# Clean Air Choice
# Lesson on *Biodiesel*

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AMERICAN LUNG ASSOCIATION.
OF THE UPPER MIDWEST

The American Lung Association of the Upper Midwest provides this *Lesson on Biodiesel* as an educational reference.

## Lesson One: The Basics

### What is biodiesel?

Biodiesel is an alternative fuel produced from vegetable oils (including soybean, canola and corn), animal fats, or waste grease. Biodiesel itself contains no petroleum, but in most cases it is mixed with petroleum diesel to create a biodiesel blend. These blends are identified by the letter "B" followed by the corresponding level of biodiesel: **B2** (two percent), **B10** (10 percent), **B20** (20 percent).

### Why is biodiesel recognized as an "advanced biofuel" by the Environmental Protection Agency?

Biodiesel is a renewable fuel that cuts lifecycle greenhouse gas emissions by more than 50%. In addition, it displaces fossil fuels, increasing our energy security and supporting local economies.

### How is biodiesel produced?

Biodiesel is produced in a process called transesterification, which separates fats in the oil from glycerin. The remaining products are methyl ester (biodiesel) and a glycerin, commonly used in soaps. Fuel-grade biodiesel must be produced to strict industry specifications (ASTM D6751 for B100) in order to ensure proper performance.

### Is biodiesel the same as raw vegetable oil?

No! Biodiesel is legally registered with the Environmental Protection Agency as a motor fuel for sale and distribution. Raw vegetable oil cannot meet biodiesel fuel specifications, and it is not a legal motor fuel in the United States. Research shows that vegetable oil or greases used in diesel engines at levels as low as 10%-20%, can cause long-term engine problems due to the greater viscosity of raw oils compared to that of diesel fuel.

### Where can biodiesel be purchased?

Biodiesel is available nationwide. For an updated listing of stations, visit Biodiesel.org.

### What are benefits of using biodiesel?

**Biodiesel is clean.** Using biodiesel instead of traditional petroleum diesel fuel can reduce emissions, including particulate pollution, air toxics and lifecycle carbon dioxide emissions associated with global climate change.

**Biodiesel is renewable.** Biodiesel can be produced from a variety of non-petroleum feedstocks—often locally available, renewable sources.

**Biodiesel is made here.** Whatever the source, the feedstocks can be produced locally. In 2014, approximately 1.75 billion gallons of biodiesel were consumed, largely produced from locally grown materials - providing jobs and support to local economies and a shorter, more secure supply line to your community.

**Biodiesel is high performance.** Biodiesel adds lubricity and has a high cetane rating. Biodiesel has the highest energy balance of any alternative fuel. Power and performance remain virtually unchanged.

Cleaner Fuel
Cleaner Car
+ Cleaner Driving
**Clean Air Choice**

# Lesson Two: Vehicle Technologies

**What is a diesel engine?**
The first diesel engine was patented by Rudolf Diesel in 1898. The engine was powered by peanut oil, a very early form of biodiesel. Rudolf Diesel was eager to utilize vegetable oils as a form of fuel in the hopes of supporting agriculture in the countries that would rely heavily on the use of the diesel engine.

Diesel vehicles operate by compression ignition. This means the diesel fuel is injected into the combustion chamber containing compressed air, causing the fuel to self-ignite. Diesel engines run solely on diesel fuels, including biodiesel and ultra low sulfur diesel. A growing selection of clean diesel vehicles is now available to consumers and fleets. Today's diesel vehicles are certified to the same stringent federal and California emissions standards as gasoline cars, pickups and SUVs and often get more than 20 percent more miles per gallon than a comparable gasoline engine.

**Is my diesel vehicle compatible with biodiesel?**
Biodiesel can be used in any diesel engine with little to no modifications to the engine or the fuel system.

**Is there a concern that biodiesel will gel in colder climates?**
When properly blended for winter use, blends up to 20 percent (B20) can be used in cold climates. This has been proven in our region with municipal snowplows, heavy trucks, and even fire engines using biodiesel year round.

**Will using biodiesel void a vehicle warranty?**
No. Federal law prohibits the voiding of a warranty just because biodiesel was used. In fact, many major vehicle manufacturers have stated formally that the use of biodiesel blends up to B20 (20% percent) will not void their parts and workmanship warranties. The only instance in which a vehicle warranty would be voided would be if an engine experienced a failure caused by external conditions, such as bad diesel fuel.

**How does biodiesel compare to petroleum diesel in terms of performance?**
If B20 is used, there is no noticeable difference in power and torque, however fuel economy could decrease by 1%-2%, depending on the petroleum diesel used. Most users report little difference between B20 and No. 2 diesel, and as biodiesel blend levels decrease, performance differences are nearly diminished between the two. Typically, biodiesel (B100) contains 8% less energy per gallon than No. 2 diesel in the United States. This difference is caused by an 11% increase in oxygen by weight in biodiesel, which allows it to burn more cleanly.

## Did you know?

Many refueling sites in the region are already selling varying percentages of biodiesel. Make sure to check with local retailers to find out where higher blends of biodiesel are sold!

PLUS: Visit your local legislative website to check out biodiesel incentives and requirements in your area!


For a listing of biodiesel retailers in your area visit:
**Biodiesel.org**

# Lesson Three: How Much…?

**How much energy does it take to produce biodiesel?**

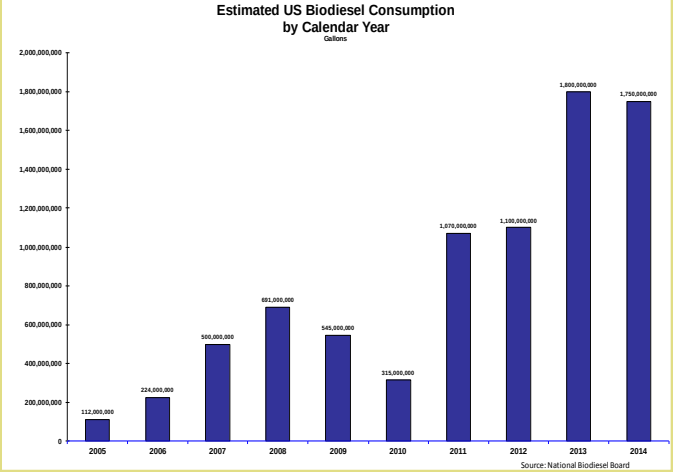
According to the latest U.S. Department of Energy facts, cleaner-burning biodiesel provides 5.5 units of energy for every one unit expended in production — the greatest energy return of ***any fuel*** approved for use as a legal motor fuel.

## Energy Balance of Production

**Yield in liquid fuel BTUs per BTU of fossil energy inputs*

| Fuel | *Energy Yield | *Balance |
|---|---|---|
| Gasoline | 0.81 | -19% |
| Diesel | 0.83 | -17% |
| Ethanol | 1.87 | +87% |
| Biodiesel | 5.50 | +450% |

Sources: USDOE, USDA, University of Idaho, ASABE




**How much biodiesel does the U.S. consume?**

In 2013, biodiesel consumption in the U.S. set a new record, reaching approximately 1.8 billion gallons.

**How many soybeans does it take?**

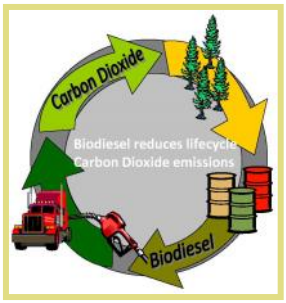
One bushel of soybeans (60 pounds) yields about 1.44 gallons of B100 biodiesel and 44 pounds of animal feed.

## Clean Driving Tips:

- ☑ No Idling — All you have to do is shut off your diesel engine. New diesel engines have no problem restarting, so idling for long periods of time is rarely necessary.
- ☑ Drive responsibly — Keep in mind. Aggressive driving habits can reduce your fuel economy by 20%, while even low tire pressure can cause a loss of more than 5%.
- ☑ Auxiliary Power Unit — An auxiliary power unit is specifically designed to heat, air condition, and/or provide electrical power while the vehicle is not in motion. These devices provide a more efficient alternative to idling as they use less fuel and emit less pollution.
- ☑ Diesel Oxidation Catalyst — An aftermarket accessory that is installed in place of a standard muffler. It contains a honeycomb ceramic core coated with a material that catalyzes a chemical reaction to reduce particulate matter, hydrocarbons, and carbon monoxide pollution. It can be used on any diesel engine.
- ☑ Visit CleanAirChoice.org — Clean Air Choice® conservation tips and information on biofuels and other new fuels and technologies at your fingertips!

# Lesson Four: The Environment

**What effect does biodiesel have on global warming?**




Using biodiesel instead of petroleum-based fuels can reduce lifecycle emissions of carbon dioxide. In a 1998 biodiesel lifecycle study conducted by the US Departments of Energy and Agriculture, biodiesel was found to reduce net carbon dioxide ($CO_2$) emissions by **78 percent** compared to petroleum diesel. Biodiesel is part of a "carbon cycle" in which the carbon released into the atmosphere by burning biodiesel is reabsorbed by the next generation of energy crops grown to produce biodiesel. Conversely, use of fossil fuels, like petroleum diesel, unlocks carbon that has been stored in the earth for millions of years. Releasing that carbon into the atmosphere is altering our climate systems.

**Is the speculation true that biofuels cause global warming?**

No! While some well-hyped studies have suggested this, they are based on computer models and speculation on global land use to grow biofuels crops. The Energy Independence and Security Act of 2007 expressly prevents uncultivated land to be used for biofuel crops. Because the United States imports very little of its biofuel, there is little incentive for foreign farmers to convert forests and prairies into fields to meet our biofuel needs. While not all nations protect their natural resources equally, responsibility for global deforestation and poor land management decisions made overseas cannot be reasonably attributed to biofuel use in the United States.

**How do biodiesel emissions compare to that of petroleum diesel?**

**Biodiesel Emission Reduction Potential**

| Pollutant | B100 | B20 |
|---|---|---|
| Total Unburned Hydrocarbons | -67% | -20% |
| Carbon Monoxide | -48% | -12% |
| Total Particle Pollution | -47% | -12% |
| $NO_x$ | 10% | 0* |
| Ozone Potential Speciated HC** | -50% | -10% |

*Engine Dependent—negligible increase or decrease
**Estimated B100 results

**Source:** Compilation of NBB, NREL and others

The use of biodiesel in a conventional diesel engine results in substantial reduction of unburned hydrocarbons, carbon monoxide and particulate matter compared to emissions from diesel fuel. In addition, the exhaust emissions of sulfur oxides and sulfates (major components of acid rain) from biodiesel are essentially eliminated. Of the major exhaust pollutants, both unburned hydrocarbons and nitrogen oxides are ozone or smog forming precursors. The use of biodiesel results in a substantial reduction of unburned hydrocarbons. Emissions of nitrogen oxides are either slightly reduced or slightly increased depending on the duty cycle of the engine and testing methods used. Based on engine testing, using the most stringent emissions testing protocols required by the Environmental Protection Agency (EPA) for certification of fuel additives, the overall ozone forming potential of the speciated hydrocarbon emissions from biodiesel was nearly 50 percent less than that measured for diesel fuel.

**Biodiesel exhaust can lessen the harmful impact of motor vehicle emissions on human health**

Air pollution poses a serious threat to human health. It can worsen lung diseases like asthma, bronchitis and emphysema; make your eyes water; irritate your nose, mouth and throat; and make you cough and wheeze. Motorized vehicles are the single largest source of air pollution in the upper Midwest. The American Lung Association of the Upper Midwest encourages Americans to proactively identify and reduce exposure to harmful air pollutants.

## For additional information on biodiesel, please contact:

The American Lung Association of the Upper Midwest
CleanAirChoice.org

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