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**National Renewable Energy Lab**  
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**Triangle Clean Cities**  
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Web site: www.biodiesel.org

**Renewable Fuels Association**  
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# BIOFUELS

## for Transportation in North Carolina



## Transportation in North Carolina: Why Biofuels?

- Transportation accounts for more than two-thirds of U.S. petroleum use.
- North Carolina used 4.24 billion gallons of motor gasoline in 2002 and 4.28 billion gallons in 2003!
- Motor gasoline has been responsible for about 60% of U.S. carbon emissions over the last twenty years.
- North Carolinians have increased their miles travelled per vehicle per day by 17% over the past 12 years

Source: DOE Energy Information Administration and National Renewable Energy Laboratory (NREL).



## Where to Purchase Biodiesel: A Citizen's Guide

Citizens in North Carolina now have five choices for purchasing biodiesel.

Exxon  
4401 Roxboro Road  
(at N. Duke Street)  
Durham, NC 27704  
919-471-6924

BP/Han-Dee Hugo  
401 Benson Rd  
(at Hwy 50)  
Garner, NC 27529  
919-779-3858

BP  
102 Gregson Road  
(at Hwy 64)  
Cary, NC 27511  
919-481-4493

Carolina Biodiesel (B100 only)  
6600 Nicks Road  
Mebane, NC 27302.  
(919) 304-2220  
info@carolinabiodiesel.org  
Daylight hours only- call first

Penn Mart  
Salisbury, NC 28145  
704-636-0592

## A Fleet Manager's Guide

Fleet managers in North Carolina have a variety of choices for purchasing biodiesel for their fleets.

### Distributors:

World Energy  
Chelsea, MA  
800-256-4853  
617-889-7300  
www.worldenergy.net

Piedmont Biofuels Cooperative  
Pittsboro, NC 27312  
919-542-2900  
<http://biofuels.coop/index.php>

Griffin Industries, Inc.  
Cold Spring, KY  
859-572-2589  
www.griffinind.com

Filter Specialty  
Autryville, NC 28318  
910-567-5474  
<http://www.filter-specialty.com>

Grain Growers Cooperative  
Rocky Mount, NC 27804  
252-446-7100

Monroe Oil Company  
Monroe, NC 28111-1109  
704-289-5438  
monroeoilinc@carolina.rr.com

Potter Oil & Tire Co., Inc.  
Aurora, NC 27806  
800-962-8473

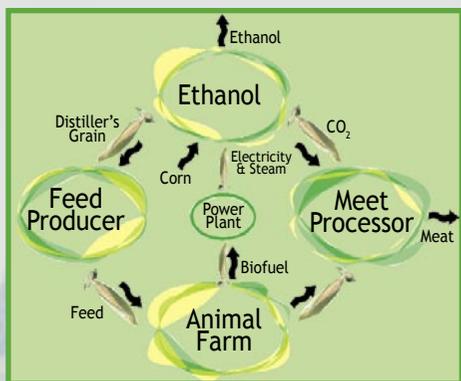
Oakboro Oil  
Oakboro, NC 28129  
704-485-8018  
DLHeath@carolina.rr.com

United Energy  
Aiken, SC  
888-207-2009

# Biofuels

## A unique case for North Carolina

The State of North Carolina has a unique economic opportunity related to the financial viability of ethanol and/or biodiesel production. With the termination of the federal tobacco quota, more farms could now devote their land to growing ethanol and biodiesel feedstocks. Also, North Carolina is second in hog production nationally, producing 16.4 percent of the total production in 2002. Our state ranks third in the nation for poultry and egg production. By strategically locating biofuel production facilities near these com-



plementary industries, the price of fuels would be significantly reduced. Local feed manufacturers will benefit from distillers grains, a waste product of ethanol plants. Waste CO<sub>2</sub> will provide a cooling agent for meat processor's refrigeration needs. The animal wastes from hog and poultry production will provide an energy source for biofuel plants in the form of methane. Methane collected from animal waste can be burned to produce electricity in a micro turbine or hydrogen can be extracted and run through a hydrogen fuel cell.

## Biofuel Incentives

Currently in North Carolina grants exist to offset the added cost of biofuels. These savings are passed on to the consumers who pay lower prices for B20 and ethanol. Because of the grants, biofuels can cost the same as petroleum diesel and gasoline. These awards are part of a \$284,000 Federal Congestion Mitigation Air Quality grant administered by the NC Department of Transportation. The grant was designed to reduce harmful emissions and promote biofuels in North Carolina. The current grant recipients will displace around 200,000 gallons of petroleum diesel. In addition to grants, some bills are being considered that may add incentives to the purchase of an

alternative fuel vehicle. The federal government passed an Energy Bill in July 2004 containing renewable energy language that supports a biodiesel tax incentive. The bill was supported by both North Carolina senators and provides for a 1-cent reduction of the diesel excise tax on biodiesel blended with standard diesel, up to 20 percent. This tax incentive will significantly increase biodiesel demand. The bill also includes a Renewable Fuels Standard which calls for the nation to increase its use of renewable domestic fuels to 5-billion gallons by 2012. Through new legislation, grants, and advocacy, the use of biofuels in North Carolina will increase rapidly, improving air quality.

# Biofuels in North Carolina

## What are Biofuels?

Biofuels are fuels manufactured from natural, renewable resources such as vegetable oils, animal fats, corn starch, recycled cooking grease, and agricultural residues. These fuels are domestically produced and benefit agriculture, as well as local economies. Many biofuels can be used in existing engines and some even help extend engine life. The three most prominent feedstocks currently being utilized for biofuels used in North Carolina are soybeans, corn, and waste vegetable oil.

## Benefits of Biofuels

The use of biofuels substitutes a renewable resource for a finite resource and helps reduce our dependence on foreign oil. Greenhouse gas emissions, like carbon dioxide and certain particulates are also reduced. The production of biofuels in the state will help to divert the approximately \$7 billion currently leaving the state for the purchase of petroleum products and create a new employment sector, indirectly creating thousands of new jobs. (North Carolina State Energy Office)

## Why are Biofuels Important for North Carolina?

Biofuels are clean sources of energy, that have much lower environmental impacts than conventional transportation fuels. Because the citizens of North Carolina are concerned about the environment, biofuels are becoming more accessible throughout the state. Biofuels will never run out, while conventional fuels are finite. Because most of the money spent on domestically produced biofuels goes to materials and workmanship, rather than costly importation, biofuel investments create jobs at home and directly benefit local economies.

Biofuels also create energy security for the citizens of North Carolina. North Carolina's future depends on the use of renewable energies such as these.



# Biodiesel in North Carolina

## What is Biodiesel?



Biodiesel is a naturally oxygenated fuel produced from organic sources such as vegetable oil, used cooking oil, and animal fats. Biodiesel can be used in its pure form (B100) or blended at any ratio with petroleum diesel. It is commonly used as B20, a blend of 20% biodiesel and 80% petroleum diesel.

## What types of vehicles can use Biodiesel?

Biodiesel can be used in any diesel vehicle without modification. Applications include passenger vehicles, buses, delivery trucks, waste disposal, construction and farm equipment, and boats. Currently more than 300 major fleets use this alternative fuel, including many federal and state agencies, and major public utilities. Throughout the nation, more than 25 million gallons of biodiesel are consumed annually. (National Biodiesel Board and DOE EIA)

## Biodiesel Performance

Biodiesel performance is equivalent to that of petroleum diesel, with only a very slight reduction in fuel economy. Biodiesel is a better lubricant than petroleum diesel, extending engine life and increasing time between oil changes. ASTM International issued a final specification for the fuel to insure quality. Consumers should be sure that their biodiesel meets the ASTM D6751 standard.

## Biodiesel Emissions

The use of biodiesel results in significantly lower emissions of carbon monoxide, sulfur dioxide, particulate matter, toxic contaminants, hydrocarbons, and visible smoke and noxious odors. The use of biodiesel can result in a 75% reduction in carbon dioxide emissions.



# National Success Stories

## U.S. Postal Service Trucks



Postal vehicles fueled with E85 have performed well in Florida and other areas of the United States. The USPS purchased 10,000 E85 Ford Explorers that were custom-built with right-hand drive and fitted with the USPS delivery body. Overall, the USPS has purchased more than 23,000 flexible fuel vehicles which run on gasoline or ethanol. (EPA)

## Missouri Department of Transportation



MoDOT began using B20 in approximately 600 diesel vehicles and pieces of diesel equipment in the spring of 2001. Department vehicles now running on biodiesel include motor graders, dump trucks, off-road vehicles, high lifts, pull-behind message boards, and other miscellaneous diesel powered equipment. A mechanical supervisor for MoDOT states, "We like biodiesel because as a fuel it has excellent lubricating qualities, and the emissions are much better than with diesel fuel."

On March 12, 2004, Missouri received \$180,500 from the trade of 200 federal alternative fuel vehicle (AFV) credits earned by the Missouri Department of Transportation (MoDOT). The funds will be used to purchase cleaner-burning biodiesel fuel for MoDOT's equipment and vehicles.

# Biodiesel Production

## North Carolina Success Stories

### B20 Fuel Pumps



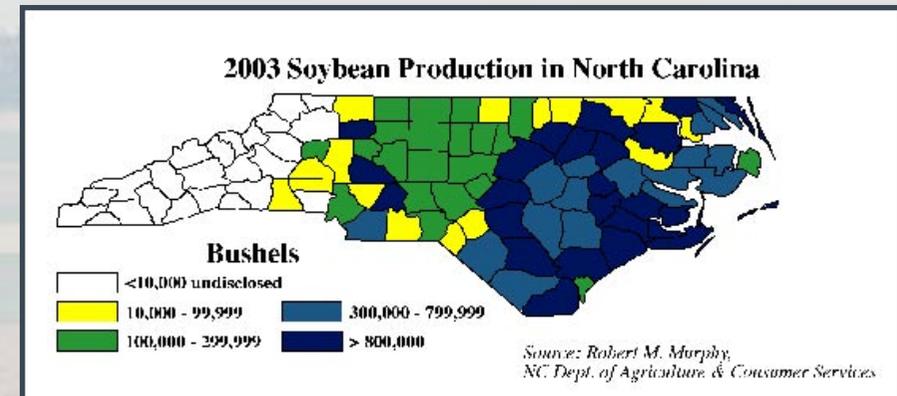
Drivers in Garner NC now have the choice to fill up with B20 at the pump. With the help of a recent grant, the biodiesel blend can be purchased at the same price as petroleum diesel. At the launch event for the pump, Mayor Sam Bridges stated, "Making B20 available is an important step towards solving our air quality problems." Sales have increased 75% at the Garner B20 station since introducing the fuel last year.

### Durham Public Schools



Durham currently runs 284 school buses, plus activity and spare buses on B20. They use 600,000 gallons of B20 annually. Workers have had fewer complaints about buses and fewer breakdowns due to the fueling system. Since the switch, drivers notice a significant reduction in fumes and smoke.

As of April 2005 there were 35 active commercial biodiesel production facilities in the U.S., with approximately 17 more proposed plants in the development or construction phase. Producing soy-based biodiesel is very energy efficient, having an energy ratio of 3.2, as compared to 2.5 for ethanol. For every 1 unit of energy that goes into producing biodiesel, 3.2 units of energy are contained in the fuel. It is estimated that, including existing dedicated biodiesel production capacity and long-term production agreements, more than 200 million gallons of biodiesel capacity currently exists. (National Biodiesel Board and NREL)



### What are the Feedstocks for Biodiesel in NC?

Virgin soybean oil, waste oil, and waste animal fats can all be utilized for biodiesel in North Carolina. Virgin soybean oil has the greatest potential for a feedstock produced in-state. North Carolina produced 42 million bushels of soybeans in 2003. Around 47 million bushels are estimated for 2004 (Robert M. Murphy, NCDACS). Of the total cropland in North Carolina, around 500,000 acres are idled and available for production. In addition to currently idled cropland, reductions in tobacco quotas will lead to additional cropland available for energy crops. This available in-state cropland could help to support a new biofuel production industry, while giving farmers a share in the value-added products.

## Alternative Biodiesel Feedstocks

### Waste Vegetable Oil

Restaurants, hospitals, cafeterias, supermarkets, and some large food processors all produce waste vegetable oil that can be used to manufacture biodiesel. Currently waste oil is picked up at businesses by waste oil renderers. Moisture, solids, and other impurities are removed to create yellow grease. Using data from renderers, estimates for waste oil produced in North Carolina can be made.

Estimated annual waste oil production:

Eastern NC .....	45 mil pounds
Central NC.....	40 mil pounds
Western NC .....	30 mil pounds
<b>Total.....</b>	<b>115 mil pounds</b>

Currently almost all processed “yellow grease” originating in North Carolina is sold to the animal feed industry. The product is utilized as concentrated calories, offsetting the quantity of corn and soybeans used in feed.

### Waste Animal Fats

Waste animal fats can also be utilized for biodiesel production. Currently North Carolina ranks second in the U.S. for hog production and third for poultry and egg production. Currently, the vast majority of fats from these industries are used in animal feed. As with waste vegetable oil, future research may indicate that these resources could be better utilized in the production of biodiesel if viable alternatives are available for the feed industry.



## Emissions

### Biodiesel Emissions

According to the National Renewable Energy Laboratory, emissions characteristics of B20 relative to petroleum diesel are as follows:

- 12.6% reduction in carbon monoxide
- 11% reduction in hydrocarbons
- 18% reduction in particulates
- 1.2% increase in nitrogen oxide
- 12%-20% reduction in air toxins
- 15.7% reduction in carbon dioxide

While studies have indicated a slight increase in nitrogen oxide emissions from biodiesel, other ozone precursors, as well as particulates and air toxins, are greatly reduced. Keith Overcash PE, the director of the North Carolina Department of Environment and Natural Resource’s Division of Air Quality, states that, “When considering the combined benefit of all these reductions, the small increase in nitrogen oxides (NO<sub>x</sub>) should not overshadow the net environmental gain with biodiesel use in North Carolina. Biodiesel is a viable part of the overall effort to improve our air quality.” Solutions to the NO<sub>x</sub> increase already exist and in the future they will eliminate the issue altogether. These solutions include effective additives and improved catalyst technologies.



# Emissions

## Ethanol Emissions

According to the EPA, emissions characteristics of E85 fuel ethanol (85% ethanol, 15% gasoline blend) relative to conventional gasoline are as follows:

- Fewer total toxins are produced
- 15% reduction in ozone forming volatile organic compounds
- 40% reduction in carbon monoxide emissions
- 20% reduction in particulate emissions
- 10% reduction in nitrogen oxide emissions
- 80% reduction in sulfate emissions
- Lower reactivity of hydrocarbon emissions
- Higher ethanol and acetaldehyde emissions

In contrast to fossil fuels, the use of ethanol as a transportation fuel contributes little if any net CO<sub>2</sub> to the earth's atmosphere. This is due to the reduction in tailpipe emissions of CO<sub>2</sub> during the burning of ethanol, and because the plants that serve as feedstocks for ethanol production absorb CO<sub>2</sub> from the atmosphere as needed for their growth. According to the latest figures from Argonne National Laboratory, the use of ethanol fuel blends reduced carbon-dioxide equivalent greenhouse gas emissions by approximately 5.7 million tons in the U.S. in 2003. It is estimated that this reduction is equivalent to removing the annual greenhouse gas emissions of more than 853,000 vehicles from the road. Ethanol and biodiesel don't just affect air quality, they also affect water quality. Because ethanol and biodiesel are not considered toxic pollutants, accidental releases of E100 and B100 are virtually harmless. This makes biofuel safer to transport, store, and dispense.

# Ethanol in North Carolina

## What is Ethanol?

Transportation grade ethanol is essentially denatured grain alcohol. It can be made from corn, potatoes, wood, waste paper, wheat and many other organic materials. More than 90% of U.S. ethanol production comes from corn. Ethanol can be combined with gasoline to produce ethanol blends. The most common blends are E10 (10% ethanol, 90% gasoline) and E85 (85% ethanol, 15% gasoline). (DOE EIA)



## Ethanol Performance

Ethanol is sold nationwide as a high octane transportation fuel that reduces vehicle emissions. Because ethanol is an octane booster, E10 will have a higher octane than regular gasoline. According to the Nebraska Ethanol Board, adding 10 percent ethanol boosts octane from 87 to 89.5. Ethanol also absorbs moisture and helps prevent fuel system freeze-up in cold weather, preventing the need to add expensive and possibly harmful fuel additives. Due to detergent properties, ethanol reduces engine build-up and keeps fuel injection systems clean. (EPA)

## What types of vehicles use Ethanol?

Every auto maker in the United States warrants their vehicles for the use of E10. Auto makers also produce a variety of vehicles known as flexible fuel vehicles (FFV's). These automobiles can operate on any combination of ethanol and gasoline. Ethanol vehicles exhibit the same power, acceleration, payload, and cruise speed as conventionally fueled vehicles. With mass production, manufacturers can offer FFV's at the same price as comparable gasoline vehicles. There are more than 10,000 alternative fuel vehicles currently on the road in North Carolina. With dual-fueled vehicles now available from several major U.S. manufacturers, the number of these vehicles in use in the state is expected to increase at a much greater rate in the near future.

photo courtesy of NREL PIX



### Ethanol Production

As of June 2005, there were 87 operational ethanol production facilities in the U.S., with a total annual capacity of 3.9 billion gallons per year. An additional 18 plants, representing an additional capacity of 952 million gallons were under construction. (Renewable Fuels Association) The increase in domestic production of transportation fuels creates American jobs and provides value-added markets to bolster agriculture and rural America.

### What are the ethanol feedstocks in North Carolina?

Currently, North Carolina's major potential feedstock for the production of ethanol is corn. However, large amounts of timber and agricultural residues exist in the state that could be utilized as feedstocks in the future. Ongoing research is improving the economic viability of these cellulosic feedstocks.

## Emissions

The principle air quality concerns arising from petroleum powered mobile source emissions are ozone, toxic air pollutants, and carbon monoxide. Carbon dioxide is the most prevalent greenhouse gas and the U.S. has the highest CO<sub>2</sub> emissions per capita of any country in the world. About one third of U.S. CO<sub>2</sub> emissions are generated by producing and consuming transportation fuels. The use of fossil fuels for transportation releases tremendous quantities of CO<sub>2</sub> into the atmosphere, greatly offsetting the natural balance of the carbon cycle. Atmospheric CO<sub>2</sub> concentrations have increased by 25% since the beginning of the industrial age, with more than half of this increase occurring in the last three decades. Biofuels provide an alternative to petroleum and decrease these greenhouse gases. (EPA)



### About the 8-Hour Standard

The EPA issued the 8-hour ozone standard in July 1997, based on information demonstrating that the 1-hour standard was inadequate for protecting public health. Scientific information shows that ozone can affect human health at lower levels, and over longer exposure times than one hour. Breathing ozone can irritate air passages, reduce lung function, aggravate asthma, and inflame and damage the cells lining the lungs. It also may aggravate chronic lung diseases like emphysema and bronchitis, may reduce the immune system's ability to fight off bacterial infections in the respiratory system and may cause permanent lung damage. The 8-hour ozone standard is 0.08 parts per million (ppm), averaged over eight hours. The 1-hour standard is 0.12 ppm, measured in hourly readings. (NCDENR, Division of Air Quality)