

BIOFUELS: ETHANOL



In cooperation with the US
Department of Energy



Biomass energy converted into liquid fuels is sometimes called *biofuels*. Two examples of biofuels are Ethanol and Renewable Diesel.¹ **Fuel ethanol** is regularly made in the United States by a process called fermentation, where single-cell plants (usually yeast) digest and convert sugar derived from plants into ethanol.

Ethanol can be made from biomass materials containing sugars, starches, or cellulose (starch and cellulose are more complex forms of sugar). Examples of cellulose are corn stalks, trees and grasses. Although pilot plants and a few government-subsidized plants exist, currently there are no commercial plants producing ethanol from cellulose. Further research is being conducted to improve the economic viability of converting cellulose materials into ethanol.

About 95 percent of all fuel ethanol made in the US and Canada is made from the starch contained in corn grain. The remaining fuel ethanol is produced from other grains, waste potatoes, cheese whey, and beverage wastes. Cheese whey and beverage wastes (from production upsets or out-of-date beverages) are examples of biomass materials that are primarily sugar. Grains and root crops like sweet potatoes are examples of starch-containing materials.



Some corn is grown in the Southeast and a large amount of corn grain is imported into the region for livestock feed. Since it will ultimately be used for livestock feed, much of this corn could be processed into ethanol first and the distillers grains coproducts fed to livestock. Some other potential biomass materials that could be used for ethanol production in the Southeast include beverage wastes, sweet potatoes, sweet sorghum, citrus processing wastes, sugar beets, and sugarcane. The potential ethanol yield per acre for some of these materials—such as sweet potatoes and sugarcane—can exceed that of corn.

In the Southeast, corn grain-based ethanol plants are operating in Tennessee, Kentucky, and Missouri, with plants planned or under construction in Mississippi and North Carolina. Kentucky has a production facility that produces fuel ethanol from beverage wastes.

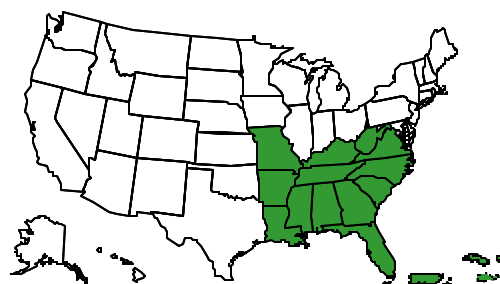
Ethanol production. Carbon dioxide is generated during the fermentation process and can be a valuable co-product. Additionally, when corn is processed into ethanol, only the carbohydrate portion is used. The protein, in the form of distillers wet grains (DWG, or if dried—distillers dried grains, or DDG) is a valuable co-product which can be used for livestock feed (distillers grains works best as feed for dairy cows and beef cattle, although it can be used for swine and poultry feeds).

Ethanol uses and markets. In addition to being renewable, ethanol has a major advantage in that it can be easily blended with gasoline. In fact, ethanol was one of the first fuels used in internal combustion

¹ Ethanol can also be made from petroleum; however, it is more commonly made from biomass.

engines. Ethanol has advantages as a motor fuel because it is clean burning and readily mixes with gasoline. Unlike gasoline, ethanol is nontoxic (safe to handle) and biodegradable, it quickly breaks down into harmless substances if spilled. When small amounts of ethanol are added to gasoline, usually less than 10 percent, there are many advantages. Ethanol reduces carbon monoxide and other toxic pollution from the tailpipes of vehicles, making the air cleaner. It keeps engines running smoothly without the need for lead or other octane enhancers (chemical additives), such as MTBE. Because ethanol is made from crops that absorb carbon dioxide and give off oxygen, it helps reduce greenhouse gas emissions. This carbon cycle maintains the balance of carbon dioxide in the atmosphere when using ethanol as a fuel.

Ethanol is added to gasoline as an octane enhancer, or to improve the emissions from gasoline, or simply as a substitute for gasoline. If it is blended at the rate of 10% ethanol to 90% gasoline, it is called **E10**. E10 can be used in all gasoline-fueled vehicles without any special engine modifications. Some states, like Minnesota, promote more widespread use of E10 through state-imposed mandates.



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E85, which is a mixture of 85% ethanol and 15% gasoline, can be used in special vehicles called Flexible **Fuel Vehicles (FFVs)**. Flexible Fuel Vehicles can use any mixture of ethanol and gasoline up to E85. Examples of FFVs are the Ford Taurus, Ford Ranger² pickup truck, the Chevrolet S-10, and Chrysler's Voyager minivan (for a full listing of vehicles contact the National Ethanol Vehicle Coalition at www.e85fuel.com). Because E85 cannot be used in all vehicles, it is mainly used in fleets of vehicles, which use centralized refueling stations. Vehicles are not modified to run on E85; they are specially manufactured as flexible fuel vehicles (FFV). There are about 146,000 cars and trucks using E85 (As of the end of production of Model Year 2005, there are approximately 4.5 million E85 compatible vehicles on the road according to NEVC). Almost half of these are private vehicles; the rest are fleet vehicles.

A special diesel-fuel mixture of 15% ethanol and 85% **diesel fuel (E15)**, made with the help of an additive, can be used to fuel diesel engines.

For additional information on ethanol production, markets, and incentives contact the Renewable Fuels Association, One Massachusetts Ave., NW, Suite 820, Washington DC 20001, phone (202)289-3835, fax (202)289-7519, e-mail info@ethanolrfa.org, and website www.ethanolrfa.org.

This series of fact sheets was prepared by the Southeast Biomass State and Regional Partnership (formerly the Southeastern Regional Biomass Energy Program). The Partnership is one of five regional administrations of the U.S. Department of Energy's (DOE) National Biomass State and Regional Partnership. The Partnership was established in 2003, and is managed for DOE by the Southern States Energy Board. The goal of this Partnership is to work cooperatively with the DOE Office of Biomass Programs (OBP) to facilitate the increased use of bioenergy and biobased products through coordinated federal, regional, and state outreach, education and technical assistance programs.

Partnership Project Staff

Kathy Baskin, Project Manager	Phillip Badger, Technical Mgr
Southern States Energy Board	General Bioenergy, Inc.
6325 Amherst Court	3115 Northington Court
Norcross, GA 30092	Florence, AL 35630
(770) 242-7712	(256) 740-5634
(770) 242-9956 fax	(256) 740-5635
baskin@sseb.org	pbadger@bioenergyupdate.com

² Trade names are used for illustrative purposes only and do not constitute a direct or implied endorsement, nor does lack of mention constitute a lack of endorsement.