

Ethanol

Ethanol is grain alcohol (booze). It is produced when yeast ferments sugar. In order to produce much ethanol, you need a biological product high in sugar: grains, fruits, sugarcane and sugar beets are traditional choices. However, plants high in starches, including cellulose, could also be used if a method could be found to efficiently convert the starch to sugar.

Brazil uses sugarcane, deriving about 20% of their energy from ethanol in 2002.ⁱ In the U.S., corn is the plant most often used. Corn is lower in sugar than sugarcane, producing ethanol less efficiently: it requires cooking in the presence of an enzyme.ⁱ The manufacture of ethanol has a number of steps: farming the crops, transporting the crops to the manufacturing plant, manufacturing the ethanol, and transporting the finished ethanol to fueling stations. Each step consumes energy. Sources agree that sugarcane has a significant positive net energy yield, but there has been controversy regarding whether corn ethanol does. If it does, the net return is low compared to gasoline.ⁱⁱ

Ethanol fuel (E85) burns cleaner than gasoline. It emits about the same amount of CO₂. Since the CO₂ was captured from the atmosphere when the corn was grown, however, it is considered a carbon neutral fuel. (The CO₂ in gasoline was captured millions of years ago and stored underground ever since.) Ethanol works well in cars, but contains less energy than does gasoline (fewer miles per gallon). High concentrations of ethanol (higher than 10% or E10) dissolve low and medium grades of rubber and plastic, which are commonly used in fuel systems, tanks, and pipelines. Thus, ethanol requires special infrastructure (called *flex-fuel*). It is not a technical challenge, but it is a big, expensive retrofit.ⁱⁱⁱ

In gasohol, ethanol is added to gasoline (10% ethanol, or E10) to prevent engine knock at high compression (increase octane), and reduce tailpipe emissions (carbon monoxide). It is highly effective in this use, which accounts for most of the ethanol use in the U.S.ⁱⁱⁱ

Manufacturing ethanol uses water, as much as 350 million gallons per year for large plants, which are sometimes located in areas where water is not plentiful. They can put stress on rural water systems and aquifers.^{iv} Manufacturing also creates pollution in the form of carbon monoxide and volatile organic compounds (carcinogens). I did not find literature comparing pollution between ethanol production and gasoline refining.

An acre of corn yields about 429 gallons of ethanol.^v In 2004, Missouri consumed about 77 million barrels of gasoline.^{vi} To grow corn for an equivalent amount of E85 ethanol would require an area over 1/6 the size of the entire State of Missouri.

Using corn to produce ethanol has the effect of converting farm production from food to fuel. It is likely that food pricing and availability may be affected. In 2007, a 60% increase in corn prices was attributed to ethanol.^{vii} Similarly, the USDA collects surplus food and distributes it to food pantries. But the surplus is down, thus, USDA distributions are down, and the shelves of food pantries are bare.^{viii} We don't know if the decline is the result of ethanol production, but it is the kinds of effect one would expect to occur.

ⁱ Nersesian, Roy. (2007). *Energy for the 21st Century*. Armonk, NY: M.E. Sharpe.

ⁱⁱ For instance, one source concluded that corn ethanol yields almost 25% more energy than it takes to make it. See Shapouri, H., Duffield, J. & Graboski, J. *Estimating the net energy balance of corn ethanol*. Agricultural Economics Report No. AER721. Available at <http://www.ers.usda.gov/Publications/AER721/>. But another researcher concluded that corn ethanol required 29% more energy to make than it yielded. See Pimentel D, Patzek TW (2005). *Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower*. *Natural Resources Research* 14 (1): 65-76. doi:10.1007/s11053-005-4679-8.

ⁱⁱⁱ *Low-level ethanol fuel blends*. Energy efficiency and renewable energy fact sheet, Department of Energy. Viewed online 12/4/2007 at http://www.eere.energy.gov/afdc/fuels/ethanol_blends.html.

^{iv} Kenney, Dennis, & Muller, Mark. (2006). *Water use by ethanol plants: Meeting the challenges*. Institute for Agriculture and Trade Policy. Downloaded 12/4/2007 from www.iatp.org/iatp/publications.cfm?accountID=258&refID=89449.

^v Biofuel conversion factors. Addendum to *FAPRI ethanol briefing materials for Congressman Peterson*, Food and Agriculture Policy Research Institute, University of Missouri. Downloaded 12/4/2007 from http://www.fapri.missouri.edu/outreach/publications/umc.asp?current_page=outreach.

^{vi} Energy Information Administration, U.S. Department of Energy.

^{vii} For instance, see Sauser, Brittany, (2/13/2007) Ethanol demand threatens food prices. *Technology Review*. Viewed online 12/5/2007 at <http://www.technologyreview.com/Energy/18173>.

^{viii} Gustin, Georgina. (12/5/2007). The pantries are bare. *St. Louis Post-Dispatch*. Viewed online 12/5/2007 at <http://www.stltoday.com/stltoday/news/stories.nsf/stlouiscitycounty/story/9393DF315E7730B6862573A80013E711?OpenDocument>.