

freedomCAR & vehicle technologies program

U.S. Department of Energy • Office of Energy Efficiency and Renewable Energy

Just the Basics

Biodiesel

In many ways, biodiesel is the perfect fuel for buses and trucks. It produces fewer polluting emissions, supplies of it can be renewed indefinitely, and because feedstock materials can be grown domestically, use of it can help bolster the U.S. economy while lessening this country's dependence on foreign petroleum products.

Why Biodiesel Is Important

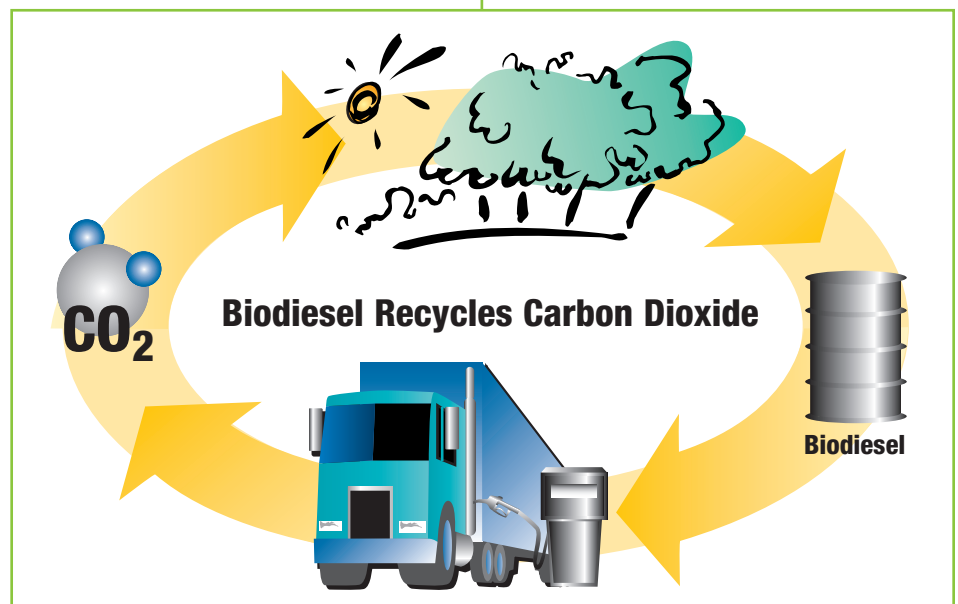
The diesel engines that power most trucks and buses are not only highly efficient power plants; they are also very versatile in the fuels they can use. Rudolf Diesel first conceived of the engine that now bears his name as running on powdered coal. A ruinous engine explosion taught him to value liquid fuels. He subsequently hit on the idea of using vegetable oil. The engine that he demonstrated at the World Exhibition in Paris in 1900 ran on oil extracted from peanuts.

Nearly a century of reliance on dwindling petroleum reserves has taught us the wisdom of looking to Nature's bounty for our fuels, as Rudolf Diesel once did. Biofuels, such as biodiesel and bioethanol, are good for the environment because they add fewer emissions to the atmosphere than petroleum-based fuels. Biofuels are also made from plant materials, which are available in inexhaustible supply. The energy content of plants comes from the sun through the natural process of photosynthesis. That energy content persists even when plants are processed into other materials.

Biodiesel is a biodegradable and nontoxic diesel fuel substitute that can be used in late-model (after 1992) diesel engines without any need to modify the engines beforehand. Biodiesel is actually good for diesel engines. It lubricates better than petroleum-based diesel fuel and has excellent solvent properties. Conventional diesel fuel can leave deposits inside fuel lines, storage tanks, and fuel delivery systems over time. Biodiesel dissolves this sediment while adding no deposits of its own, resulting in cleaner, more trouble-free fuelhandling systems once fuel filters clogged with diesel sediments have been replaced after the switch to biodiesel has been made. Use of 100% biodiesel fuel does reduce the fuel economy and power of diesel engines by 10%. This means that 1.1 gallons of biodiesel are equivalent to one gallon of conventional diesel fuel. Although both biodiesel and conventional diesel fuel tend to



Less dependence on foreign oil, and eventual transition to an emissions-free, petroleum-free vehicle



vehicle systems

gel or freeze in cold weather, biodiesel switches from the liquid state at higher temperatures than petroleum-based diesel fuel.

Biodiesel is not a type of vegetable oil. Although diesel engines will run on various vegetable oils, prolonged use of these fuels can cause engine deposits that eventually lead to engine failures. These problems can be avoided, however, by modifying the oil-based feedstock materials. A process called transesterification chemically alters organically derived oils in forming biodiesel fuel.

Biodiesel is safe to handle and transport because it is as biodegradable as sugar, ten times less toxic than table salt, and burns at a relatively high temperature. Biodiesel actually degrades about four times faster than petroleum-based diesel fuel when accidentally released into the environment.

Because it is physically similar to petroleum-based diesel fuel, biodiesel can be blended with diesel fuel in any proportion. Many federal and state fleet vehicles now use biodiesel blends in their diesel engines. The most common blend is a mixture consisting of 20% biodiesel and 80% petroleum diesel, called B20. The motive for blending the fuels is to gain some of the advantages of biodiesel while avoiding higher costs. Biodiesel is currently higher in price than conventional diesel fuel.

Emissions Benefits from Using Biodiesel

The production and use of biodiesel creates 78% less carbon dioxide emissions than conventional diesel fuel. Carbon dioxide is a greenhouse gas that contributes to global warming by preventing some of the sun's radiation from escaping the Earth. Burning biodiesel fuel also effectively elimi-

nates sulfur oxide and sulfate emissions, which are major contributors to acid rain. That's because, unlike petroleum-based diesel fuel, biodiesel is free of sulfur impurities. Combustion of biodiesel additionally provides a 56% reduction in hydrocarbon emissions and yields significant reductions in carbon monoxide and soot particles compared to petroleum-based diesel fuel. Also, biodiesel can reduce the carcinogenic properties of diesel fuel by 94%.

How Biodiesel Supplies Can Be Sustained

The United States is currently producing biodiesel at the rate of about 20 million gallons per year, but has a capacity to produce more than 50 million gallons per year. Most biodiesel is now made from soybean oil and "yellow grease," which is recycled cooking oil that may include canola, palm, soy, and other oils. These sources represent only a small fraction of the possible feedstock materials. Other biodiesel feedstocks include oils from corn, sunflower, peanut, cottonseed, canola, and mustard seeds; and animal fats, such as those from sheep, cattle (tallow), and pork (lard).

The Future of Biodiesel

Biodiesel is seen not as potentially replacing conventional diesel fuel, but as extending its usefulness in targeted applications. There is a growing interest, for example, in using biodiesel in situations where workers may be exposed to diesel exhaust for extended periods. School bus fleets are also switching to biodiesel or the B20 blend to reduce the possibility of student riders inhaling harmful emissions. Biodiesel is additionally being considered for use in locomotives that face restricted use unless their emissions can be reduced.

One of biodiesel's most promising future roles could be as a fuel additive. The U.S. Environmental Protection Agency has ordered a reduction in the sulfur content of diesel fuel from the current level of 500 parts per million (ppm) to 15 ppm, starting in 2006. Although it is an impurity, sulfur contributes significantly to the lubricating value of conventional diesel fuel. Without a high-lubricity additive, therefore, engines running on low-sulfur diesel fuel could be subjected to excessive wear. Tests have shown that blending biodiesel with petroleum-based diesel fuel at just a 1% level could increase the lubricity of diesel fuel by up to 65%. Biodiesel is also being considered as a replacement for some petroleum-based lubricants.

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.



U.S. Department of Energy
Energy Efficiency
and Renewable Energy

August 2003

Printed on recycled paper