Biofuels

Converting Biomass into Renewable Fuels and Chemicals

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National Security Challenges of Fossil Fuel Consumption

In the fight against global warming, the need to develop clean, green and renewable sources of energy has become an international call to action. Sandia scientists are conducting fundamental and applied research into the sustainability and environmental impact of biofuels productions and use.

Creating Drop-In Fuel Replacements

Sandia's biofuels program is focused on creating and demonstrating next-generation conversion technologies that can create "drop-in" replacements for today's gasoline, diesel and aviation fuels from lignocellulose and microalgae. We analyze, understand and control the functions of biological systems to meet challenges in biofuels production including:

- Maximizing sugar yields and energy output based on the whole biomass conversion
- Biomass conversion in complex environments by creating and controlling new ionic liquids, enzymes and microbes
- The co-evolution of renewable fuels and engines to guide production of advanced biofuels for any engine type
- The development and optimization of enzyme mixtures capable of efficiently degrading lignocellulose and algae

Co-evolution of Biofuels and Engines

The co-evolution of biofuels and powertrain engines has the potential to cut the time required to bring new sustainable transportation solutions to market. Sandia, in partnership with stakeholders from industry and other national labs, is beginning research into an adaptable framework that will develop biofuels for advanced engines.

Lignocellulosic Biomass

Lignocellulosic biomass is one of the most abundant plants on Earth and is a critical feedstock for the production of renewable fuels. Lignocellulose is a mixture of complex sugars and lignin, a non-carbohydrate polymer that provides strength and structure to plant cell walls. By extracting simple fermentable sugars from lignocellulose and producing biofuels, the potential of the most energy-efficient and environmentally sustainable non-food feedstock can be realized.

Sandia is focused on:

- Advanced technologies that breakdown biomass and liberate sugars that can be converted to biofuels
- Developing a new tool box to transform intermediaries into fuels
- Pioneering a new process to convert lignin to renewable fuels and chemicals using ionic liquids
- Increasing the sugar yields from diverse feedstocks with ionic liquid processing
- Enzyme engineering to produce thermotolerant and halotolerant enzymes
- Understanding and developing a wide range of biochemical, chemical and thermochemical approach to depolymerizing lignin to increase its value
- Lifecycle analysis and techno-economic modeling of biorefineries

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Partnerships Drive Technology Maturation

Sandia partners with industry, universities and other national labs to build multidisciplinary teams for scientific breakthroughs in biofuels.

Joint BioEnergy Institute

The Joint Bioenergy Institute (JBEI) is a U.S. DOE BioEnergy Research Center in Emeryville, California that is investigating the efficient conversion of lignocellulosic biomass in fuels. Sandia joined Lawrence Berkeley and Lawrence Livermore national labs, the UC Campuses of Berkeley and Davis and the Carnegie Institution of Science in the formation of JBEI.

Algae Testbed Public-Private Partnership

Sandia is teaming with scientists, engineers and business executives who are leading the national network of algae testbeds as part of the Algae Testbed Public-Private Partnership (ATP^3) at Arizona State University (ASU). The open testbed and evaluation facilities are a hub for research and commercialization of algae-based biofuels and other biomass co-products.

Algae Testbed at Sandia / California

Sandia is employing an algae raceway testbed in the Livermore Valley Open Campus as a tool to test new technology and investigate current production challenges facing algae biofuels.

Microalgae Biomass

Advanced biofuels derived from microalgae at the commercial scale could meet, depending on productivity, the transportation fuel needs of the entire United States using a relatively small land area as compared to that required by lignocellulosic fuels. Microalgae consume CO_2 as a nutrient, can be grown with impaired (e.g., brackish) water sources on land that does not compete with food, and have been calculated to produce much higher fuel yields than other terrestrial biomass feedstocks.

Sandia is focused on:

- Production and conversion of whole turf algae polycutures that maximize fuels, chemicals and other nutrients
- Real time diagnostics and monitoring of pathogens and predators to mitigate crop losses from pond crashes
- Efficient and economical methods to remove water from algal ponds
- Nutrient recycle