BIOFUELS: RENEWABLE DIESEL

In cooperation with the US Department of Energy

Biomass energy converted into liquid fuels is usually called **"biofuels."** Two examples of biofuels are Renewable Diesel and ethanol. Ethanol is covered under a separate fact sheet in this series. **Renewable Diesel** includes biodiesel, pyrolysis oils, and other biomass-derived liquids that can be used to either supplement or substitute for fossil-based diesel fuels.

Biodiesel is a popular clean-burning biofuel. Biodiesel, as the name is commonly used in the American trade, is made from vegetable oils, animal fats and tallow, and recycled cooking oils.

Fueling engines with biodiesel has just started to catch on, but this isn't a new idea. Before petroleum diesel fuel became popular, Rudolf Diesel, the designer of the diesel engine, experimented with using vegetable oil as fuel. In the U.S., the most common vegetable oil is soybean oil; less common oils are sunflower, canola (rapeseed), and mustard. Peanut oil and other vegetable oils are also potential sources for biodiesel production. Waste vegetable oils include recycled restaurant cooking oil (frequently called "yellow grease") and grease recovered from sewer traps (frequently called "brown grease"). Biodiesel also can be made from animal tallow.

Biodiesel is renewable, nontoxic, and biodegradable. Since Biodiesel is nontoxic and biodegradable it is frequently used in pristine environments (e.g., natural parks, aquatic recreational areas) so that fuel spills do not create an environmental disaster.

Compared to diesel, biodiesel is significantly cleaner burning. It results in much lower emissions of almost every pollutant: carbon dioxide, sulfur oxide, particulates, carbon monoxide, air toxics and unburned hydrocarbons. Under some conditions, biodiesel can have nitrogen oxide emissions that are slightly higher. Blending biodiesel into petroleum diesel can help reduce emissions overall. Biodiesel produces less black smoke and smells better, too. Sometimes biodiesel smells like French fries!

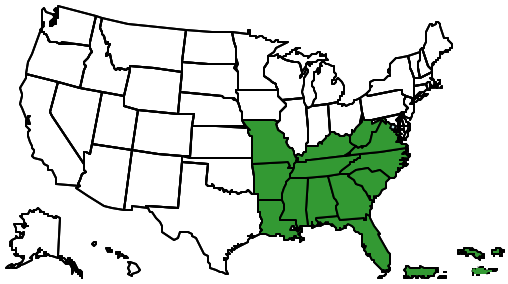
Fossil-based diesel fuel contains sulfur but most types of biodiesel contain almost no sulfur and can help reduce sulfur in diesel fuel used throughout the country. Sulfur can cause damage to the environment when it is burned in fuels where it produces sulfur dioxide. New environmental laws will require the amount of sulfur in diesel fuel to be dramatically reduced over the next few years. When sulfur is removed from regular diesel fuel, the fuel loses its lubricating properties, which can cause premature engine wear and tear. Adding even a small amount of biodiesel can fix the problem.

For the most common processes to make biodiesel, greases or oils are first mixed in a container with either ethanol or methanol and a catalyst where they react. Part of an oil molecule is stripped away and

replaced with the ethanol or methanol molecule, leaving an "ester." The part of the oil molecule stripped away is glycerine, which becomes an important co-product in the manufacturing process.

Biodiesel at 100% (B100) and biodiesel blends are sensitive to cold weather and may require special anti-freeze, just like petroleum-based diesel fuel does. Biodiesel acts like a detergent additive, loosening and dissolving sediments in storage tanks. Because biodiesel is a solvent, B100 may cause rubber and other components to fail in older vehicles. This problem occurs less with biodiesel blends, but for blends of 20 percent and higher, it is recommended that natural rubber components be replaced with a more modern material. Natural rubber is usually found in pre-1994 vehicles.

Biodiesel does it require special refueling equipment. A 2% blend of biodiesel is sometimes added to diesel fuel (commonly called B2) to enhance fuel lubricity in an engine. More common yet, a 20% blend of biodiesel (commonly called B20) is added to diesel fuel to reduce engine exhaust emissions. Although it is relatively inexpensive to process biodiesel, the oils and greases used to make the biodiesel can be relatively expensive. A new federal tax incentive helps make it more cost-competitive. Mixing biodiesel at a 20% rate provides most of the emission reduction benefits associated with biodiesel with only a slight increase in cost over regular fossil diesel.



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A variety of other alcohols, including methanol, can also be made from biomass and used for chemical production or fuel. Using an additive which allows ethanol and diesel fuel to mix, **diesel/ethanol blends** of up to 15% ethanol can be made.

Liquid fuels can also be made via **liquefaction** and **pyrolysis processes**. These processes may use combinations of heat, pressure, and other conditions to convert biomass into a liquid product. In general, these fuels are less likely to be suitable for transportation applications and few processes are commercial. However, these processes can usually convert cellulosic materials into liquid fuels with a relatively high degree of efficiency and at relatively low cost. And various methods of upgrading these fuels into transportation fuels are close to commercialization. They thus hold great promise for the future.

The **Fisher Tropisch process** was developed in the 1930's by the Germans and used by the Germans to provide liquid fuels during WWII. This process first gasifies the biomass and then passes the gas across a catalyst where it is converted into liquids, some of which are usable in diesel engines and some of which are usable in gasoline engines. The Fisher Tropisch process is currently being used commercially in other parts of the world to make biofuels and synthetic natural gas from coal.

For additional information: National Biodiesel Board, www.nbb.org

This series of fact sheets was prepared by the Southeast Biomass State and Regional Partnership (formerly the Southeastern Regional Biomass Energy Program). The Partnership is one of five regional administrations of the U.S. Department of Energy's (DOE) National Biomass State and Regional Partnership. The Partnership was established in 2003, and is managed for DOE by the Southern States Energy Board. The goal of this Partnership is to work cooperatively with the DOE Office of Biomass Programs (OBP) to facilitate the increased use of bioenergy and biobased products through coordinated federal, regional, and state outreach, education and technical assistance programs.

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