jbei
Joint BioEnergy Institute

WHY BIOFUELS?

Global human energy consumption is about 150,000 terawatt-hours each year, while the earth receives an estimated 174,000 terawatt-hours of solar energy through its upper atmosphere every hour. This means that an hour's worth of global sunlight could potentially meet a year's worth of human energy needs!

A portion of this solar energy is stored, via photosynthesis, in lignocellulosic biomass, which includes plants, grasses, trees, and agricultural residues such as wheat straw and corn stover. A study by the U.S. Departments of Energy and Agriculture determined that the United States could produce at least 1 billion dry tons of lignocellulosic biomass per year without any decrease in the production of food, animal feed, or agricultural exports.

This much lignocellulosic biomass could yield annually more than 100 billion gallons of biofuels, or about half the country's current annual consumption of gasoline and diesel. The worldwide outlook is even brighter, with the potential production of fuels made from lignocellulosic biomass far exceeding today's entire global production of oil.

Imagine filling your car at your local service station with a fuel that is identical to gasoline and diesel in terms of performance and vehicle compatibility. These advanced biofuels are produced in the U.S. from lignocellulosic biomass and have a much lower footprint in terms of overall carbon emissions and their associated contributions to climate change. Clean air, sustainable transportation fuels, and energy independence — that is the promise of biofuels made from lignocellulosic biomass and the central mission of the Joint BioEnergy Institute (JBEI) funded by the U.S. Department of Energy (DOE). To promote breakthroughs and enable rapid commercialization of its biofuels research efforts, JBEI is organized into four integrated divisions: Feedstocks, Deconstruction, Fuels Synthesis, and Technology.

Feedstocks Division

The Feedstocks Division develops tailored plants that can be more easily deconstructed into targeted intermediates, such as fermentable sugars. JBEI researchers study rice and sorghum as genetic models for switchgrass and other prairie grasses with great potential as energy feedstocks. They also study *Arabidopsis* (a type of mustard plant), as a model for poplar, as well as pine and eucalyptus. These have been touted as future sources of biofuels. These models go from seed to mature plant in weeks, as compared to the year or more required for switchgrass or poplar, thereby enabling rapid discovery of traits and characteristics in plants that are desirable for biofuel production.

Deconstruction Division

The Deconstruction Division develops new and improved ways to convert lignocellulose

into fermentable sugars for biofuel production. The Deconstruction Division has pioneered the development of ionic liquids as novel solvents for biomass pretreatment. This includes the development of novel "bionic liquids" generated from renewable sources, such as lignin and amino acids. To identify new enzymes and microbes compatible with ionic liquids, JBEI researchers are investigating microbial communities isolated from rain forest floors, salt flats, and composts.

Fuels Synthesis Division

The Fuels Synthesis Division is using systems and synthetic biology to understand and engineer new microbial hosts that can efficiently convert the fermentable sugars generated by the Deconstruction Division. These hosts produce advanced "drop-in" biofuels that are replacements for gasoline, diesel, and aviation fuels used today.

Technology Division

JBEI researchers in the Technology Division are developing new analytical capabilities to advance the scientific research that can speed the development of biofuels. For example, using high-throughput protein expression, purification, and screening techniques, they are engineering new enzymes capable of efficiently liberating fermentable sugars from lignocellulose, fully characterize the molecular machinery of plant cell wall synthesis, and perform functional analysis of tens of thousands of microbes that produce biofuels.

Industry Partnerships

As a DOE Bioenergy Research Center, JBEI serves to catalyze fundamental scientific discovery and innovation for the development of commercial products and new conversion technologies that will benefit the U.S. biofuels industry. JBEI's Industry Partnership Program provides companies with the opportunity to become a part of the JBEI research community as well as an effective means to license JBEI technologies.

Education & Outreach

JBEI promotes interest in science through educational outreach programs with students and the general public. These programs include internships, seminars, and collaborations with academic, namely UC Berkeley's Lawrence Hall of Science, and industry-based science institutions. JBEI will continue to expand its educational outreach programs by working with research institutes, universities, national laboratories, and the two other DOE Bioenergy Research Centers — the BioEnergy Science Center and the Great Lakes Bioenergy Research Center.

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