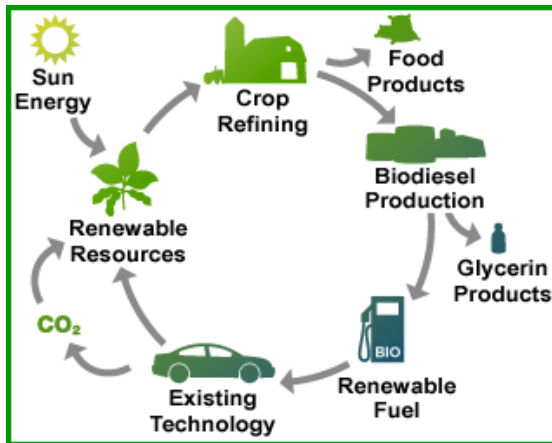


## BIODIESEL PROJECTS @ UNH

- UNH Dining Services, the New England Center, and Dairy Bar currents have their **waste vegetable oil** collected for biodiesel conversion.
- Cooperative Extension and Kingman Farm conduct research with **local farmers** examining the feasibility of small-scale seedcrop production and pressing.
- The UNH Biodiesel Group, a collaborative effort of the Chemical Engineering and Physics Departments, looks at New England seedcrop and algae as sources for oil as well as innovative production techniques.



- Biodiesel is part of the university ECO-Cat fleet of clean and alternative fueled vehicles. The new ECO-Cat buses are some of the cleanest diesel vehicles on the road.
- The UNH ECO-Cat diesel buses were funded with Air Quality Improvement grants from the USDOT.



## RESOURCES

### UNH Office of Environmental Health & Safety

11 Leavitt Lane, Perpetuity Hall  
Durham, NH 03824  
603.862.4041 (Telephone)  
<http://www.unh.edu/ehs>

### UNH Office of Sustainability

131 Main Street, 107 Nesmith Hall  
Durham, NH 03824  
603.862.4088 (Telephone)  
<http://www.sustainableunh.unh.edu/>

### UNH Energy Office

17 Leavitt Lane, Figment Hall  
Durham, NH 03824  
603.862.2345 (Telephone)  
<http://www.energy.unh.edu/>

### Biodiesel.org

The official Site of the National Biodiesel Board  
<http://www.biodiesel.org>

### B100 Supply LLC

E-mail: [support@bsupply.org](mailto:support@bsupply.org)  
<http://www.b100supply.com/>

### Environmental Protection Agency

Customer Call Center  
888.372.7341 (Telephone)  
<http://www.epa.gov/>

UNIVERSITY of NEW HAMPSHIRE

## BIODIESEL @ UNH

### Best Practices for Production, Use, Handling, & Safety

## BACKGROUND

Biodiesel is a clean burning alternative fuel, produced from domestic, renewable resources. Pure biodiesel contains no petroleum and is generally blended with petroleum diesel for commercial use. It can be used in compression-ignition (diesel) engines with little or no modifications and is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatic hydrocarbons.

Biodiesel is the only alternative fuel to have completed the health effects testing requirements of the 1990 Clean Air Act Amendments. It is legally registered with the U.S. Environmental Protection Agency and is a legal motor and home heating fuel for sale and distribution. Biodiesel is considered to be better for the environment than petroleum based fuels because it is made from renewable resources, like sunflowers and soybeans.

## PRODUCTION

Biodiesel can be produced from vegetable oil, animal oil/fats, tallow, and waste oils. There are three basic routes to biodiesel production from oils and fats:

- Base catalyzed trans-esterification;
- Direct acid catalyzed trans-esterification
- Conversion of oils to fatty acids then biodiesel.

Almost all biodiesel is produced using base catalyzed trans-esterification. This process is currently the most economical process, producing a 98% conversion yield. It also does not require high temperatures or pressures for the reaction.

The trans-esterification process is the addition of a triglyceride (fat/oil) with an alcohol to form esters and glycerol. A triglyceride has a glycerine molecule as its base with three long chain fatty acids attached. The characteristics of the fat are determined by the nature of the fatty acids attached to the glycerine. The nature of the fatty acids can in turn affect the quality and composition of the biodiesel.

## SAFETY CONCERNS

The most dangerous part of making biodiesel is from the time the methanol is purchased to the time the methoxide is completely introduced into the oil. Safety considerations are critical during this stage.

### Helpful tips:

- ✓ Purchase only the amount of methanol you need. The National Fire Protection Association limits the amount of methanol you can store at a residential location to two, 5-gallon containers.
- ✓ When mixing methoxide, wear a protective respirator, splash proof goggles, apron, and gloves. If you spill on clothing, remove them and replace them immediately.
- ✓ When mixing methoxide in the oil, make sure there is an open vent to let air out of the tank, as it contains methanol fumes.
- ✓ Mist-wash the biodiesel to reduce fumes; washing outside in a drum is best.
- ✓ Pour by-product into 5 gallon buckets, leaving no air gaps at the top, and bring to a landfill for proper disposal.
- ✓ Stockpiling raw glycerin is a fire hazard. It also can leach into the soil.



The acute oral LD<sub>50</sub> (lethal dose) is >17.4 g/kg of body weight. By comparison, table salt (NaCl) is nearly 10 times more toxic. Biodiesel degrades about

four times faster than petroleum diesel. The flash point for biodiesel is > 260°F; the flash point for petroleum based diesel approximately 125°F.

## WORKING WITH BIODIESEL

- All personnel should wear appropriate Personal Protective Equipment (PPE) when working with hazardous materials in a biodiesel facility.
- All personnel working in a biodiesel facility should be trained in the safe use and handling of the equipment and chemicals.
- All storage containers should be approved by the U.S. DOT and the local fire department.
- A Class "ABC" fire extinguishers should be installed in the facility.
- Secondary containment equipment is required for biodiesel, methanol, and other ingredients.
- A certified engineer should review all building design codes and electrical specifications to ensure compliance with federal, state, and local codes.



## USAGE AT UNH

Biodiesel use in both vehicle fleet and home heating is growing exponentially driven by market forces and emissions benefits. According to the National Biodiesel Board, production in the United States has grown ten-fold since 1999 with an estimated 75 million gallons sold in 2005.

UNH began use of low sulfur B20 in August 2006 with dispensing at the NHDOT fueling station in Durham – the first NH owned site in the state.

**UNH Wildcat Transit and Campus Connector diesel vehicles are exclusively B20 powered.** Post 1990 non-transit diesel vehicles are phasing in to B20 during 2007. **No transition or winter operational problems have been observed.**

## WHY SWITCH?

Biodiesel can be distributed using today's petroleum infrastructure and is increasingly available in B5 and B20 blends for consumer use. In New Hampshire, biodiesel is blended with fuel additives in winter.

Blends higher than B20 are not recommended for fleet use in winter but, with weather protection and heater blocks, might be fine for general consumer use. UNH and NHDOT require fuel purchased to meet ASTM and BQ9000 quality standards.

In 2007, low sulfur B20 blends carried a minor price premium over petroleum diesel. It is expected that the lubricity and wear benefits accrued to users make up for this premium. Biodiesel emissions are significantly lower than equivalent diesel for most pollutants.

## TAXATION & OFFICIAL USE RULES

The UNH licensed vehicle fleet should only use B20 procured from DOT-owned fuel pumps.

In the future, any biodiesel produced on campus may only be used in UNH-owned and *licensed* vehicles for official business. This use is exempt from federal excise tax since the USNH is a state agency. Due to excise tax law, biodiesel produced on campus is not to be used in privately licensed vehicles or in any non-official capacity. Biodiesel produced at UNH may be used in *off-road* equipment, which is not subject to taxation.

UNH produced biodiesel product cannot be sold without USNH business/legal office review. Tax and regulation issues change frequently, please contact the USNH legal office for updates.



Photograph courtesy of John McLean.