



# Diesel

Diesel is a petroleum-based fuel made of hydrocarbons that contain energy. At refineries, crude oil is separated into different fuels including gasoline, jet fuel/kerosene, lubricating oil, and diesel. There are five million diesel cars, pickups, and sport utility vehicles (SUVs) on the road today.

Approximately 10 gallons of diesel are produced from each 42-gallon barrel of crude oil. Diesel can only be used in a specifically designed diesel engine, a type of internal combustion engine used in many cars, boats, trucks, trains, buses, and farm and construction vehicles.

## History of Diesel

Rudolf Diesel originally designed the diesel engine to use coal dust as fuel, but petroleum proved more effective. The first diesel-engine automobile trip was completed on January 6, 1930. The trip was from Indianapolis to New York City, a distance of nearly 800 miles. This feat helped prove the usefulness of the diesel engine design. It has been used in millions of vehicles since that time.

## Diesel as a Transportation Fuel

Diesel fuel plays a vital role in America's economy, quality of life, and national security. As a transportation fuel, it offers a wide range of performance, efficiency, and safety features. Diesel fuel contains between 18 and 30 percent more energy per gallon than gasoline. Diesel technology also offers a greater power density than other fuels, so it packs more power per volume.

Diesel fuel has a wide range of applications. In agriculture, diesel powers more than two-thirds of all farm equipment in the U.S. because diesel engines are uniquely qualified to perform demanding work. In addition, it is the predominant fuel for public transit buses, school buses, and intercity buses throughout the U.S.

America's construction industry depends upon diesel's power. Diesel engines are able to do demanding construction work, like lifting steel beams, digging foundations, drilling wells, digging trenches for utilities, grading and paving new roads, and moving soil—safely and efficiently. Diesel power dominates the movement of America's freight in trucks, trains, boats, and barges; 94 percent of our goods are shipped using diesel-powered vehicles. No other fuel can match diesel in its ability to move freight economically.

A new generation of clean diesel cars, light trucks, and SUVs is now available and offers consumers a new choice in fuel-efficient and low-emissions technology. Clean diesel is a proven technology that is clean, quiet, and fun to drive. Many new diesel options are available for car consumers in every state. Thanks to their inherent fuel efficiency, diesel engines also offer a viable and readily available strategy for reducing greenhouse gas emissions as they produce 25 percent fewer carbon dioxide emissions than gasoline vehicles. American drivers who purchase cleaner-burning diesel cars, trucks, and SUVs are eligible for similar **tax incentives** as purchasers, of gasoline-hybrid electric

## DIESEL TRUCK



vehicles.

## Characteristics and Environmental Impacts of Diesel

Diesel-powered cars achieve 30-35 percent better fuel economy than gasoline powered equivalents, especially in popular SUVs and light trucks, which now make up more than half of all new vehicle sales. Safety is another advantage of diesel fuel; it is safer than gasoline and other alternatives because it is less flammable.

Significant progress has been made in reducing emissions from diesel engines. As of 2010, new trucks and buses have near zero emission levels. Ultra low sulfur diesel (ULSD) fuel is highly refined for clean, complete combustion and low emissions, enabling the use of emission treatment systems. In 2006 the EPA lowered the legal limit of sulfur in diesel from 500 parts per million (ppm) to 15 ppm. Today, refiners reduce the sulfur content in diesel fuel by 97 percent. This new, ultra-clean fuel is important because sulfur tends to hamper exhaust-control devices in diesel engines, like lead once impeded the catalytic converters on gasoline cars. Removing the sulfur from diesel has helped usher in a new generation of clean diesel technology.

Advanced technologies such as electronic controls, high-pressure fuel injection, variable injection timing, improved combustion chamber configuration, and turbo-charging have made diesel engines cleaner, quieter, and more powerful. Using low sulfur diesel fuel and exhaust control systems, such as particulate traps and diesel specific catalytic converters, can reduce particulate emissions by up to 90 percent and nitrogen oxides (NO<sub>x</sub>) by 25-50 percent.



# Biodiesel

**Biodiesel** is a fuel made by chemically reacting alcohol with vegetable oils, fats, or greases, such as recycled restaurant greases. It is most often used in blends of two percent or 20 percent (B20) biodiesel. It can also be used as neat biodiesel (B100). Biodiesel fuels are compatible with and can be used in unmodified diesel engines with the existing fueling infrastructure. It is the fastest growing alternative transportation fuel in the U.S.

Biodiesel contains virtually no sulfur, so it can reduce sulfur levels in the nation's diesel fuel supply. Removing sulfur from petroleum-based diesel results in poor lubrication. Biodiesel is a superior lubricant and can restore the lubricity of diesel fuel in blends of only one or two percent. Biodiesel can also improve the smell of diesel fuel, sometimes smelling like french fries.

B100 and biodiesel blends are sensitive to cold weather and may require special anti-freeze, as 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 vehicles manufactured before 1994. Using B20 minimizes these problems.

## Environmental Impacts

Biodiesel is renewable, safe, and biodegradable, and reduces serious air pollutants such as particulates, carbon monoxide, hydrocarbons, and air toxics. Emissions of nitrogen oxide (NO<sub>x</sub>), however, increase slightly with the concentration of biodiesel in the blend. The industry is developing additives that will decrease NO<sub>x</sub> emissions, and if used with clean diesel technology, NO<sub>x</sub> emissions will not increase.

Biodiesel's fuel characteristics exceed those of petroleum-based diesel in **cetane number**, resulting in superior ignition. Therefore, biodiesel has a higher flash point, making it more versatile where safety is concerned. Horsepower, torque, and fuel economy are comparable to diesel.

## Distribution of Biodiesel

Currently, biodiesel is available mainly through bulk suppliers; there are 618 public biodiesel refueling stations in the United States. Biodiesel, therefore, is more practical for fleets with their own fueling facilities. Biodiesel is delivered by distributors directly to fleet operators. Currently there are almost 650 biodiesel filling stations. Availability is increasing as the market expands.

Today, the national average of B100 costs about \$4.20 a gallon, depending on purchase volume and delivery costs. Biodiesel is taxed as a diesel fuel, so taxes are added to the purchase price. At today's prices, B20 costs slightly more per gallon than diesel. However, because it is stored in existing infrastructure and can fuel vehicles without modification, biodiesel has emerged as the fastest growing and lowest cost alternative fuel for fleets regulated by the **Energy Policy Act**

### BIODIESEL GARBAGE TRUCK



Biodiesel is more practical for fleets with their own fueling facilities, like these garbage trucks from Denver.

### BIODIESEL SCHOOL BUS



Images courtesy of NREL

Used vegetable oil can be used in modified diesel engines, making the exhaust smell like the food that was fried in the oil.

**(EPACT)**. The cost difference will continue to decrease due to projected petroleum price increases, EPA rules requiring a 97 percent reduction of sulfur in diesel, and production improvements in the biodiesel industry. Minnesota and Washington were the first states to mandate the addition of at least two percent biodiesel in every gallon of diesel fuel and many other states are considering mandates as well.