NREL Highlights RESEARCH & DEVELOPMENT

Cellulosic Ethanol Technology on Track to Being Competitive With Other Transportation Fuels

Technologies to make fuels from non-food sources show progress from focused R&D, integrated demonstration, and industry partnerships.

Researchers at the National Renewable Energy Laboratory (NREL) have been driving down the cost of cellulosic ethanol and overcoming the technical challenges that surround it—major milestones toward the Department of Energy (DOE) goal of making cellulosic ethanol cost-competitive by 2012.

As corn ethanol production has grown in the United States, next-generation technologies that make fuel from non-food resources have been the centerpiece of the DOE-NREL program. Cellulosic ethanol technology promises huge new volumes of fuel, but higher costs have meant that it cannot directly compete with gasoline.

To ensure the best and most rapid progress on closing this cost gap for cellulosic technology, NREL is concurrently working on biochemical and thermochemical conversion.

The biochemical pathway involves the degradation of cellulose and hemi-cellulose into simple sugars through pretreatment and enzymatic saccharification. NREL's work with industrial leaders has resulted in a 20-fold improvement in enzyme costs and the development of an ethanologen that can use both five- and six-carbon sugars.

The thermochemical pathway involves gasifying the biomass to "syngas" (hydrogen and carbon monoxide) and then catalytically converting it to ethanol. Here, too, collaboration with industry has yielded successful reformation of byproducts and the co-development of a mixed alcohol synthesis catalyst.

All of these technological advancements have been demonstrated in an integrated fashion using NREL's unique pilot plant capabilities. The result is that modeled costs of cellulosic ethanol production have decreased from more than $6.50 a gallon in 2001 to less than $2 a gallon in 2010.

References: Cellulose, Volume 16, No. 4, August 2009, Special issue: Corn Stover Conversion to Biofuels, Ed. Michael E. Himmel.

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Key Research Results

Achievement

Significant improvements in pretreatment, enzymatic hydrolysis and fermentation in biochemical conversion, and methane/tar reforming and fuel synthesis in thermochemical conversion put cost goals within reach.

Result

From 2001 to 2010, the modeled cost of cellulosic ethanol production has decreased from $6.50 a gallon to less than $2 a gallon.

Potential Impact

Cost-competitive cellulosic ethanol is crucial to meeting near-term and long-term Energy Independence and Security Act alternative fuels targets.

NREL
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NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

NREL/FS-2700-50846 • February 2011

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