

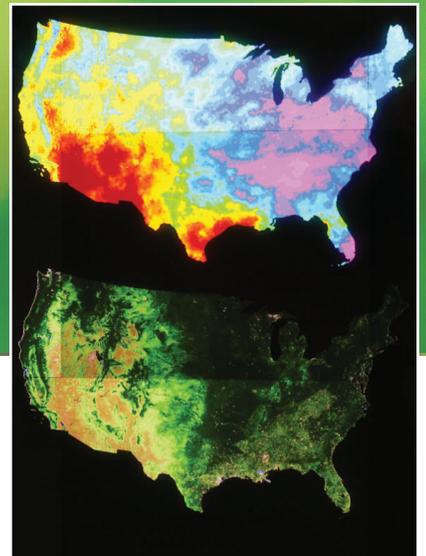


Research to Advance the Bioenergy Supply Chain

Growing a stronger bioenergy future through sustainable resources, reliable supply systems, and innovative technologies.

OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY



Together, transforming Ame

Through support from the U.S Department of Energy (DOE), the Environmental Protection Agency, and NASA, Oak Ridge National Laboratory (ORNL) is performing research, development, and analysis throughout the bioenergy supply chain.

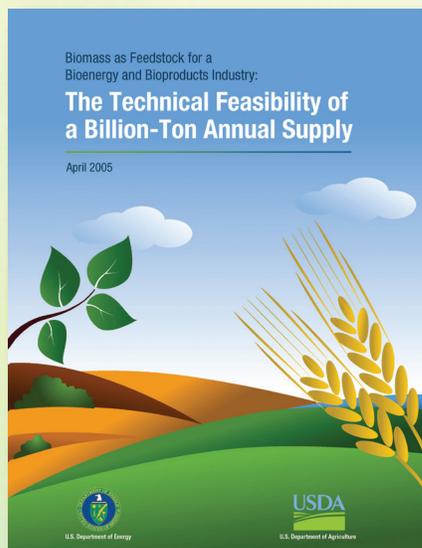
ORNL's Bioenergy Program is bringing together teams from across laboratory disciplines and the country to research biofeedstocks, feedstock logistics, biorefineries, product delivery, and the sustainability of the supply chain. Its goal is to enable the U.S. national vision of large-scale sustainable production of biofuels, bioproducts, and biopower to enhance energy security, reduce greenhouse gas emissions, and promote the rural economy. ORNL also supports national agencies and decision makers by supplying timely, extensive information on all aspects of bioenergy.

Biofeedstocks – Combining cutting-edge genomic, computer, and image technology, the ORNL BioEnergy Science Center is exploring the fundamental biology-controlling cell wall construction and chemistry. In the future such knowledge will enable the design of plants that are readily converted into biofuels.



Switchgrass is a common bioenergy feedstock ORNL researchers are studying.

Projections of potential future biomass supplies are critical to decision makers and the growing bioenergy industry. Using sophisticated economic models combined with detailed geographic information, ORNL has been the national provider of biomass resource estimates for the past 30 years. ORNL's 2005 study that confirmed the technical feasibility of U.S. lands supplying a billion tons of biomass annually was pivotal in the development of the Energy Independence and Security Act of 2007.



The Billion Ton Study findings were the basis for the Energy Independence and Security Act of 2007.

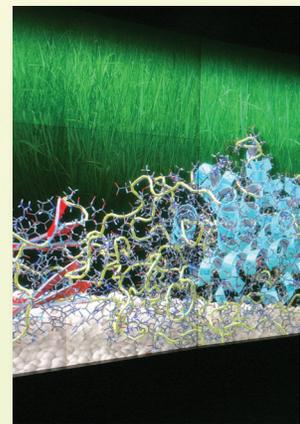
Feedstock Logistics – ORNL agricultural engineers evaluate and model the changes in biofeedstock qualities as they move along the supply chain, as well as the energy cost and resources used. This includes evaluating the harvest and storage of feedstocks, the transformation of raw feedstocks (e.g., pelletization or grinding), and transportation to biorefineries. Located in the southeast, ORNL is especially interested in woody feedstocks such as forest thinnings and perennial native grasses such as switchgrass.



Switchgrass harvesting.

Biorefineries – While today's biorefineries largely use corn as their feedstock, future biorefineries will rely on plant materials like wood and grasses to produce ethanol and other fuels, as well as high-value bioproducts that can displace their fossil-based counterparts.

ORNL biorefinery-relevant research includes basic research to understand the genetic controls on enzymes that breakdown cellulose. Applied research includes developing processes for transforming lignin into carbon fibers that could replace materials such as steel used in automotive production, and understanding how materials respond to the chemical and temperature conditions in biorefinery processes.



Visualization showing a cellulase enzyme in action on a cellulose surface with switchgrass in the background.

rica's renewable resources

Product Delivery – Optimizing biorefinery locations in relation to energy demand and transportation infrastructure is a major step in growing a bioenergy industry. ORNL is applying its rich history and expertise in both transportation and electric grid research to evaluate the delivery elements of the bioenergy supply chain.

End Users – ORNL researchers who specialize in fuels, engines, and emissions are examining various biofuels and their impact on engine performance, emission controls, general vehicle performance, and material compatibility issues related to storage tanks, pumps, etc. For example, the lab leads an ongoing DOE-industry collaborative Intermediate Ethanol Blends Test Program studying the effects of E15 or E20 fuels on the emissions and performance of vehicles and non-road engines. E15 is a fuel blend with 85 percent gasoline, 15 percent ethanol; E20 is 80 percent gasoline, 20 percent ethanol.



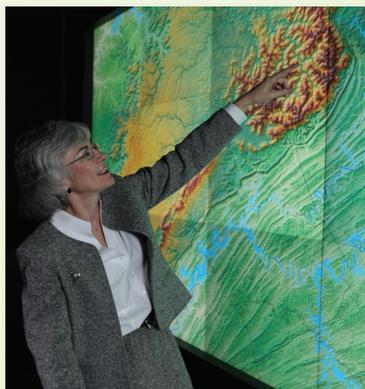
ORNL ethanol pump.



Intermediate blends testing at the Fuels, Engines, and Emissions Research Center.

Sustainability – Drawing on ORNL's historic environmental studies on bioenergy crops, the Center for BioEnergy Sustainability was opened in 2009. The Center uses science and analysis to understand and promote the sustainability (environmental, economic, and social) of bioenergy production and distribution, and serves as an independent source of the highest quality data and analysis for bioenergy stakeholders and decision makers.

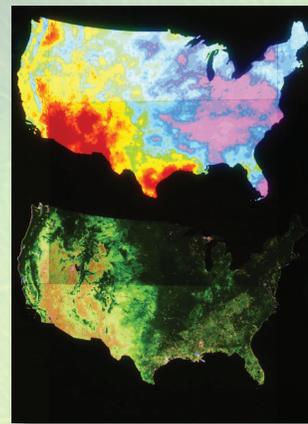
Land use information helps determine best placement of bioenergy crops to achieve greatest environmental and economic benefits.



Information – Through a variety of formats and technologies, ORNL provides relevant, easily accessible information essential to effective policy development and support of the national bioenergy industry.

Using a geospatial-based framework based on advanced computer and data science technology, ORNL's Bioenergy Knowledge Discovery Framework facilitates informed decision making through the synthesis, analysis, and visualization of vast amounts of information related to the economic and environmental impact of biomass feedstocks, biorefineries, and infrastructure development options.

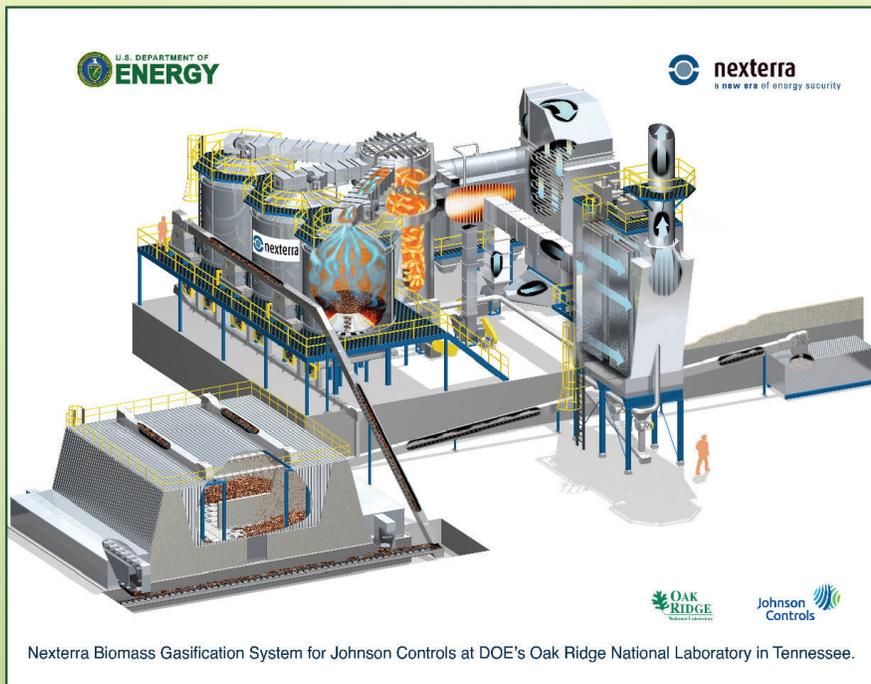
ORNL also produces the Biomass Energy Data Book, integrating biomass data from diverse sources and providing that information on the web in a familiar book-like format for quick look-ups or more detailed analyses.



Comparing spring precipitation (color) to summer foliage production (green).

Specialized bioenergy research centers at ORNL:





Nexterra Biomass Gasification System for Johnson Controls at DOE's Oak Ridge National Laboratory in Tennessee.

ORNL steam plant rendering.

Bioenergy Heats Up at ORNL

Since the 1950s, most buildings on ORNL's main campus have been heated or cooled by the centrally located steam plant. To produce steam, the plant has long burned fossil fuels—initially coal and then natural gas and heating oil. ORNL will soon switch to biofuel in the form of locally-derived wood chips. This transition will produce steam while reducing spiraling energy costs and unwanted carbon dioxide emissions.

Supporting Sustainable Transportation

ORNL's applied bioenergy research is aligned under the lab's Sustainable Transportation Program, supporting basic research funded by DOE's Office of Science. The program brings together scientists and engineers, commercialization experts, and technology transfer specialists from across laboratory directorates to address today's transportation challenges. Through partnerships with government, industry, and academia, their research and development efforts are resulting in knowledge discovery and technology development, maturation, and implementation. The program drives four broad and integrated areas of concentration to advance the mobility of people and goods within America's transportation systems: vehicle, energy, information, and infrastructure.

For more information about bioenergy research, contact:

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