Volume Five • Issue 3 *Summer 1997*

BiofuelsUPDATE

Report on U.S. Department of Energy Biofuels Technology

Chrysler and Ford Add More Vehicles to the Flexible Fuel Lineup

Ford Ranger E85 pickup truck and Chrysler E85 Town & Country minivan.

Chrysler Motors and Ford Motor Company plan to build and sell flexible fuel vehicles (FFVs) that run on gasoline or as much as 85% ethanol (E85). Chrysler will make its 3.3-liter Town & Country E85 minivan available this fall; Ford plans to offer its 3.0-liter E85 Ranger pickup in model year (MY) 1999. Each will be the first production vehicle from its respective manufacturer to include the flexible fuel system as standard equipment. Until now, prospective buyers had to specifically request an FFV.

Chrysler's announcement reflects the largest production of any type of alternative fuel vehicle (AFV) in any model year, by any manufacturer, according to Eric Vaughn, executive director of the Renewable Fuels Association. Chrysler plans to introduce "more than 150,000 FFVs during the first year alone," he said. The V-6 engines will include an upgraded fuel system that allows the FFV to operate on any mixture of gasoline and ethanol. Power and torque ratings are identical to those of the gasoline version. The E85 minivans will be built at Chrysler's Windsor (Ontario, Canada), and St. Louis, Missouri, assembly plants.

Ford will equip 50,000–60,000 Rangers with flexible fuel systems in MY 1999. Ford stated it will be able to manufacture 250,000 Ranger FFVs between 1999 and 2002, but it would not speculate on production numbers for the final 3 years of the 4-year program.

"We will gradually insert [the FFV Ranger] into the marketplace," said Sara Tatchio, spokesperson at Ford. "We want to develop our FFV sales to not only match, but help develop and increase the refueling infrastructure needed to keep these vehicles running on ethanol. Flooding the nation with Ranger FFVs before the E85 infrastructure can support them will increase the vehicles' chances of being powered by gasoline only." (See box at the end of this article.)

Similar to Ford's E85 Taurus and Windstar, engine parts with material upgrades on the Ranger FFV

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Did You Know?

The Ford Taurus is the best-selling AFV on the market today. From 1992 to 1996, Ford sold more than 5,200 Taurus FFVs, and that total has nearly been matched in 1997 alone. Ford plans to increase the number of E85 Taurus FFVs available in MY 1998.

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include fuel pump, fuel rails, fuel injectors, fuel lines, and filler pipe. The package also includes an electronic engine control module to calibrate engine response to varying fuel mixtures of gasoline and ethanol. The 2.3-liter V4 and four-wheel drive versions of the compact pickup will not have flexible fuel capabilities.

"We believe the Ranger FFV will be instrumental in turning AFVs into mainstream automobiles. A consumer who wants to purchase the FFV Ranger just has to ask for the 3.0-liter V6. With the Taurus, a prospective buyer had to ask for the FFV option," said Tatchio.

Recently Opened E85 Stations

- Colorado Springs and Denver, CO
- Chicago, Peoria, and Rock Island, IL
- Lansing and Detroit, MI
- Blue Earth, Fairmont, Mankato, and St. James, MN

For a complete list of E85 refueling stations in the United States, contact the National Alternative Fuels Hotline at 800.423.1363 or hotline@motorfuels.com.

Colloquies Examine Status of Enzymatic Cellulosic Conversion

The availability of cost-effective cellulase enzymes to support the creation of an economically feasible biomass-to-ethanol industry was the focus of a series of discussions among engineers, scientists, ethanol plant managers, business managers, and potential processors this spring. The meetings, or colloquies, were part of an assessment of the availability of cellulase preparations used for bioethanol production. Cellulases are specialized enzymes used to break down the cellulose in biomass to glucose (sugar), and thus comprise an essential element of an enzymatic hydrolysis ethanol production process. The cellulase preparations needed to convert lignocellulosic biomass, whether waste materials, forest residue, corn stover, or switchgrass, can cost 10 to 30 times more than enzymes used for corn-starch based ethanol production.

"The idea of the colloquies was to have a multidisciplinary discussion of cellulase enzyme availability and cost that would involve enzyme suppliers, potential ethanol producers, academic experts, and various industrial concerns to evaluate the current situation," said David Glassner, technology manager for the Biofuels Program at the National Renewable Energy Laboratory (NREL). As part of this effort, NREL is developing a technical strategy to reduce the costs of cellulase enzyme production.

The attendees agreed more work was needed to understand the current national cellulase market. "To date, no thorough market analysis has been done on the associated costs of applying cellulase to various biomass market segments of cellulosic ethanol production," said Jim Hettenhaus, a consultant from Chief Executive Assistance. The economics of cellulase and ethanol production have been studied extensively by NREL and some companies, but not from the perspective of the enzyme producers. Before we can develop a market-driven industry, we must first find companies that are willing to produce the special enzymes needed to convert cellulose to glucose," said Hettenhaus.

"Research on availability and cost of several biomass materials, including sawdust, forest thinnings, and solid waste from paper, is still incomplete," said Glassner. "The results of extensive research by select private companies are not public knowledge." Aside from the economic barriers, cellulase enzyme production is a technical challenge. The cellulase-producing fermentation process is complex, more so if a producer attempts to manufacture the enzymes in a plant constructed for ethanol production, according to Glassner. Participants agreed that producing enzymes on-site at bioethanol plants is one way to reduce their costs.

The meetings were successful, partly because they helped establish a consensus on the technical and economic status of the biomass industry. Glassner said, "Today, there is no clear-cut answer to the most cost-effective way to produce the enzymes needed. That is why these colloquies, and a continued communication between everyone in the biofuels industry, are so vital to achieving market feasibility and wide-scale production." Attendees understood the economic barriers to cellulosic biomass conversion,

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but the colloquies "gave the U.S. Department of Energy (DOE) an opportunity to talk with our customers, receive feedback regarding their perspectives, and most importantly, helped DOE direct program efforts in the most effective way," said Valerie Sarisky-Reed, of DOE's Office of Fuels Development. NREL and DOE will continue to work on stimulating the availability of cost-effective cellulase enzyme.

NREL Appoints New Biofuels Technology Manager

In January of this year, David Glassner was appointed program manager in the Technology Management Center at NREL. He has worked in the bio-processing industry for more than a decade, and is now the key liaison between NREL's biofuels program and DOE's Office of Fuels Development. In this position, Glassner leads and manages biofuels program activities for DOE. He allocates resources for various projects to achieve DOE goals, establishes specific objectives that lead to the achievement of DOE goals, and monitors progress toward these objectives.

Cellulase Technology Research

Economic, highly effective biocatalysts (enzymes) are key to converting biomass to ethanol at a high yield. Scientists at the National Renewable Energy Laboratory (NREL) are collaborating with industry and academic researchers to create cellulase systems that break down (hydrolyze) the crystalline structure of cellulosic biomass. This process is essential for converting biomass to sugars that can then be fermented into high-grade ethanol.

The ideal cellulase complex must be highly active on the intended biomass feedstock, able to completely hydrolyze the biomass, operate well at mildly acidic pH, withstand process stress, and be cost effective. The ability to construct such cellulase systems in anticipation of specific industrial requirements is key to the successful commercialization of bioethanol and other renewable-based products. Using standard and novel methods to compare new cellulase enzyme systems, the goal of the NREL researchers is to develop optimal, use-specific, artificial cellulase systems, produced economically on an industrial scale.

For more information on all biofuels-related projects at NREL, visit its biofuels web site (*www.biofuels.nrel.gov*).

Regional Biomass Energy Program Updates

Northeastern Region

The Northeast Regional Biomass Program (NRBP), Twin Rivers Technologies, New England Power, and Engelhard Inc., have teamed up to measure specific pollutant levels in a large diesel engine. The group will use petroleum-based diesel, diesel mixed with soy-based biodiesel (in 5%–20% blends), and blends that use a catalyst to determine the cleanest way to power their engine. The engine is equivalent to those that power diesel locomotives. NRBP's role is to ensure quality control of the tests administered by the other three organizations.

Great Lakes Region

The Automotive Engineering Technology Department at Minnesota's Mankato State University recently completed a study that compares the characteristics of compatibility, exhaust gas emissions, opacity, horsepower, and fuel economy of various blends and concentrations of petroleum-based diesel, biodiesel, and ethanol. It was designed to identify mixtures most beneficial to the environment and to the engine that uses the mixtures. Findings include:

- Carbon monoxide emissions were reduced more than 47% on biodiesel blends and as much as 90% with ethanol blends during wide open throttle conditions
- The largest reduction in hydro carbon emissions occurred during wide open throttle conditions
- Emissions of oxides of nitrogen were greatly reduced with biodiesel, diesel, and ethanol blends during wide open throttle conditions.

To obtain a copy of this study, contact Fred Kuzel, Great Lakes Regional Biomass Program, 312.407.0177.

Northwestern Region

The Northwestern Region is conducting a three-phase, 200,000-mile operational demonstration that uses a Caterpillar engine and Kenworth truck fueled by biodiesel and petroleum-based diesel in

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50% blends. Emissions, performance, and over-the-road testing will be conducted during the entire program, and the engine will be inspected at the program's completion. Cooperators and participants in the program include DOE; Caterpillar, Inc; Western States Caterpillar; University of Idaho; JR Simplot Co.; Kenworth Truck Company; University of California, Idaho Department of Natural Resources; and the Coalition of Northeast Governors, Northeast Regional Energy Biomass Program. The program demonstration is scheduled to begin in early fall.

Western Region

The Western Regional Biomass Energy Program (WRBEP) added one biomass-testing program in 1997. Titled Tallow Based Biodiesel Test at the Kansas City Area Transit Authority, the initiative will compare the effect of tallow use on engine metals. Kansas City will power four urban buses on 20/80 tallow/diesel blended fuel. Four other buses that run on petroleum-based diesel will be monitored and compared with those that run on biodiesel blends. Participants include:

- WRBEP (sponsoring agency)
- MARC-IV
- National Biodiesel Board
- University of Nebraska.

WRBEP is providing $89,896, and the Fats and Protein Research Center and the Kansas Value-Added Center are providing $5,000 each. The Excel Corporation donated the tallow.

Southeastern Region

Ongoing biomass-related projects in the region include:

- A region-wide assessment of potential biodiesel feedstocks
- A study on the use of farm cooperatives to reduce the cost of biodiesel production
- A region-wide assessment of textile wastes as ethanol feedstocks
- A study of land reclaimed from phosphate mining in Florida for sugar cane production for ethanol
- Partial funding for installing two E85 refueling stations each in Kentucky and Missouri.

Biofuels-Related State Legislative Activities

Montana—House Bill 555, signed by Governor Marc Racicot on May 2, extends the ethanol credit for 4 more years, through 2005.

Minnesota—House Bill 2150, signed by Governor Arne Carlson on May 30, adds an additional $4 million to ethanol production incentives, which increases the total to $34 million annually.

Biofuels UPDATE
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