THE BIOENERGY RESEARCH CENTER (BRC) PROGRAM

Biological & Environmental Research Program in the Department of Energy's Office of Science

The BRC program was established in 2007 to address one of this country's greatest challenges – developing sustainable alternatives to the fuels and chemicals currently derived from petroleum. The BRCs are thus charged with making the basic science advances needed to produce fuels and chemicals from biomass and to add non-edible, lignocellulosic plant material to the nation's energy supply chain.

Roughly a thousand BRC scientists, engineers, and staff work collaboratively to improve the sustainable production and conversion of bioenergy crops into fuels and chemicals. Research activities include increasing biomass yield, improving plant feedstocks, optimizing biomass deconstruction for cost-effectiveness, and engineering microbes to maximize biomass conversion.

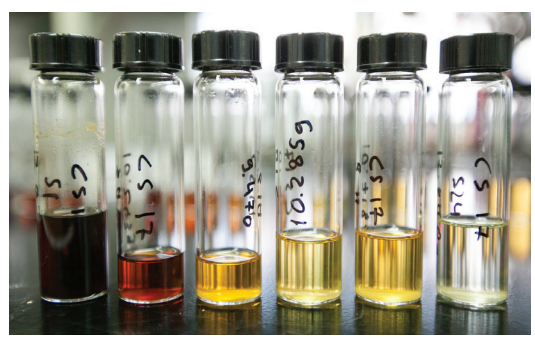
BRC Research Highlights

BRC advances have led to over 600 invention disclosures, shaped over 180 technology licenses and options, and catalyzed the formation of more than a dozen start-up companies. A sample of key research accomplishments from one BRC, the Great Lakes Bioenergy Research Center (GLBRC), include:

Sustainable Biomass Supply – Studies predict that lignocellulosic biomass could meet almost one-third of the current demand for transportation fuels and offer advantages over starch-based ethanol. Since the land needed to grow this biomass is substantial, it's critical to understand the agronomic, economic, and ecological tradeoffs of growing lignocellulosic biomass. Research shows that perennial crops grown on marginal lands not currently in use for food production could provide large quantities of biomass and major ecological and environmental benefits.

Improved Biomass Crops – One of the key obstacles to extracting sugars from biomass is a complex polymer called lignin. Researchers have redesigned lignin to include weak bonds, or "zips," which make it much easier and cheaper to break apart. Zip-Lignin™ technology, already licensed to an international leader in woody biomass processing, can reduce the cost of producing fuels and chemicals from many energy crops, improve the economics of the paper and pulping industry, and enable pathways to new products from biomass.

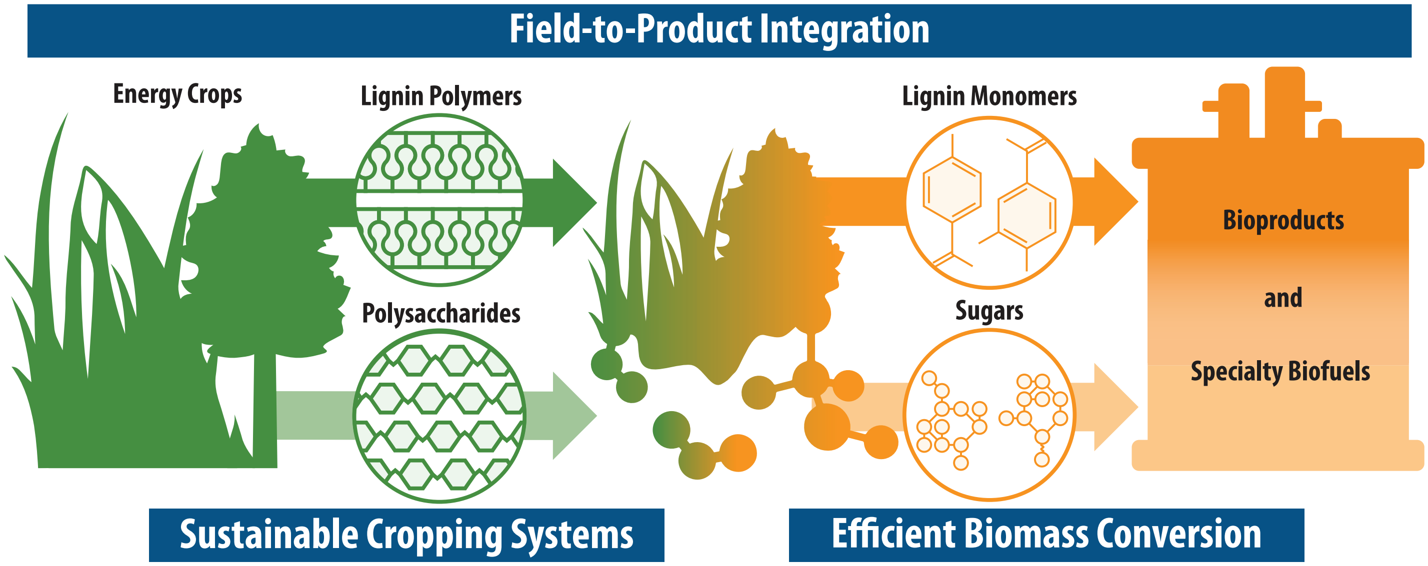
Biomass Degrading Enzymes – New, cost-effective enzymes are needed that cleave major plant components into simple products. Researchers have mined bacterial genomes to identify enzymes with improved capacity to degrade plant polysaccharides and lignin, potentially enhancing the ability and lowering the cost to generate products from all major biomass fractions.



Improved Biomass Deconstruction – Researchers have developed a new biomass deconstruction method that works with a wide variety of energy crops and avoids the use of expensive chemicals. By using gamma-valerolactone (GVL), a chemical that can be produced from plants, researchers can deconstruct biomass and produce sugars that can be chemically or biologically upgraded into biofuels or chemicals. Since GVL is created from plant material, it's both renewable and more affordable than most enzyme-based deconstruction methods. GVL can also produce valuable chemicals currently imported into the country. GlucanBio, a start-up company with research facilities in WI, has licensed the GVL technology to produce furans from biomass.

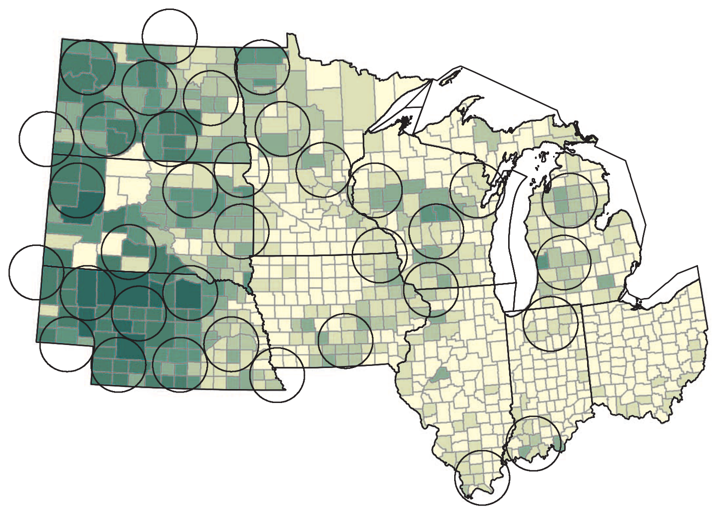
Biomass-Derived Chemicals – Researchers have discovered a cost-effective method for producing aromatics from lignin. Traditionally derived from petroleum, aromatics are used in plastic bottles, Kevlar, pesticides, pharmaceuticals, and are essential components of jet fuel. Producing aromatics from lignin can provide new markets for agricultural and forestry biomass, and create new cost-effective products for the chemical industry.

Optimized Biomass Conversion – Dissolving biomass releases chemicals that inhibit the ability of microbes to generate products. Researchers have used genomics to identify the inhibitors, determine the mode of action, and mitigate negative impacts on microbes, increasing the ability to convert biomass into products.



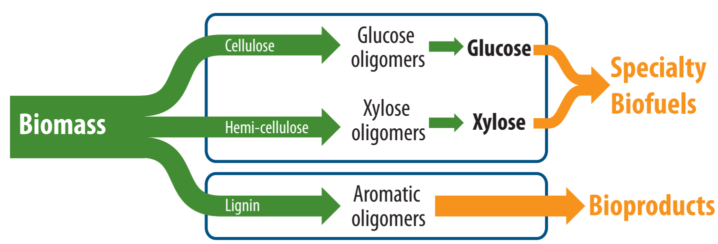
Future BRC Opportunities

Continued federal investment in the BRC program could transform how we produce fuels and chemicals, and establish the U.S. as the leader in a new lignocellulosic bioindustry. The recent BRC Funding Opportunity Announcement seeks to remove barriers to producing specialty biofuels (i.e., hydrocarbons similar to those found in petroleum) and chemicals from dedicated energy crops. This new lignocellulosic bioindustry could spark local economic growth, create new jobs for rural communities across the country, and create U.S.-made products for export. Future GLBRC priorities include:

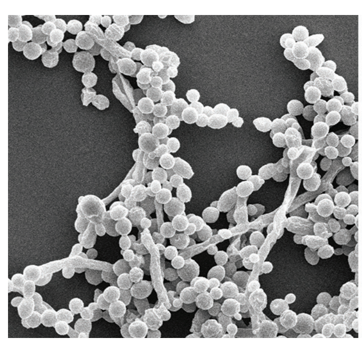


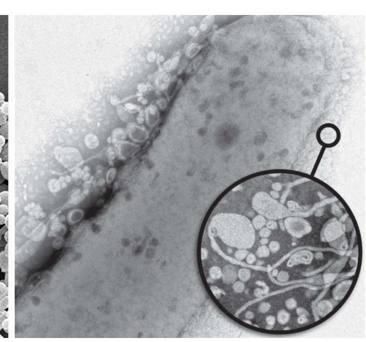
Grow Energy Crops on Non-Agricultural Lands
While the U.S. contains some of the most productive farmland in the world, there are large swaths of marginal, yet productive land, which are not used to grow crops. Understanding how to produce high yields of dedicated energy crops on marginal lands could provide new income to biomass producers and abundant feedstocks for industry, while offering major ecosystem benefits and reserving farmland for food production.

Maximize Production of Fuels and Chemicals from Biomass
The keys to a successful lignocellulosic bioindustry are the ability to process biomass at low cost, produce fuels for use in multiple engine types (e.g., automotive, diesel, aviation, and others), and convert as much material as possible into products. Understanding how to efficiently deconstruct biomass and convert the bulk of its components into products will provide economic benefits to this industry.



Optimize the Field-to-Product Pipeline
For a new lignocellulosic bioindustry to succeed, additional information is needed on crop production, deconstruction and conversion into fuels and products, and how these individual components can be integrated. Understanding how locally-grown bioenergy crops can be used to produce a profitable mix of products can remove some of the greatest barriers to success of a new lignocellulosic bioindustry.





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