



Biofuels & Greenhouse Gas Emissions: Myths versus Facts

The U.S. Department of Energy (DOE) is committed to advancing technological solutions to promote and increase the use of clean, abundant, affordable, and domestically- and sustainably-produced biofuels to diversify our nation's energy sources, reduce greenhouse gas emissions, and reduce our dependence on oil.

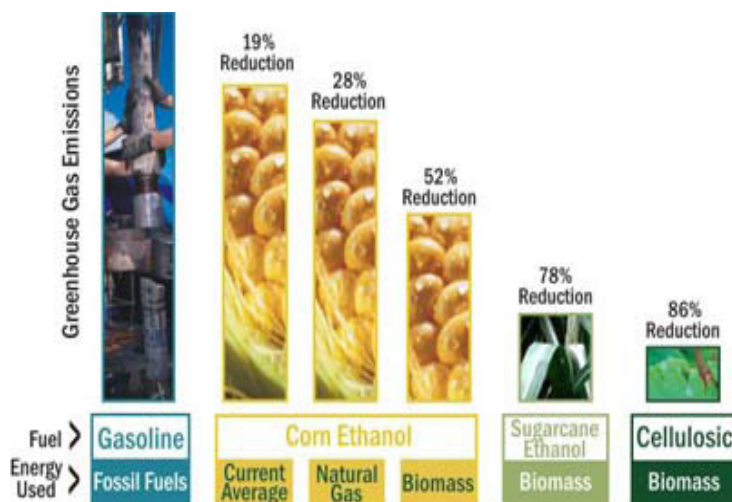
U.S. Energy consumption is expected to grow over 18 percent by 2030. Biofuels must continue to play a significant role as we work aggressively to diversify our nation's energy sources and provide a balanced portfolio of energy solutions to help meet our growing demand for energy.

Since 2007, DOE has announced over \$1 billion in multi-year biofuels research and development projects. Integral to this work is the ongoing examination of reducing greenhouse gases as well as land and water use.

MYTH: In terms of emissions, ethanol pollutes the same as gasoline or more.

FACT: Ethanol results in fewer greenhouse gas (GHG) emissions than gasoline and is fully biodegradable, unlike some fuel additives.

- Today, on a life cycle basis, ethanol produced from corn results in about 20 percent fewer GHG emissions relative to gasoline. With improved efficiency and use of renewable energy, this reduction could reach 52 percent.
- In the future, ethanol produced from cellulose has the potential to cut life cycle GHG emissions by up to 86 percent relative to gasoline.
- Ethanol-blended fuels currently in the market – whether E10 or E85 – meet stringent tailpipe emission standards.
- Ethanol readily biodegrades without harm to the environment, and is a safe, high-performance replacement for fuel additives such as MTBE.



Source: Wang et al, *Environmental Research Letters*, Vol. 2, 024001, May 22, 2007

In comparison to gasoline, ethanol made from cellulose and produced with power generated from biomass byproducts can result in an 86 percent reduction in greenhouse gas emissions.

MYTH: Ethanol cannot be produced from corn in large enough quantities to make a real difference without disrupting food and feed supplies.

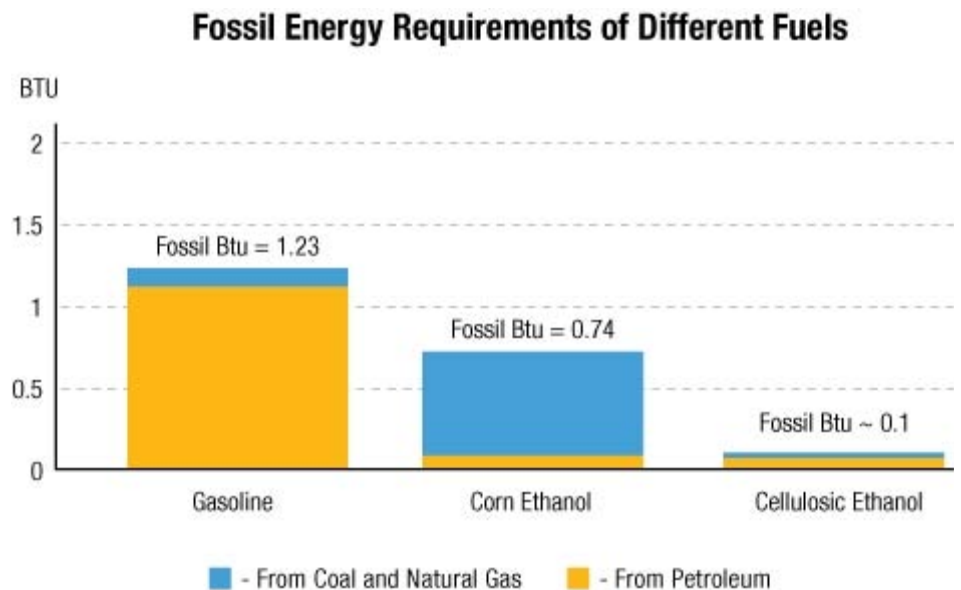
FACT: Corn is only one source of ethanol. As we develop new, cost-effective methods for producing biofuels, a significant amount of ethanol will be made from more abundant cellulosic biomass sources.

- Future ethanol will be produced increasingly from cellulose found in crop residues (e.g., stalks, hulls), forestry residues (e.g., forest thinning, wood byproducts), energy crops (e.g., switchgrass, sorghum), and sorted municipal wastes. Some promising energy crops grow on marginal soils not suited for traditional agriculture.
- A high-protein animal feed, known as Distiller's Dried Grains with Solubles (DDGS), is produced in the process of making ethanol from corn.
- The *Energy Independence and Security Act of 2007 (EISA)* requires use of 36 billion gallons of renewable transportation fuels in the U.S. by 2022. Of that quantity, 16 billion gallons must be cellulosic biofuels. Ethanol from corn is capped at 15 billion gallons.
- The U.S. Departments of Energy and Agriculture's *Billion Ton Study* found that we can grow adequate biomass feedstocks to displace approximately 30 percent of current gasoline consumption by 2030 on a sustainable basis – with only modest changes in land use. It determined that 1.3 billion tons of U.S. biomass feedstock is potentially available for the production of biofuels – more than enough biomass to meet the new renewable fuel standard mandated by EISA.

MYTH: More energy goes into producing ethanol than it delivers as a fuel.

FACT: In terms of fossil energy, each gallon of ethanol produced from corn today delivers one third or more energy than is used to produce it.

- Ethanol has a positive energy balance – that is, the energy content of ethanol is greater than the fossil energy used to produce it – and this balance is constantly improving with new technologies.
- Over the last 20 years, the amount of energy needed to produce ethanol from corn has significantly decreased because of improved farming techniques, more efficient use of fertilizers and pesticides, higher-yielding crops, and more energy-efficient conversion technology.
- Most studies that claim a negative energy balance for ethanol fail to take into account the energy contained in the co-products.

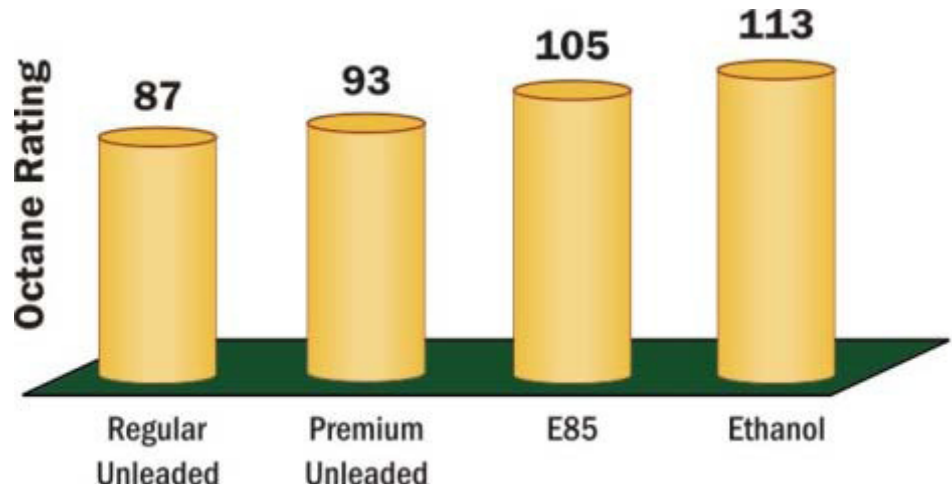


This graph shows how much fossil energy is required to provide 1 BTU of each fuel at the pump. The graph does not reflect energy derived from solar or other renewable sources used in the production of ethanol.

MYTH: Ethanol-gasoline blends can lower fuel economy and may harm your engine.

FACT: Ethanol blends in use today have little impact on fuel economy or vehicle performance.

- While ethanol delivers less energy than gasoline on a gallon-for-gallon basis, today's vehicles are designed to run on gasoline blended with small amounts of ethanol (10 percent or less) with no perceptible effect on fuel economy.
- Flex-fuel vehicles designed to run on higher ethanol blends (E85 or 85 percent ethanol) do experience reduced miles per gallon, but show a significant gain in horsepower.



Race cars in the Indy Racing League take advantage of the high-performance benefits of 100 percent ethanol.

- As a high-octane fuel additive and substitute for MTBE, ethanol enhances engine performance and adds oxygen to meet requirements for reformulated gasoline.

MYTH: Rainforests will be destroyed to create the new croplands required to meet food, feed, and biofuels needs, thus accelerating climate change and destroying valuable ecosystems.

FACT: Biofuels have the potential to significantly reduce global GHG emissions associated with transportation, but—as with all types of development—controls are needed to protect ecologically important lands.

- In Brazil and elsewhere, laws have already slowed deforestation, and for the past decade China has converted marginal croplands to grassland and forests to control erosion.
- Links between U.S. ethanol production and land use changes elsewhere are uncertain. We cannot simply assume that increases in U.S. ethanol production will lead to increased crop production abroad. Since 2002, during the greatest period of ethanol growth, U.S. corn exports increased by 60 percent and exports of Distiller's Dried Grains (DDGs) also increased steadily. In part, improvements in U.S. corn yield (about 1.6 percent annually since 1980) have enabled simultaneous growth in corn and ethanol production.
- Greenhouse gas emissions will decrease dramatically as biofuels of the future are increasingly made from cellulosic feedstocks and as the associated farming, harvesting, transport, and production processes increasingly use clean, renewable energy sources.

As part of President Bush's Advanced Energy Initiative, the U.S. Department of Energy is carrying out a comprehensive plan to increase energy efficiency as well as the use of renewable fuels in the transportation sector. This includes basic and applied research and development projects with a broad range of technology demonstrations to help rapidly bring online next-generation biofuels.

For more information on the Department's work to increase the use of biofuels, visit:
<http://www.eere.energy.gov>.