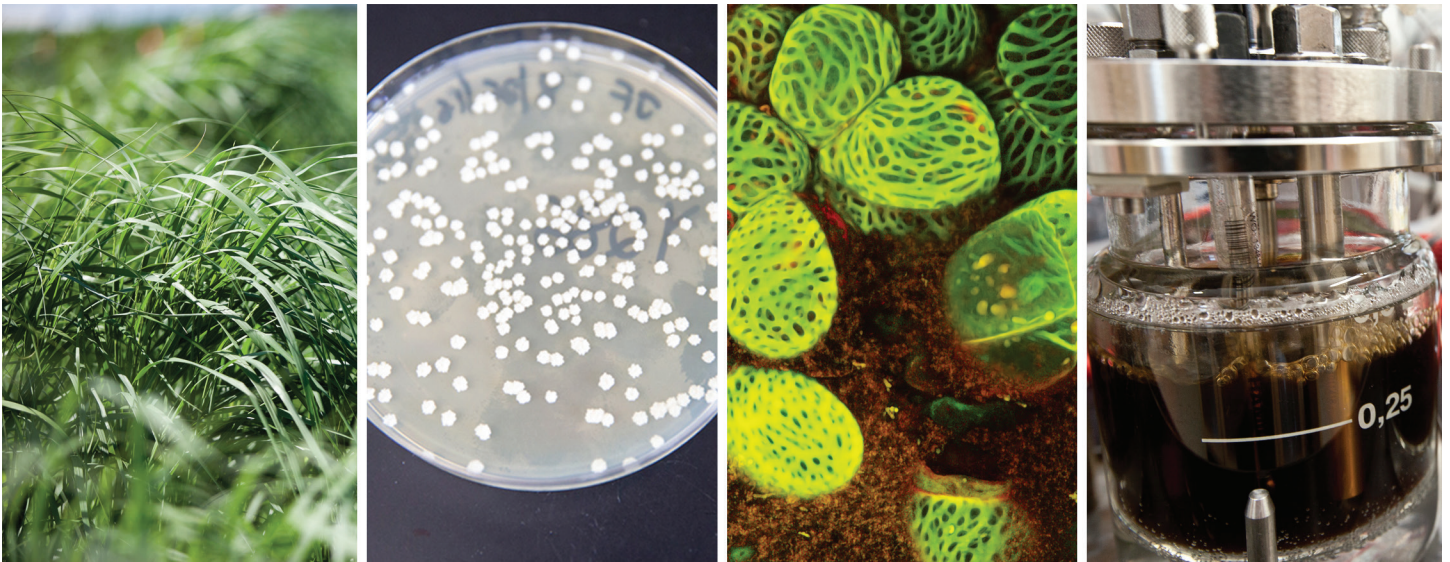


Delivering Advanced Biofuels & Bioproducts to the Marketplace

A Progress Report from the Department of Energy Bioenergy Research Centers



The Bioenergy Research Center Charge

The U.S. Department of Energy-funded Bioenergy Research Centers (BRCs) are conducting research to develop a viable and sustainable domestic biofuel and bioproducts industry from dedicated bioenergy crops such as switchgrass, poplar, and energy sorghum. This research has the potential to boost future energy security, lower greenhouse gas emissions, diversify the range of available bio-based products, and create jobs in rural areas.

Each BRC is led by a DOE National Laboratory or a top university, and consists of a multidisciplinary partnership involving experts from science and engineering, as well as from private companies and non-profit organizations. Geographically diverse, each BRC takes a unique approach to improving and scaling up the production of advanced biofuels and bioproducts, and each is focused on biomass energy crops with promise for its particular region.

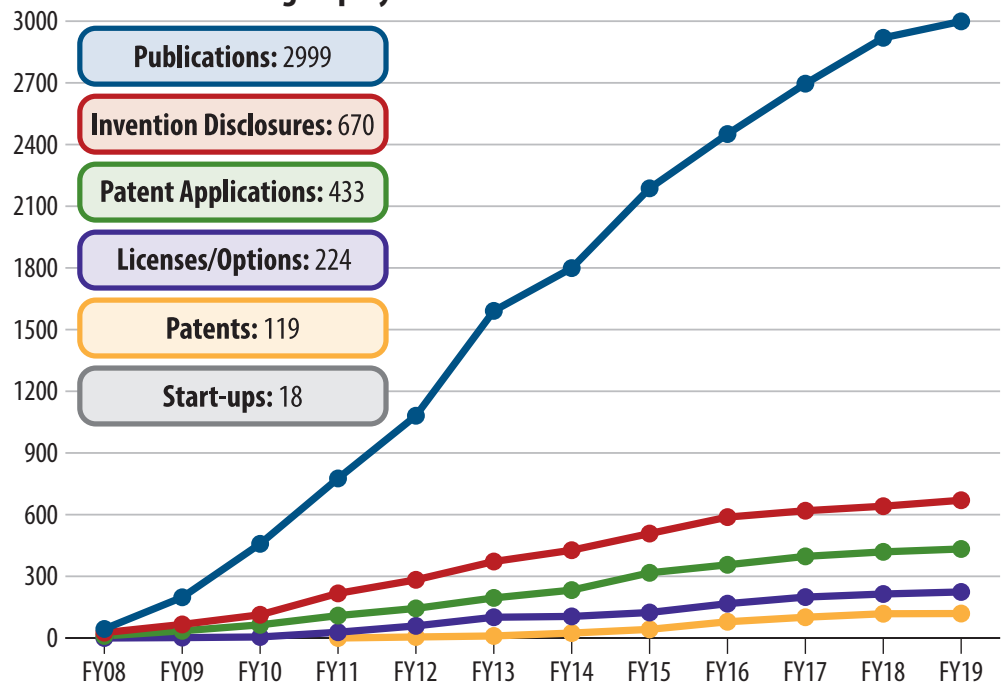
First created by the Department of Energy in 2007, the BRCs expanded from three centers to four in 2017. In this next phase of the BRCs, research has expanded from an initial focus on ethanol to advanced biofuels such as isobutanol, and to bioproducts that can replace chemicals currently derived from petroleum or natural gas.

Together the BRCs are addressing the challenges of converting biomass to biofuels and bioproducts on a scale far greater than any effort to date.

“To meet the energy needs of a growing vehicle fleet, a diverse set of transportation fuels will be required. We look to BRC researchers for new knowledge and scientific discoveries that will support the sustainable production of advanced biofuels.”

- Candace Wheeler, Former Technical Fellow at General Motors

DOE Bioenergy Research Centers: Accelerating Deployment of Science & Commercialization



Bioenergy Research Centers at a Glance



Center for Advanced Bioenergy and Bioproducts Innovation | cabbi.bio

The Center for Advanced Bioenergy and Bioproducts Innovation (CABBI), led by the University of Illinois at Urbana-Champaign, is developing efficient ways to grow, transform, and market biofuels and other bioproducts by integrating recent advances in genomics, synthetic biology, and computational biology to increase the value of biomass crops. CABBI represents a transformative research model designed to accelerate bioproduct development while retaining the flexibility to assimilate new disruptive technologies, regardless of their source. The center aims to develop the predictive capability to determine which feedstock combinations, regions and land types, market conditions, and bioproducts have the potential to support the ecologically and economically sustainable displacement of fossil fuels.

Technology Contact: Vijay Singh - vsingh@illinois.edu



Center for Bioenergy Innovation (CBI) | cbi.ornl.gov

The Center for Bioenergy Innovation (CBI), led by Oak Ridge National Laboratory, seeks to accelerate domestication of bioenergy-relevant, non-model plants and microbes to enable high-impact, value-added coproduct development at multiple points in the bioenergy supply chain. In this endeavor, CBI is pursuing a host of new technologies to alleviate critical cost barriers facing the emerging bioeconomy. Specifically, the center is creating robust, high-yielding feedstock plants using genetic technology and bioengineering; developing biocatalytic methods for high-yield production of advanced biofuels that can be blended with existing transportation fuels; and studying ways to produce valuable byproducts from lignin left over after biomass processing.

Technology Contact: Brian H. Davison - davisonbh@ornl.gov



Great Lakes Bioenergy Research Center (GLBRC) | glbrc.org

The Great Lakes Bioenergy Research Center (GLBRC) is a cross-disciplinary research center led by the University of Wisconsin-Madison. With Michigan State University and other partners, GLBRC is developing sustainable biofuels and bioproducts from dedicated energy crops grown on marginal lands. GLBRC has three integrated areas of research – sustainable cropping systems, efficient biomass conversion, and field-to-product integration – that together will help replace petroleum-derived fuels and products and enable a new generation of biorefineries. GLBRC's mission is simple: to create biofuels and bioproducts that are economically viable and environmentally sustainable.

Technology Contact: Jennifer Gottwald - jennifer@warf.org



Joint BioEnergy Institute (JBEI) | jbei.org

The Joint BioEnergy Institute (JBEI), led by Lawrence Berkeley National Laboratory, is working to convert bioenergy crops into economically viable, carbon-neutral biofuels and renewable chemicals currently derived from petroleum, and other bioproducts that cannot be efficiently produced from petroleum. Ultimately, JBEI aims to advance basic understanding of plant cell walls, biomass recalcitrance, and microbial physiology; to establish predictive biosystems design tools for plants, microbes, and enzymes; and to develop technologies for feedstock-agnostic deconstruction, coproduction of fuels at less than \$2.50 per gallon, and production of drop-in fuels and novel bioproducts.

Technology Contact: Peter Matlock - pymatlock@lbl.gov

Enabling Commercialization, Creating Opportunity

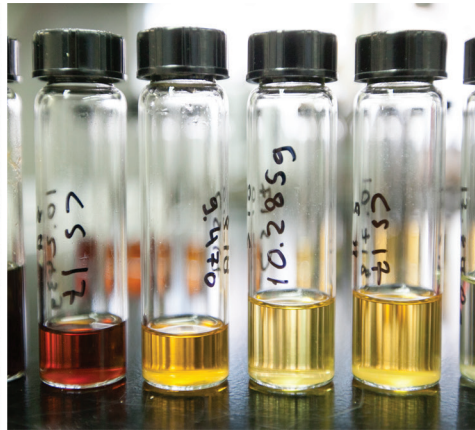
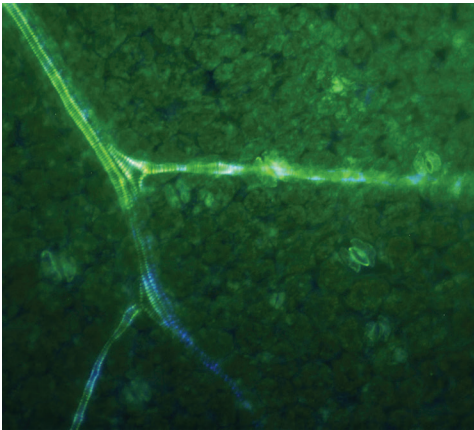
The BRCs are enabling a new generation of biorefineries and developing a portfolio of new bio-based products, methods, and tools for use in the biofuels industry. Using a broad range of genome-driven research methods, BRC technologies represent a variety of approaches to different bottlenecks in the current biofuel pipeline. Some technologies focus on improved ways of breaking down biomass for conversion into fuel, some on engineering plants with the characteristics most advantageous for biofuels, and still others on creating bioproducts that can help make advanced biofuels economically viable.

The BRCs have successfully launched 18 start-up companies, disclosed well over 600 new inventions, and optioned or licensed out hundreds of technologies.

"These inventions will be the new startups, the new fuels that will be in our tanks, the renewable materials in our lives, and the manufacturing jobs in America."

- Jay Keasling, Joint BioEnergy Institute (JBEI) Chief Executive Officer

About Us



The Great Lakes Bioenergy Research Center (GLBRC) is a cross-disciplinary research center led by the University of Wisconsin–Madison. With Michigan State University and other collaborators, GLBRC draws on the expertise of over 400 scientists, engineers, students, and staff to develop sustainable biofuels and bioproducts.

Created in 2007 by the U.S. Department of Energy, GLBRC focuses on three areas of research: sustainable cropping systems, efficient biomass conversion, and field-to-product integration. Together, we are helping to replace petroleum-derived fuels and products and enable a new generation of biorefineries.

Our mission is simple: creating biofuels and bioproducts that are economically viable and environmentally sustainable.

A record of success

Since 2007, GLBRC has conducted foundational research on biofuels. Our scientists and engineers have produced more than 1,100 scientific publications, 192 patent applications, 105 licenses or options, and five start-up companies.

Integrated research

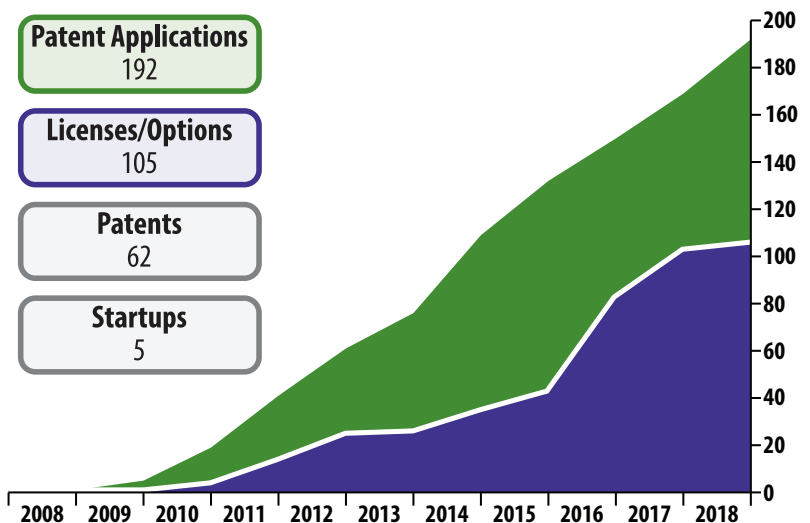
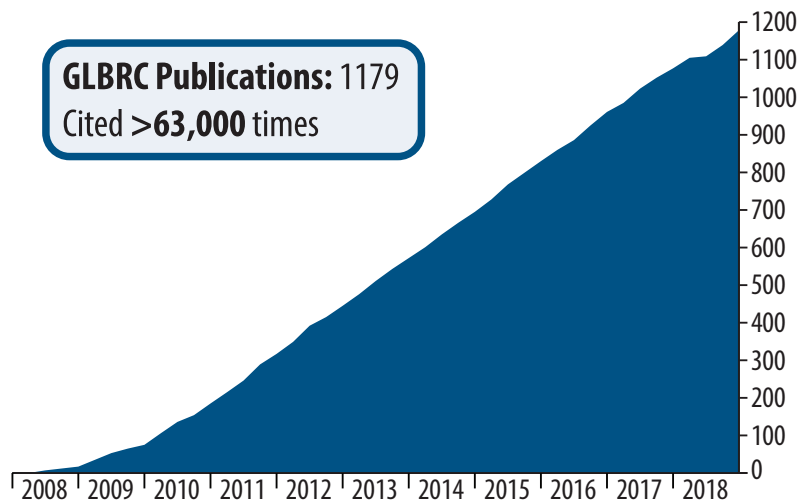
GLBRC research is collaborative, integrated, and rich in partnerships with industry. Our diverse experts work together to overcome the barriers to producing sustainable biofuels and bioproducts.

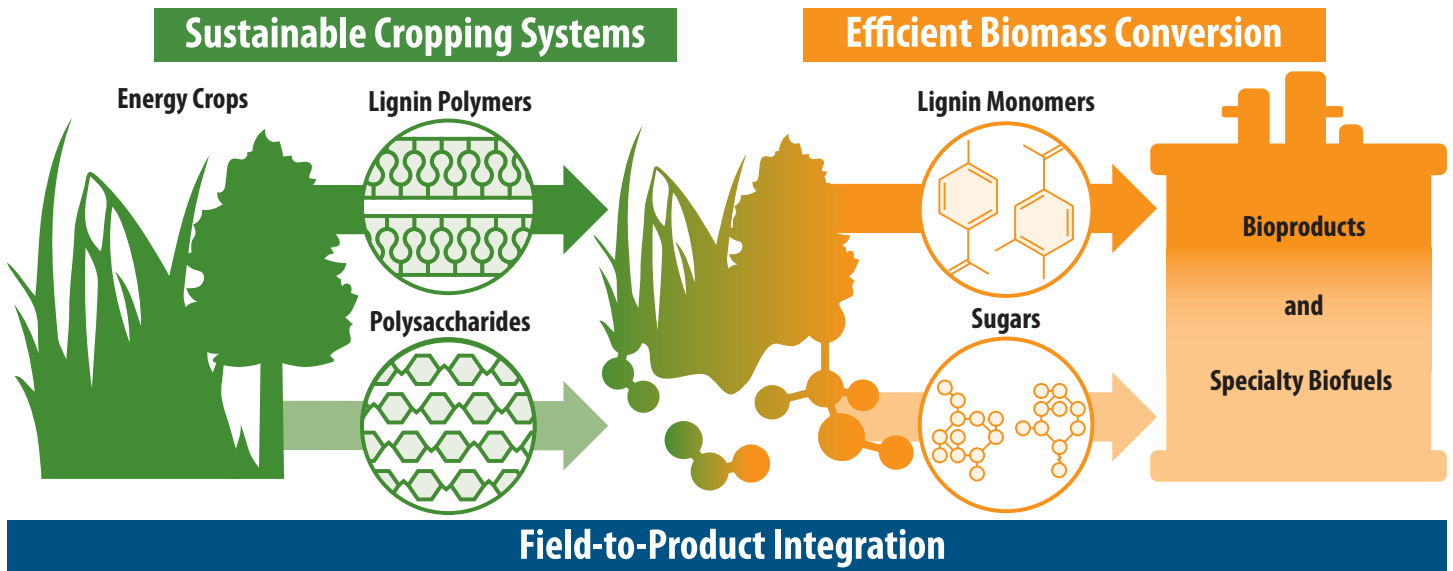
Technology transfer

At GLBRC, we work with companies and with licensing experts at the Wisconsin Alumni Research Foundation (WARF) and MSU Technologies to ensure that our research anticipates and enables commercialization and creates new economic opportunities for biorefiners, farmers, and rural communities.

Our Vision

Producing sustainable biofuels and bioproducts from all usable portions of dedicated energy crops grown on marginal, or non-agricultural, lands.





Our Research

Sustainable cropping systems

Engineering bioenergy crops to enhance their environmental and economic value

GLBRC's research focuses on dedicated bioenergy crops grown on marginal, or non-agricultural, land. Planting non-food crops such as switchgrass, energy sorghum, or poplar on marginal land reserves arable U.S. farmland for food production and has the potential to provide a range of environmental benefits such as climate change mitigation and increased diversity.

Our goal is to engineer cropping systems with both environmental and economic value. This means finding ways to produce dedicated energy crops with high yields and optimized processing traits, as well as determining how and where these energy crops should be produced.

Efficient biomass conversion

Generating multiple products from plant biomass

GLBRC is focused on enabling a new and different biorefinery, one that is both economically viable and environmentally sustainable. Realizing this goal will mean increasing the efficiency of biomass conversion and generating a mix of specialty biofuels and bioproducts from as much of a plant's biomass as possible.

Our research seeks to boost industry economics by finding new ways of processing biomass at low cost, producing a variety of fuels for use in multiple engine types, and converting as much material as possible into bioproducts that are valuable to industry.

Field-to-product integration

Understanding and optimizing the field-to-product pipeline

GLBRC research is integrated across many disciplines and areas of focus. We understand our work as part of the field-to-product pipeline and coordinate our efforts to overcome the barriers to producing sustainable biofuels and bioproducts.

The field-to-product pipeline for biofuels and bioproducts consists of several interdependent phases, including crop production, biomass deconstruction, and conversion into products. Our multi-disciplinary research projects are focused on improving these individual steps as well as integrating them into an optimized field-to-product pipeline.

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