



Biofuel: A Tankful of Green

More and more East Tennessee drivers are powering their vehicles with renewable biofuel, which can be produced locally, reduce air emissions, and curb our dependence on foreign sources of oil.

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When we discuss biofuels in the US, we're generally talking about **ethanol** and **biodiesel**. Ethanol is the product of fermentation, and biodiesel is chemically converted fat or oil. Almost 100 percent of the ethanol made in the US today comes from corn. Roughly 60 percent of the biodiesel produced here comes from virgin soybean oil; the remaining 40 percent comes mostly from animal fat and used vegetable oils.

It is likely that we will see a transition in the next 20 years to non-food-based resources for most of our biofuel production. Research into the use of renewable resources like cellulosic materials for ethanol (for example, switchgrass, wood chips, and corn stover) and algae for biodiesel is ongoing. The business sector is working to find ways to develop these non-food crops because they see the market potential.

In addition, the federal government has included this transition as a part of the Renewable Fuels Standard (RFS). The aim of RFS is to boost biofuel production in the US to 36 billion gallons by 2022. For comparison, note the following from the US Energy Information Administration: About 3.9 billion gallons of ethanol and 91 million gallons of biodiesel were produced in the United States in 2005. According to estimates based on the number of plants under construction, ethanol production capacity could rise to about 7.5 billion gallons and biodiesel capacity to about 1.1 billion gallons by 2008..." *Source: www.eia.doe.gov/oiaf/analysispaper/biomass.html*. Meeting the RFS would reduce our dependence on petroleum-based fuels while reducing greenhouse gas emissions.

Ethanol

Ethanol is a cleaner-burning, high-octane motor fuel that is produced from renewable sources such as corn. Combining ethanol with unleaded gasoline decreases fuel cost, increases fuel octanering, and decreases harmful emissions. The two common ethanol/gasoline blends are:

E10—10% ethanol and 90% unleaded gasoline

E10 is approved for use in any make or model of vehicle sold in the United States. Many automakers recommend its use because of its high-performance, clean-burning characteristics. Almost half of America's gasoline contains some ethanol, typically as an E10 blend.

It is important to note that it does not take a special vehicle to run on E10. All vehicles can use up to 10 percent ethanol with no modifications to the engine. In 2007 E10 became so commonplace in East Tennessee that approximately 60-80 percent of stations were offering it, and that trend continues in 2008. You can still find stations that don't sell E10, but it's likely that the majority of stations near you carry it. Some stations will put E10 in all of the grades of gasoline they offer, while some stations blend ethanol with their regular and mid-grades fuels but don't add it to premium grade fuel. Pumps dispensing ethanol blends are required to label the pump to clarify their ethanol content.

E85—85% ethanol and 15% unleaded gasoline

E85 is an alternative fuel for use in flexible-fuel vehicles (FFVs). There are almost 7 million FFVs on America's roads, and automakers are rolling out more each year. As more flexible-fuel vehicles hit the roads, more E85 pumps are being installed across the country. However, when E85 is not available, FFVs can operate on straight gasoline or any other ethanol blend, up to 85 percent.

FFVs have been produced since the 1980s. Dozens of models are available, and they look and perform just like the gasoline-only models. Find a listing of the available FFVs models (from 1995 to 2009) here: http://eerc.ra.utk.edu/etcfc/docs/FFVs_1998-2009.pdf.

FFVs experience no loss in performance when operating on E85. However, since a gallon of ethanol contains less energy than a gallon of gasoline, FFVs typically get about 20-25 percent fewer miles per gallon when fueled with E85. Depending on the price of gasoline, it could cost you more to use E85 instead of gasoline (visit this site for a calculator: http://www.eere.energy.gov/afdc/progs/cost_anal.php?0/E85/). However, most station owners realize that increased use of alternative fuels is important and aim to price E85 at roughly 20 percent less than the price of gasoline to offset the difference in miles per gallon. E85 does offer advantages over gasoline: it reduces demand for petroleum-based fuels, produces fewer emissions including greenhouse gas emissions and supports American-made fuels and renewable transportation fuels consumption.

Biodiesel

Biodiesel, which can be made from plant oil or animal fat, is an alternative fuel for diesel engines. Sources of biodiesel include soybean, rapeseed, and palm kernel oils, recycled restaurant cooking oil, and animal fat left over from meat processing.

Biodiesel is blended into diesel fuel in various amounts, but the most common blends are B2 (2% biodiesel, 98% diesel), B5 (5% biodiesel, 95% diesel), and B20 (20% biodiesel,

80% diesel). B100, 100% biodiesel, delivers the highest health and air-quality benefits and is used by some individuals and fleets in the United States.

Any diesel engine can operate on the lower blends (B20 or less) with few or no modifications. Lower blends can also be stored and transported using unmodified diesel tanks and equipment. When used in low-level blends of 5 percent biodiesel or below, biodiesel is transparent to the user. Use of B20 may cause a small increase or decrease in fuel economy. However, power should increase with the use of biodiesel blends because, while petro-diesel has a minimum cetane rating (the measure of combustion quality of diesel fuel) of 40, the ASTM standard minimum cetane rating for B100 is 47. Some B100s have cetane ratings in the 60s.

Biodiesel is a cleaner fuel than petroleum diesel. Diesel pollution is a serious health threat that has been linked to lung cancer, upper respiratory illnesses, allergies, asthma attacks, and death from heart and respiratory disorders. Emissions from diesel-fueled engines include more than 40 air toxins. For information on biodiesel emissions, visit: http://www.biodiesel.org/pdf_files/fuefactsheets/emissions.pdf.

Why Should You Consider Using Biofuels?

To enhance national security. In 2007, roughly half of our oil imports came from OPEC countries, and more than 60 percent of our current petroleum supply comes from outside the United States.

To diversify our mix of transportation fuels. Petroleum is a finite resource that will eventually be depleted. It is widely agreed that world oil production will peak in the next 10-30 years. Subsequent declines in supply will have significant impacts on the United States, which currently produces only 2 percent but consumes over 25 percent of the world's oil. Clearly, now is the time for the United States to begin to diversify its mix of transportation fuels and shift to increased use of renewable biodiesel and ethanol.

To protect the environment and human health. Use of biofuels can substantially reduce emissions of carbon dioxide (CO₂), the primary cause of global warming. Biofuels release fewer emissions when burned than petroleum products, and most biofuel comes from plants, which convert carbon dioxide into oxygen as they grow.

Unlike petroleum-based diesel, pure biodiesel is safe to handle because it is biodegradable and non-toxic. According to the National Biodiesel Board, "neat biodiesel is as biodegradable as sugar and less toxic than salt." If a tanker truck full of pure biodiesel flips over on the interstate, there is no need to call HazMat. The fuel is not regarded as a contaminant.

To increase efficiency over the entire fuel cycle. The Fossil Energy Ratio (FER) compares how much fossil energy is required to produce a fuel with how much fuel results from the process. The life-cycle of a fuel begins with extracting the fuel from the ground or, in the

case of biofuels, planting the crops (both of which require fossil energy) and ends at the pump where the fuel is dispensed into a vehicle.

For every unit of fossil energy that is put into the life-cycle of extracting or growing, processing, and transporting a fuel, the following is produced in units of fuel:

- gas or diesel 0.85
- corn-based ethanol 1.4
- soybean-based biodiesel 3.5
- sugarcane-based ethanol 8
- cellulosic ethanol 2-36

Note that the petroleum fuels fall below a 1:1 ratio. That is largely because petroleum is the raw material input—in other words, we use petroleum to produce petroleum. All the other fuel sources produce more energy for every unit of oil or other fossil inputs that we use to make them.

The Biofuel Fleet

In East Tennessee, the owners of more and more fleets of diesel vehicles are switching to biodiesel. Municipalities across East Tennessee—among them, Chattanooga, Knoxville, Johnson City, Maryville, Kingsport, Athens, and Oak Ridge—are now using biodiesel blends in more than 1,000 vehicles collectively. Both Alcoa and Eastman use B20 in their diesel equipment. Combined, these fleets total roughly 800 to 900 vehicles. Eastman also uses biodiesel in the locomotives that transport materials around its site.

You can join East Tennessee's growing biofuel fleet by fueling your vehicle with E10 or a biodiesel blend or by making your next vehicle purchase a flex-fuel car or truck.

If you have questions or want to join in a discussion on alternative fuel use, contact the **East Tennessee Clean Fuels Coalition** at (865) 974-3625 or ***www.ETCleanFuels.org***.