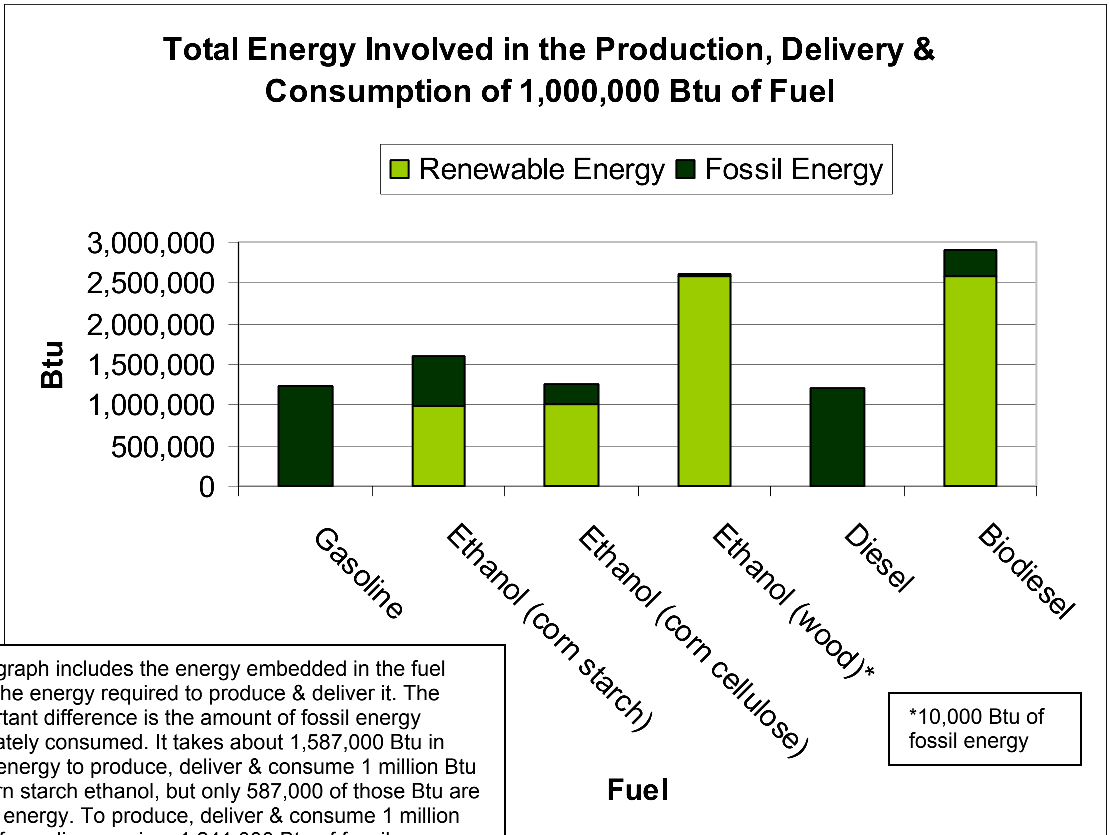
Energy Balance of Biofuels:
It's the Fossil Energy that Matters



This graph includes the energy embedded in the fuel plus the energy required to produce & deliver it. The important difference is the amount of fossil energy ultimately consumed. It takes about 1,587,000 Btu in total energy to produce, deliver & consume 1 million Btu of corn starch ethanol, but only 587,000 of those Btu are fossil energy. To produce, deliver & consume 1 million Btu of gasoline requires 1,241,000 Btu of fossil energy – more than *double* the amount required for corn starch ethanol. (Sources on back.)

There is an important difference between biofuels and petroleum fuels. The Btus in biomass feedstocks for ethanol and biodiesel are renewable, unlike the Btus in crude oil. The calculation of efficiency based on total energy input is therefore less meaningful for renewable fuels. A better indicator of the energy balance for biofuels is the ratio between the energy content of the fuel and the fossil energy ultimately consumed.

When you burn gasoline in your car, you consume the fossil energy required to produce and distribute the gasoline plus the fossil energy contained in the crude oil from which the gasoline was made. Production and distribution of ethanol made from corn starch requires more fossil energy than production and distribution of gasoline. However, when you burn a gallon of ethanol in your car, your consumption of fossil energy is only the fossil energy used in production and distribution. The feedstock is renewable biomass, not crude oil. Fossil energy use decreases when ethanol is produced from corn cellulose, and decreases even more when ethanol is produced from woody biomass.

Likewise, when you burn biodiesel in your car, your consumption of fossil energy is *only* the fossil energy used in production and distribution.

With renewable biofuels, you get more fuel energy in your tank than the amount of fossil energy used to get it there.

Sources

The ethanol figures are from *Well-to-Wheel Energy Use and Greenhouse Gas Emissions of Advanced Fuel/Vehicle Systems – North American Analysis* by the Center for Transportation Research, Argonne National Laboratory, June 2001. Total energy calculation for gasoline includes recovering crude oil from the well, transporting the crude to a refinery, refining crude oil to gasoline and finally transporting the gasoline to a service station (the energy expended in exploration for crude oil is not included). Total energy calculation for corn-based ethanol includes energy consumed in the production and transportation of fertilizer and other agri-chemicals, farming corn, transportation of corn to the ethanol production facility, production of ethanol and transportation of the fuel to a fueling station. For ethanol produced from woody biomass, lignin – one of the byproducts of ethanol – can be used as a fuel in the conversion process, displacing the use of fossil energy. A number of other studies confirm that ethanol yields a net positive energy balance, including studies by the Massachusetts Institute of Technology, U.S. Department of Agriculture, Pew Center for Global Climate Change, Institute for Local Self Reliance, California Energy Commission, and the US Department of Energy.

The biodiesel figures are from *Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus* by the U.S. Department of Agriculture and the U.S. Department of Energy, May 1998. The Btus in the chart are converted from MegaJoules in the study. This lifecycle analysis is similar, but not entirely identical, to the Argonne study on ethanol. For illustrative purposes, we feel comfortable showing the conclusions of both studies in one graph.

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