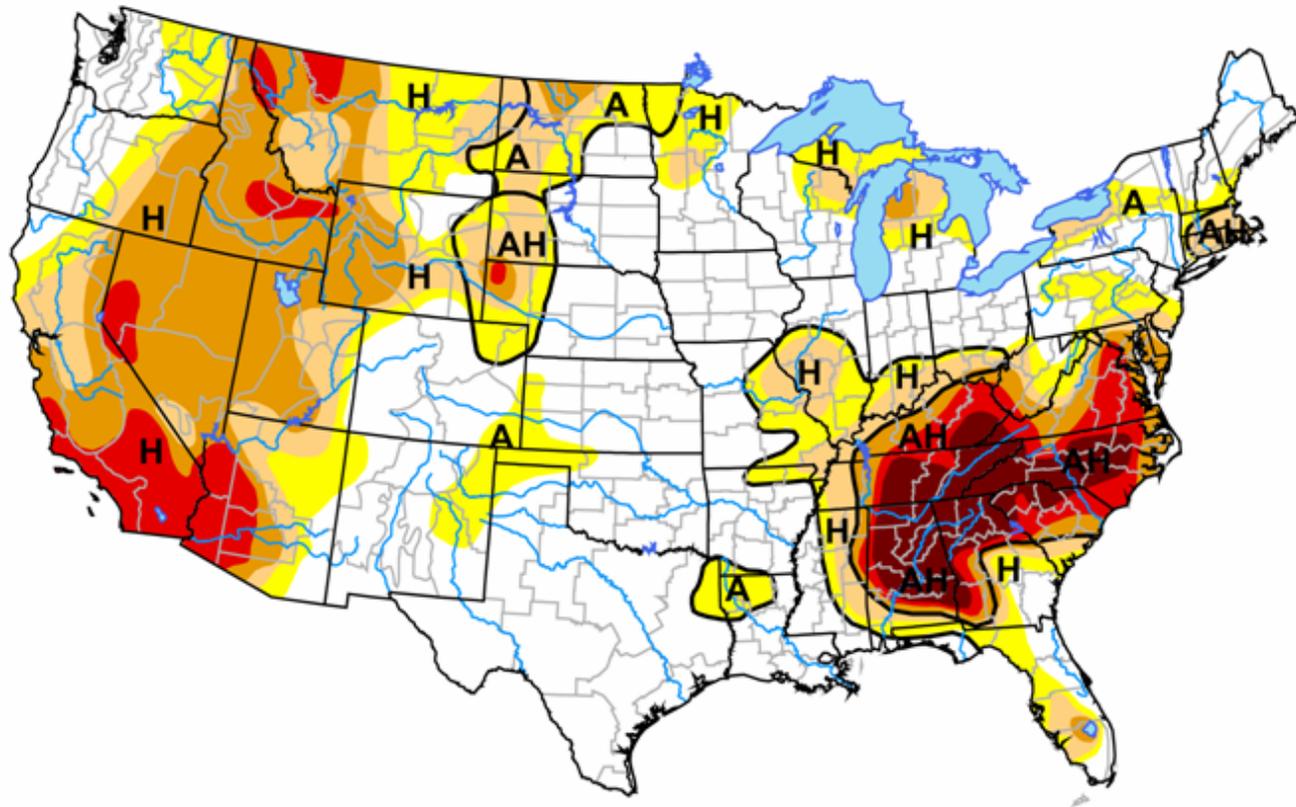
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

Source: National Drought Mitigation Center  
University of Nebraska-Lincoln

# First Year Project Completed: October 2007



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Drought Impact Types:

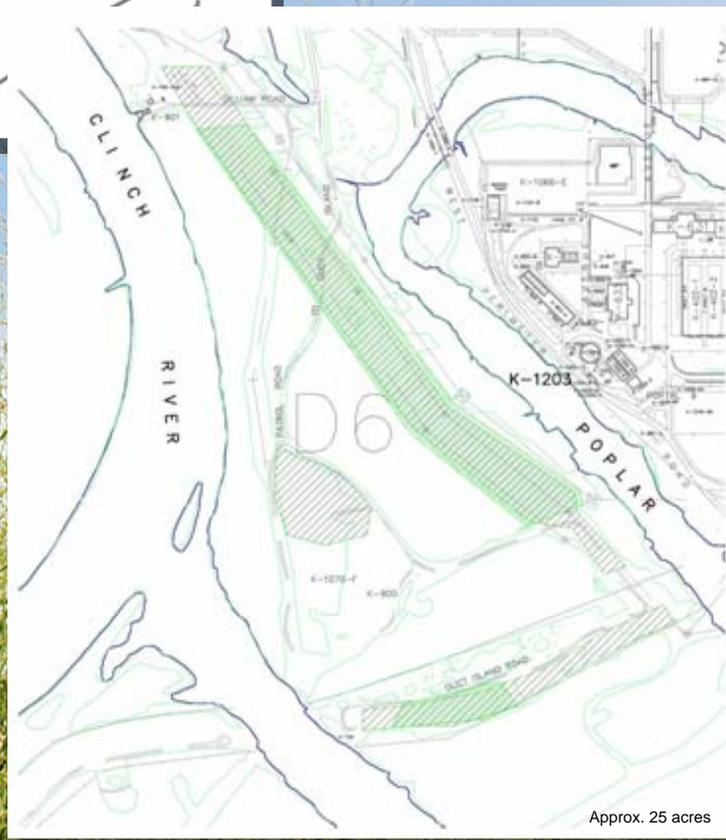
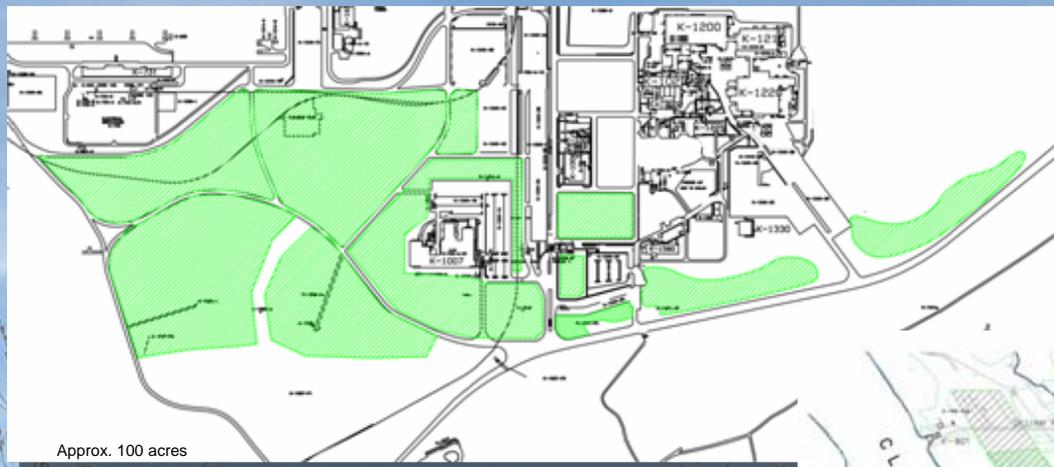
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Source: National Drought Mitigation Center  
University of Nebraska-Lincoln

# 2007 Trial Results



# 2008's Expanded Switchgrass Plan



# 2008 Initiative

**Spraying NWSGs – April 2008**



# 2008 Initiative

**Lower Duct Island plot before preparation – April 2008**



# 2008 Initiative

**Seeding switchgrass on Lower Duct Island – May 2008**



# It's Growing!

**Switchgrass on Lower Duct Island – Late May 2008**



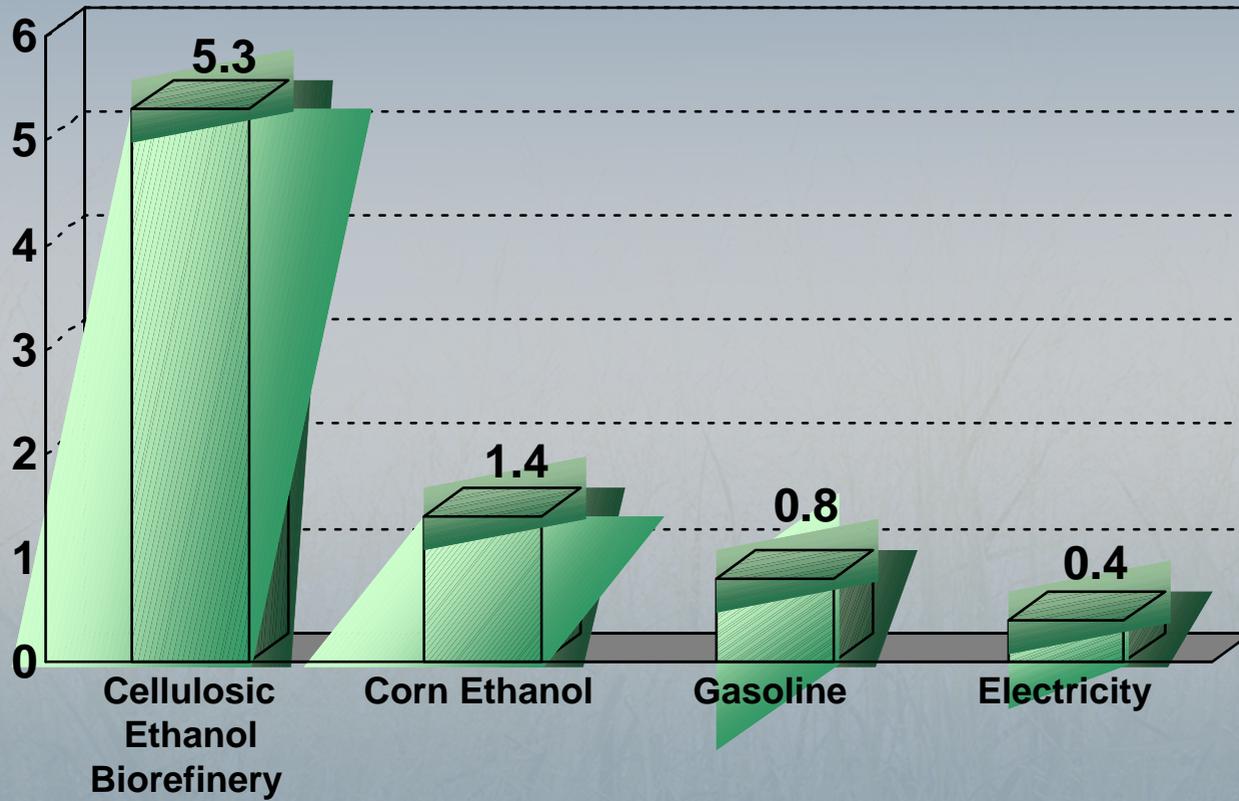
# Comparison of Switchgrass (cellulosic) ethanol to Corn-based ethanol\*

	<b>Corn</b>	<b>Switchgrass</b>
<b>Production</b>	<ul style="list-style-type: none"> <li>• Requires prime soils for optimal yields</li> <li>• Sensitive to drought</li> <li>• Requires intensive use of fertilizers</li> <li>• Annual</li> </ul>	<ul style="list-style-type: none"> <li>• Can grow in marginal soil</li> <li>• Drought-tolerant</li> <li>• No fertilizers needed</li> <li>• Perennial</li> </ul>
<b>Refining</b>	<ul style="list-style-type: none"> <li>• Proven technology (“moonshine”)</li> <li>• Many refineries on-line</li> <li>• Lower-cost investment</li> </ul>	<ul style="list-style-type: none"> <li>• Technologies under development (“moonshine plus”)</li> <li>• Pilot plants coming on-line</li> <li>• Heavy investment into research to develop key enzymes (for cellulose breakdown)</li> </ul>
<b>Effects on the Human Environment</b>	<ul style="list-style-type: none"> <li>• Water Requirements (growth and refining)</li> <li>• Heavy use of nitrogen-based fertilizers</li> <li>• Diversion of food commodity crops</li> </ul>	<ul style="list-style-type: none"> <li>• Water requirements (refining)</li> <li>• Grows in marginal soil (does not compete with food crop land)</li> </ul>

\* Using the biochemical process

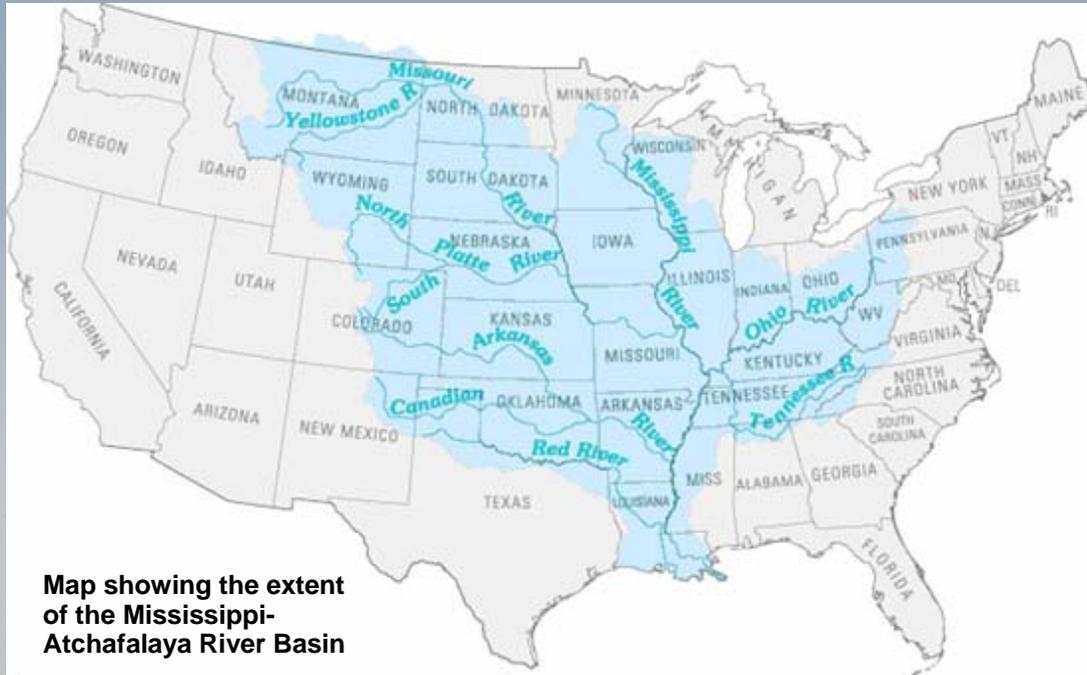
# Cellulosic feedstocks provide the maximum fossil energy replacement ratio

$$\text{Fossil Energy Ratio (FER)} = \frac{\text{Energy Delivered to Customer}}{\text{Fossil Energy Used}}$$



Source: J. Sheehan & M. Wang (2003)

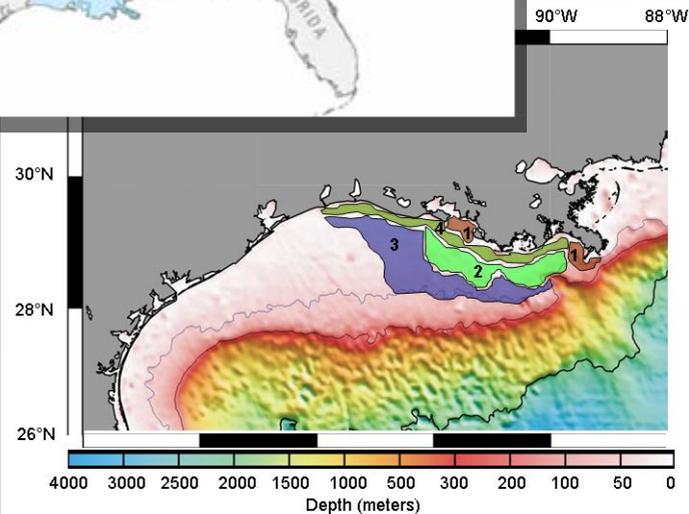
# Upstream Plantings Have Downstream Effects



Map showing the extent of the Mississippi-Atchafalaya River Basin

Zones in Northern Gulf of Mexico differ with regard to

- Stratification
- Light limitation
- Nutrient limitation
- Hypoxia



Source: Dr. Virginia Dale, Oak Ridge National Laboratory

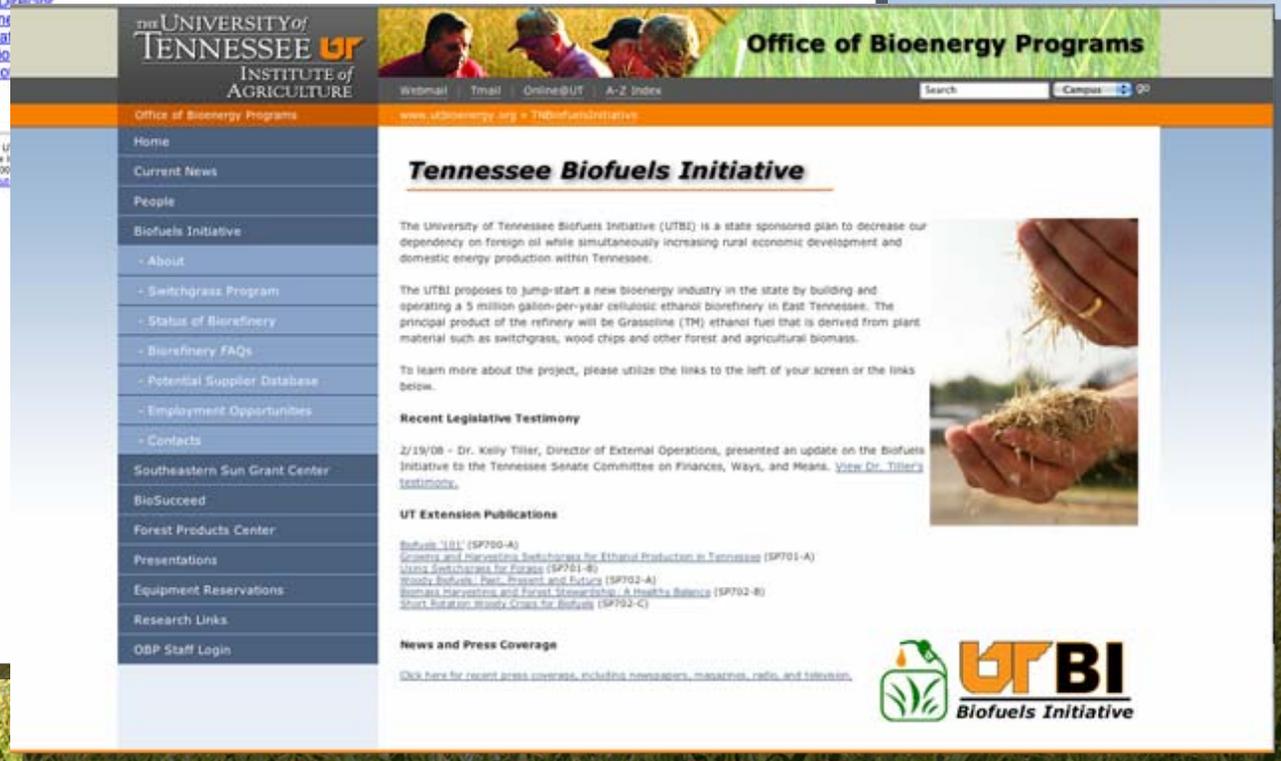
# TN's Leadership Role in Ongoing Research on Cellulosic Ethanol Refining



Management Contractor for DOE's  
Oak Ridge National Laboratory

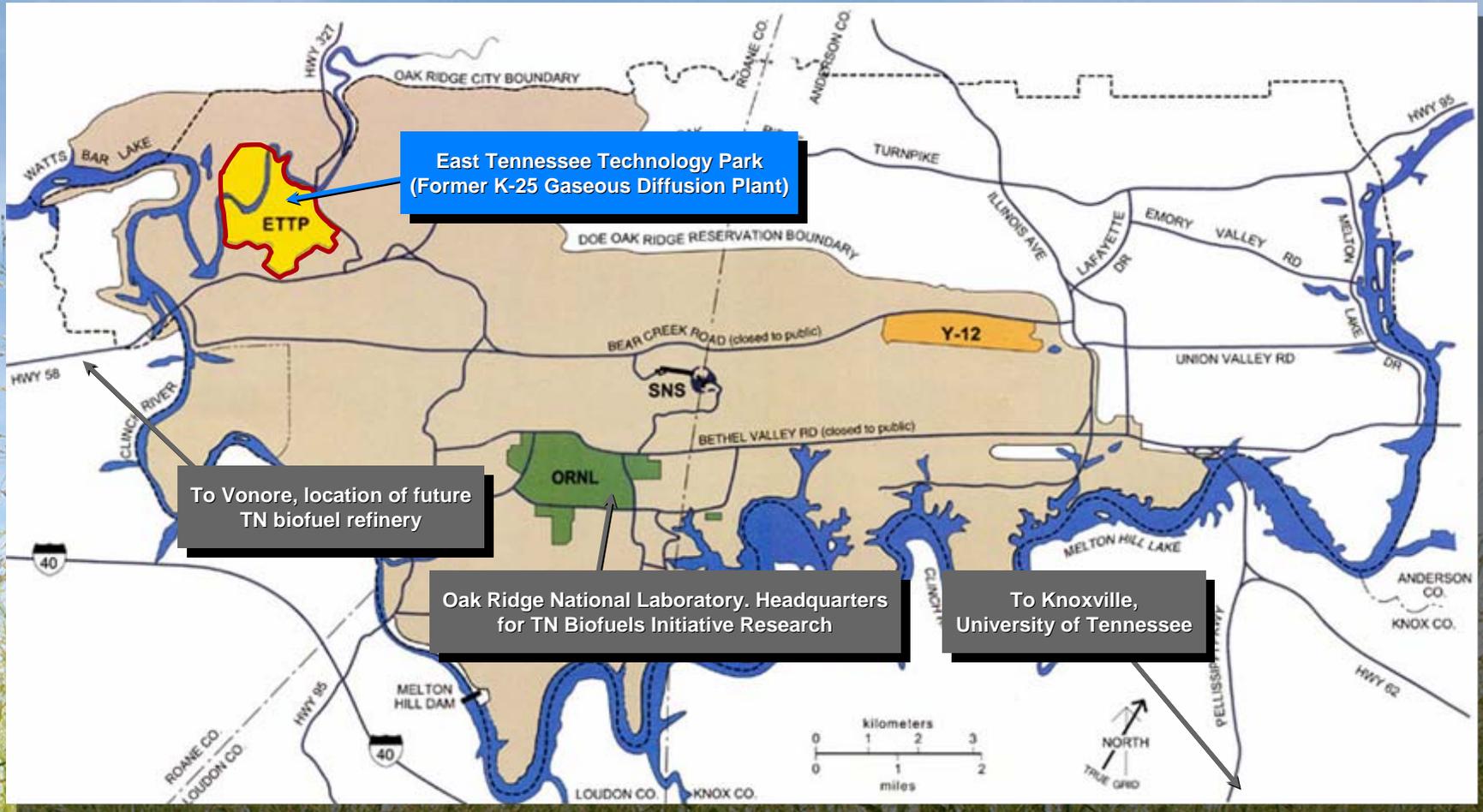
- [About UT-Battelle](#)
- [The UT-Battelle Plan](#)
- [The Leadership Team](#)
- [About the Lab Director](#)
- [University Partners](#)
- [Contact Information](#)
- [Oak Ridge National Laboratory](#)
- [The University of Tennessee](#)
- [Battelle](#)

TN has committed \$40M to a  
biofuel refinery in East TN.



The screenshot shows the website for the Tennessee Biofuels Initiative. The header includes the University of Tennessee logo and the text 'Office of Bioenergy Programs'. A navigation menu on the left lists various sections such as 'Home', 'Current News', 'People', 'Biofuels Initiative', and 'About'. The main content area features the title 'Tennessee Biofuels Initiative' and a paragraph explaining the initiative's goal to decrease dependency on foreign oil. Below this, there are sections for 'Recent Legislative Testimony' and 'UT Extension Publications'. A photograph of hands holding biomass is visible on the right side of the page. The footer includes the UTBI logo and the text 'Biofuels Initiative'.

# Location, Location, Location



# Harvested Switchgrass Needs to Be Stored



**K-33 Building**



**Biofuel Mandates**

**“Silent Tsunami of Hunger”**

**“Food vs. Fuel”**

**Gas Prices Skyrocket**

**2005 Energy Policy Act**

National Security vs. “global warming”

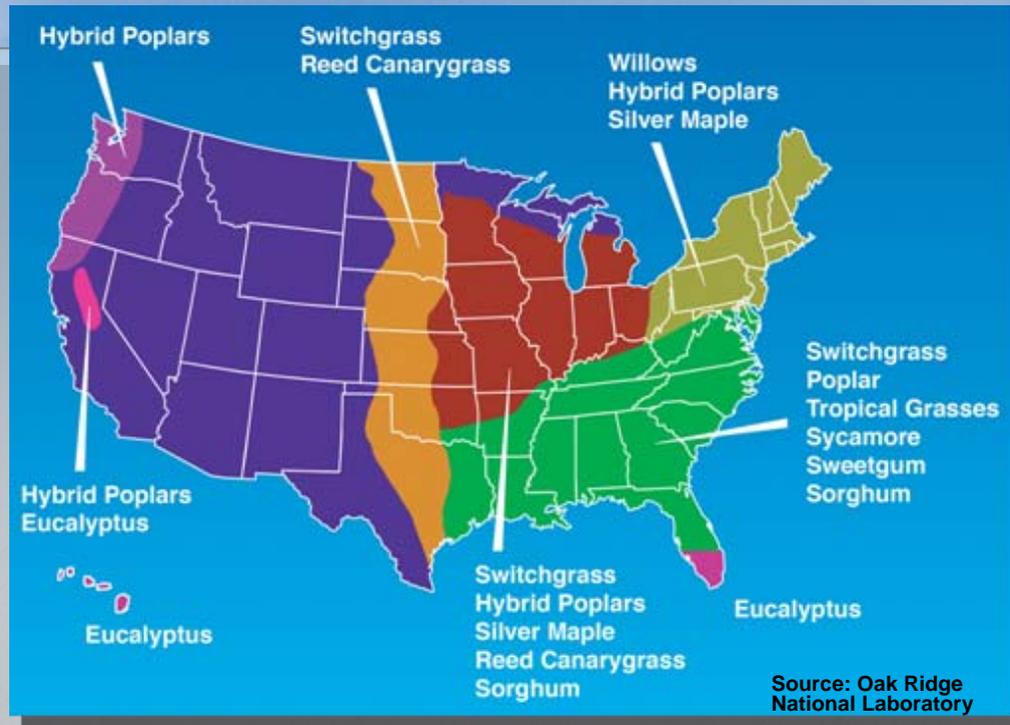
**2007 Energy Independence and Security Act**

**Rice Rationing**

**Commodity Prices Soar**

Wheat growers opt out of subsidies not to plant

# U.S. Biofuels Options



There are many alternatives for most regions

Your location, site and situation are all factors in your ability to make a contribution

Agricultural waste products (stover) are found almost in every region and need not be wasted

Don't forget algae

# Some Sustainability Benefits

- Switchgrass and other native warm-season grasses are outstanding second generation biofuels
- The establishment of NWSGs on your site can contribute to our energy independence
- NWSGs will reduce your site mowing needs, saving fuel and emissions
- NWSGs are aesthetically pleasing
- The aesthetic of NWSGs, wildflowers, etc. can “soften” your site and potentially attract a different business and industry subset
- NWSGs/switchgrass will change and broaden your site’s purpose

## Some Lessons Learned

- Apply herbicide and disc before planting in hard-packed soils
- Favorable weather is critical – especially rain – in the initial establishment phase
- Plan to work closely with your state Agriculture Extension Agent; your state land-grant university will also be an excellent information resource
- If your site has a approved list of herbicides/pesticides, plan to have it altered ahead-of-time to address potential pests and pest plants.
- Tell site occupants what you plan and provide them with updates

# For More Information

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The Community Reuse Organization of East Tennessee