Integrated Biorefinery Research Facility

Advancing Biofuels Technology

The IBRF—including a new pilot plant, laboratories, and office space—is an expansion of the Alternative Fuels User Facility on NREL's South Table Mountain campus.

IBRF At-a-Glance

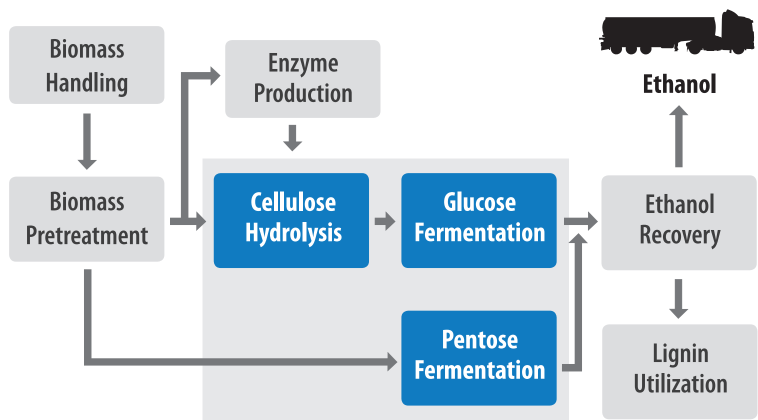
- $33.5M two-stage expansion of the Alternative Fuels User Facility
- Stage 1
  - 27,000 ft^2 high bay and associated process equipment
  - Target completion date: June 2010
- Stage 2
  - Additional high-bay process equipment
  - 3,800 ft^2 of modified lab space
  - New 11,900 ft^2 office building
  - Target completion date: 4th Quarter 2011

To achieve commercial-scale production of cellulosic ethanol at a cost that is competitive with gasoline, it is crucial to understand the entire integrated biorefining process and how one stage of the process can impact performance of the others. With the addition of an Integrated Biorefinery Research Facility (IBRF) at the National Renewable Energy Laboratory (NREL), the cellulosic ethanol industry will have access to a significantly expanded pilot plant and biochemical research facility, in addition to NREL's world-renowned scientists and engineers.

The IBRF—with a 27,000 square foot high bay area, new and upgraded laboratories, and additional office space—will allow NREL to accommodate a greater number and variety of collaboration requests from industry partners who wish to test integrated pilot-scale biochemical conversion processes but don't have the facilities or resources to do it on their own.

At NREL, our goal is to improve the cost effectiveness of cellulosic ethanol production processes and to accelerate the commercial-scale deployment of these technologies. While market needs and policy goals continue to increase demand for second generation biofuels, much work remains to be done to meet the Department of Energy's goal for cost-competitive cellulosic ethanol by 2012.

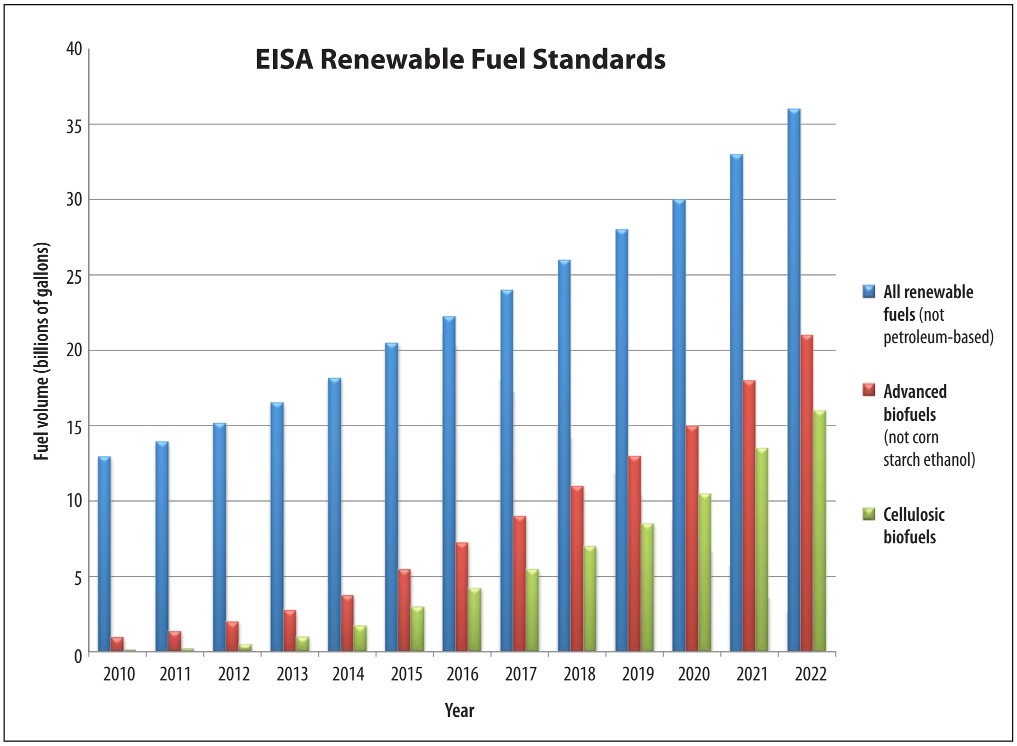
Biochemical Production of Cellulosic Ethanol



This diagram shows the process steps for biochemical production of cellulosic ethanol from biomass.

Biofuels Demand

A number of aggressive policy goals are guiding NREL's approach to cellulosic ethanol research and development. The 2007 Energy Independence and Security Act established Renewable Fuel Standards (RFS) that require 36 billion gallons of renewable fuels by 2022, and President Obama's New Energy for America plan calls for 60 billion gallons of advanced biofuels by 2030. Reducing the cost of cellulosic ethanol production is a crucial first step toward meeting these goals.



This chart depicts the Renewable Fuel Standards established by the Energy Independence and Security Act of 2007. The fuel volume is defined as the amount of renewable transportation fuel to be sold in the United States in that year.

IBRF Process Integration Capabilities

To cost-effectively convert lignocellulosic biomass into usable fuel by biochemical means, a series of steps, or processes, need to be integrated and optimized.

The IBRF will provide great flexibility at the pilot plant scale to perform integrated testing—processing up to one dry ton of feedstock per day—with a broad range of equipment options and configurations.

In order to extract fermentable sugars, the biomass must first be pretreated. This process uses heat and acid or other chemical catalysts to break down the hemicellulose into its component sugars and to prepare the cellulose for enzymatic hydrolysis. Once the cellulose has been exposed through pretreatment, specialized enzymes are used to hydrolyze, or break down, the cellulose into glucose.

Current NREL research focuses on using a dilute acid pretreatment process with corn stover residues, but the IBRF will be designed to handle a wide range of feedstocks and pretreatment options. Three parallel processing trains will allow researchers to test integrated conversion processes using a variety of pretreatment technologies.

In addition, IBRF equipment and processes will be designed to handle high solids concentrations more effectively, an important cost reduction measure in the pretreatment and hydrolysis steps.

After hydrolysis, the resulting sugars are fermented into ethanol which can be separated, purified, and recovered for use as a transportation fuel. The IBRF will be constructed next to the existing Alternative Fuels User Facility to allow for full integration with existing fermentation reactors and distillation equipment.

Researchers will use data collected from the IBRF to create detailed techno-economic and engineering analyses that estimate the cost of commercial scale fuel production and address issues such as life cycle greenhouse gas emissions, ensuring that cellulosic ethanol production technologies are not only economically feasible but also environmentally sustainable.

Working with NREL

The IBRF will be available for industry partners who wish to work with NREL through cooperative research and development agreements, work-for-others agreements, or other collaborations. The first stage of IBRF construction is scheduled to be completed by June 2010, and the facility should be available for industrial users in late 2010. For more information about the Integrated Biorefinery Research Facility, including inquiries about equipment capabilities or partnership opportunities, contact John Ashworth at 303-384-6858 or john.ashworth@nrel.gov.

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