Biofuel Research at Brookhaven

Purpose:

Conduct basic and applied research focused on identifying and developing sustainable energy sources that emit as little carbon as possible

Participating Departments:

- Energy Sciences & Technology
- Biology
- Materials Science
- Chemistry
- National Synchrotron Light Source
- Center for Functional Nanomaterials

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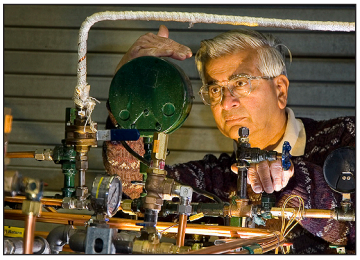

Brookhaven scientists design ultrahigh-efficiency boilers that burn 100% biofuels

U.S. reliance on fossil fuels can have a significant impact on the economy. Energy security is crucial for our nation's future success, and will likely be the most important problem of the 21st century.

Researchers modify plant enzymes to produce saturated oils that can replace petrochemicals

Developing sustainable, renewable fuels is key to solving that problem. Brookhaven National Laboratory has basic and applied research programs that focus on increasing biofuel production and testing the viability of alternative biofuels, such as biodiesel and bio-oil, in different applications.

Basic Biofuel Research

Brookhaven's scientists are conducting biological research on plant growth and plant properties with the goal of generating increased biomass for biofuels production. In one example, researchers are studying the genes and enzymes of woody plant tissues found in fast-growing poplar trees in order to design new ways to improve the biomass properties of plants and promote the efficiency of the biomass-to-energy conversion process.

Using genetic manipulation to modify the activity of a plant enzyme, other researchers have converted an unsaturated oil in the seeds of a temperate plant to the more saturated kind usually found in tropical plants. The development of new plant seed oils has several potential biotechnological applications. In particular, they could be used to produce renewable feedstocks for industrial processes in place of those currently obtained from petrochemicals, which could help reduce U.S. dependence on petroleum.

Lab microbiologists are studying the application of plant-associated bacteria to significantly improve the growth of trees on marginal land. The biomass of trees -- particularly the woody cell walls that consist of cellulose and lignin -- will be an important feedstock for biofuel production, as it does not negatively impact food supplies. Using bacteria that live inside trees, researchers are able to obtain increases of up to 40 percent in biomass production under greenhouse conditions.

Lab scientists are also looking at ways to generate clean-burning hydrogen through biological processes, studying microbes that can produce copious amounts of hydrogen gas when provided with various feedstocks. Understanding the biochemistry of these reactions, including ways to decrease their sensitivity to oxygen, may lead to practical, economical applications that produce hydrogen from agricultural resources.

Using molecular tools, other Brookhaven researchers are studying the composition of complex microbial communities that decompose plant cell walls. Better understanding the microbial decomposition process should result in the development of new processes and the isolation and application of new enzymes to more efficiently decompose plant cell wall polymers into fermentable sugars for biofuel production.

Brookhaven is a partner in the proposed Mid-Atlantic-Consortium Bioenergy Research Center (MAC-BRC), a synergistic consortium of scientists from academia, national labs and industry. The MAC-BRC, together with other bioenergy research centers around the country, will facilitate and enhance research within DOE's Genomes to Life Genomics program.

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Biofuel Research at Brookhaven (continued)

Through these centers, DOE expects to enable a quantum leap through system biology solutions to energy security, carbon management, and the remediation of contaminated sites, and reach the national goal of sustainable production of more than 60 billion gallons of ethanol a year by 2030.

The MAC-BRC vision is to develop transformational breakthroughs that will be the benchmarks for sustainable, cost-effective alternative-fuels production. Its mission is to advance technologies based on genomic and molecular analysis of plant and microbial systems that remove obstacles to the cost-efficient production of renewable biofuels from natural and engineered plant feedstocks.

Applied Biofuel Research

Brookhaven researchers work with industry to demonstrate and deploy their technologies in the public sector. Lab scientists are testing the viability of biofuels for various applications, and Brookhaven pioneered the use of biodiesel heating systems through a series of projects testing different biodiesel blends in heating oil.

In one project, about 100 homes were switched over to a blend of 20 percent soy-based biodiesel and 80 percent low-sulphur heating oil. Results showed that heating efficiency was about the same; a significant decrease in sulphur dioxide and nitrogen oxide emissions was realized.

Brookhaven biofuel test projects include one in New York City, where biodiesel blends will be tested in large apartment building boilers, and another at the Sagamore Hill national historic site on Long Island, where three buildings were switched over to a blend of soy biodiesel and home heating oil. In an ongoing project, Lab researchers are working with KeySpan Energy to test a bio-oil based on poultry waste for potential use in one or more of the energy company's large power plants.

Other current biofuel projects include:

- turbine generator applications
- development of new blend sensors and burners
- fuel processing for fuel property improvements
- development of national standards
- study of residual oil blends to reduce emissions from schools and commercial buildings
- development of ultrahigh-efficiency boilers designed for 100% biofuels

Future

Energy research represents a major growth area for Brookhaven. That research is focused on identifying and developing sustainable energy sources that emit as little carbon as possible.

Brookhaven has existing, strong programs in biofuels, solar energy, energy efficiency, materials science, and nuclear safety, and is building strong core competencies in high-performance materials, catalysis, and plant genomics and biochemistry. These core competencies are directly linked to key Lab scientific facilities, which enable Lab scientists to tackle national initiatives.

Brookhaven's new Center for Functional Nanomaterials and the proposed National Synchrotron Light Source II will both have a strong focus on energy, and will be important scientific tools for Lab researchers as well as thousands of collaborators and users.

With world-leading facilities and scientific expertise, Brookhaven presents a comprehensive, interdisciplinary approach to solving fundamental questions regarding U.S. energy independence.

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