

# Beyond Diesel—Renewable Diesel

As U.S. petroleum imports continue to increase, so do the related negative effects on energy security and human and environmental health. Researchers in the National Renewable Energy Laboratory's (NREL) Center for Transportation Technologies and Systems are working on solutions to these problems. One of the best ways to increase energy security is to displace imported petroleum with domestically produced, renewable fuels. In particular, renewable diesel fuels like biodiesel and E-diesel are attractive because diesel is used to transport 94% of U.S. freight and powers most other heavy-duty vehicles.

Renewable diesel also has an important part to play in helping engine manufacturers meet increasingly stringent heavy-duty emissions standards. In January 2001, the U.S. Environmental Protection Agency (EPA) passed the Heavy Duty Engines and Vehicle Standards and Highway Diesel Sulfur Control Requirements rule, which will require significantly lower emissions from heavy-duty vehicles by 2007. Because renewable diesels produce lower emissions of most criteria pollutants, their use can help engine manufacturers meet these 2007 emissions standards.



National Biodiesel Board, NREL/PIX 07624

Commuters Board a Biodiesel Bus in Nebraska

Research conducted in NREL's unique Renewable Fuels and Lubricants (ReFUEL) Research Laboratory will help increase renewable diesel use and displace petroleum by searching for ways to reduce costs, improve performance, insure fuel-engine compatibility, and reduce nitrogen oxide emissions. The ReFUEL laboratory will also be used to provide vital information to engine manufacturers as they work to meet the new EPA emissions standards.

## Biodiesel Reduces Emissions\*

Emission	B100	B20
Carbon monoxide	-43.2%	-12.6%
Hydrocarbons	-56.3%	-11.0%
Particulates	-55.4%	-18.0%
Nitrogen oxides	+5.8%	+1.2%
Air toxics	-60%-90%	-12%-20%
Mutagenicity	-80%-90%	-20%

\* Compared to EPA certification diesel fuel

## What Is Biodiesel?

Biodiesel is a diesel replacement fuel that is made from natural, renewable resources such as vegetable oils. It can be used pure or mixed in any proportion with #2 diesel or #1 diesel. Most consumers use a 20% blend of biodiesel with 80% diesel (B20). Biodiesel is biodegradable, and is about as toxic as table salt. Most emissions from biodiesel are significantly lower than petroleum emissions.

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Experts anticipate a huge potential supply of biodiesel—1 billion gallons may be available in the near term and, depending on various policy drivers, as much as 2 billion gallons could be available by 2010. An additional 6 billion gallons may eventually become available by producing biodiesel from mustard oil as a co-product of organic pesticide production. (DOE's Biofuels Program is currently exploring this option). In fact, the potential exists for biodiesel to displace as much as 5% to 10% of the diesel used on U.S. highways by 2010.

Although the cost of biodiesel has decreased from about \$3.50/gallon in 1997 to about \$1.85/gallon today, researchers in the ReFUEL Laboratory will continue to look for ways to reduce the cost to be competitive with petroleum diesel (around \$1.00/gallon). Researchers will also continue to explore new sources of fuel and address issues such as poor shelf life, decreased cold weather performance, and slightly higher nitrogen oxide emissions compared to petroleum diesel fuel.

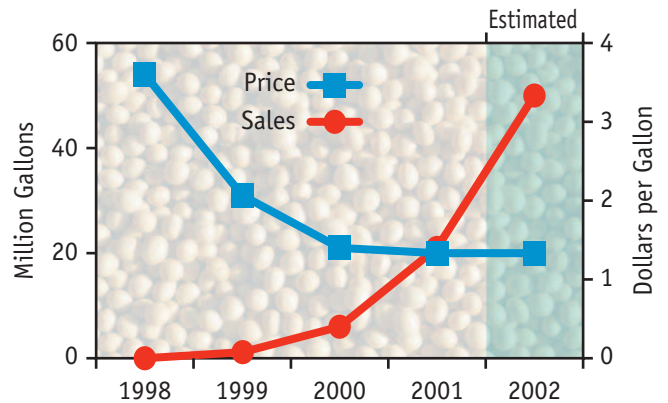
Biodiesel provides fleets with an easy way to displace petroleum use by incorporating renewable fuels. The Biodiesel Final Rule (passed in 2001) allows fleets covered by the Energy Policy Act of 1992 (EPA) to use biodiesel blends as high as 20% (B20) to earn EPA credits. Fleets receive one alternative fuel credit for every 450 gallons of biodiesel used in blends.

## What Is E-diesel?

Another way to displace petroleum diesel is to blend it with up to 15% ethanol—E-diesel. E-diesel is a promising fuel because of its lower selling price compared to biodiesel, its significantly reduced particulate matter and toxic emissions, and its improved cold flow properties. E-diesel is in the early stages of development and is not being used commercially in the United States.

Technical barriers being addressed at the ReFUEL laboratory are the low flashpoint and tank vapor flammability associated with E-diesel and the possible separation of the ethanol and diesel components at low temperatures.

## Sales Volume and Prices Trends



2001-2003 prices incorporate effect of USDA subsidy for soy biodiesel ranging between \$0.85 and \$1.30/gal B100. Assumed extended through 2003

The ReFUEL Laboratory is conducting long-term performance tests to determine the effect of E-diesel fuel on diesel engines. This information will allow engine manufacturers to determine warranty issues and further evaluate emission and health effects.

Renewable diesels can displace petroleum use and reduce petroleum imports. They can also have a significant positive impact on human health and the environment. By providing the information necessary to allow increased use of renewable diesels, the ReFUEL Lab's research into alternative and advanced fuels and lubricants will strengthen our nation's energy security, while protecting our nation's environment and public health.

*For more information on how to work with CTTS, contact:*

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