NREL FACTS

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NREL Facilities

NREL's Alternative Fuels User Facility

...developing cleaner fuels for vehicles

With the United States importing more than half its oil, and with vehicle emissions accounting for 40 to 65 percent of urban air pollution, the nation's trade imbalance is increasing while its air quality is declining. To help reverse this trend, the federal government and private industry are turning to alternative transportation fuels made from biomass resources such as plant material and waste.

The National Renewable Energy Laboratory's (NREL) Alternative Fuels User Facility (AFUF) plays a crucial role in helping industry develop cost-competitive renewable transportation fuels from biomass. These domestically produced, clean-burning biofuels reduce emissions of carbon monoxide and smog forming compounds that contribute to air pollution, and could represent a major new U.S. industry.

The Alternative Fuels User Facility

In this 28,000-square-foot building, NREL scientists evaluate the commercial potential of bioethanol technologies and work with industry to move promising research breakthroughs from the laboratory to the marketplace. Twelve state-of-the-art laboratories and a large-scale pilot plant are used to apply technology for the production of bioethanol, as well as other products made from biomass.

Ethanol Production and Use

Ethanol, one of the most promising biofuels, is made by fermenting sugar contained in various materials. A similar fermentation process is used by breweries to make beer from food materials such as barley.

Ethanol can be used in pure form or blended with gasoline to help reduce carbon monoxide and hydrocarbon emissions from vehicles. Currently, most of the 1.5 billion gallons of ethanol used annually in the U.S. is made from corn and blended with gasoline to serve as a 10% oxygenate additive in gasoline during high pollution months.

Feedstock Research

NREL researchers are developing new technologies that convert the fibrous portion of plant material to bioethanol. Plant material includes wastes and residuals from agricultural, forest and food industries, and fast-growing grasses and trees grown specifically for energy production. These feedstock materials are abundant and inexpensive.

The Process Development Unit

The heart of AFUF is an 8,000-sq. ft. fermentation pilot plant known as the Process Development Unit (PDU). NREL engineers team with industry partners to gather data for commercial use of promising technologies for bioethanol production. The PDU's four 2,300-gallon fermenters can process about one ton of feedstock material per day.

Production of ethanol from biomass involves a multi-step operation. A pretreatment step reduces the feedstock size and breaks a portion of it into sugars. Enzymes and microorganisms grown on site are added to the 2,300-gallon fermentation tanks along with the pretreated biomass to produce sugars and convert those sugars to bioethanol. A 12-meter distillation column then concentrates the ethanol for use. Solid residue is concentrated in centrifuges.

PDU Projects

The first use of the PDU was for a major cooperative research and development agreement (CRADA) between NREL and Amoco Corporation which focused on producing ethanol from agricultural byproducts. The PDU is also available to support other industrial clients interested in either bioethanol production, or development of technologies to produce other fuels and chemicals from biomass, such as butanol and lactic acid.

Bioprocessing Integration Laboratories

The AFUF contains two process development laboratories in which the various process steps necessary for biofuels production are linked together and tested as an integrated process at the bench scale. These steps are typically developed independent of one another initially and must be evaluated under actual production conditions to ensure chemical and biological interactions are accounted for.

Additional AFUF Facilities

Other AFUF facilities include research laboratories for bench-scale fermentation and enzyme production; a feedstock pretreatment laboratory; analytical laboratories; and office, conference and observation areas.

Reducing Costs

Recent genetic engineering breakthroughs at NREL have produced a new organism that expands the amount of biomass converted to ethanol by up to 50 percent, significantly reducing the cost of producing bioethanol.

These advancements, coupled with future improvements, are directed at lowering the cost of ethanol production from $1.22 per gallon to 60¢ or 70¢ per gallon, and making fuels containing 85–95% ethanol competitive with gasoline on the open market.

Alternative Fuels Hotline

For answers to a variety of questions about alternative fuels, consumers can call the National Alternative Fuels Hotline at 1-800-423-1DOE (1363).