Ethanol: Separating Fact from Fiction

When energy prices soared during the 1970s, most Americans recognized the inherent danger in the country's dependence on imported petroleum. Despite current complacency, the potential economic and national security threats have not diminished. In 1995 the United States exceeded the level of imported petroleum it reached during the 1970s.[1] Today, in fact, more than half the petroleum-based energy used by our industries and automobiles is imported.

The 1970s provided an economic wake-up call, but the ensuing 20 years brought another important issue to the energy debate. Engine emissions contain a host of pollutants that adversely affect the air we breathe and contribute to increasing levels of carbon dioxide in our atmosphere.

Warren Gretz, NREL/PIX02466

Ethanol
facts at a glance

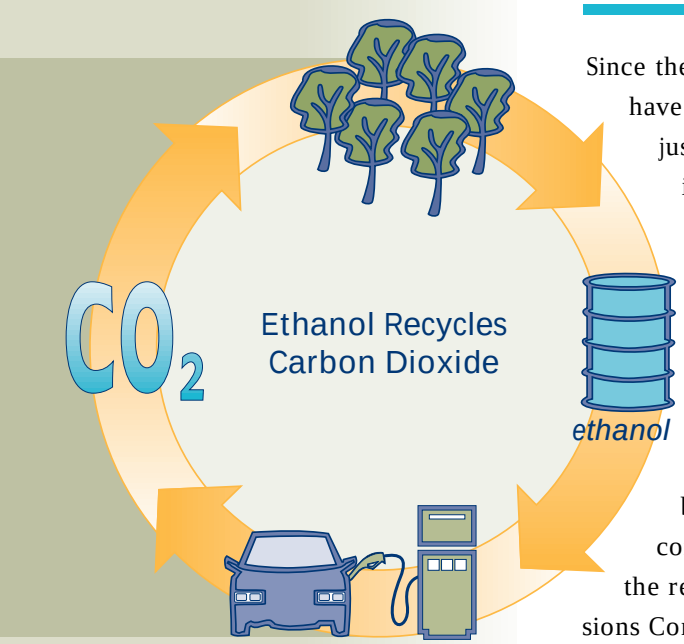
- Reduced engine emissions
- Proven engine performance
- Economic stimulation
- Made from a variety of renewable materials
- Positive energy balance

In the search for solutions, renewable fuels quickly emerged as desirable alternatives to petroleum products. One of those renewables is ethanol, which directly displaces imported oil, greatly reduces tailpipe emissions of some of the most dangerous pollutants, and helps bolster the agricultural economy.

Currently, most ethanol is derived from field corn. New techniques developed by researchers show that ethanol can also be produced from other "biomass" sources such as corn stover, pulpwood, rice straw, switchgrass, food processing waste, and even municipal solid waste.[2]

Despite the positive aspects of ethanol's use as a transportation fuel, many misconceptions concerning its performance and production persist.

Ethanol



Ethanol consumption of 4 billion *gallons annually would* eliminate *about* 26 million *metric tons of* carbon dioxide *emissions.*

Fiction: Ethanol does not benefit the environment

Fact: Ethanol significantly reduces engine emissions that endanger the environment

Since the beginning of the Industrial Age, atmospheric levels of carbon dioxide have increased 25%—and more than half of that increase has come during just the past 30 years. In the United States, about one-third of carbon dioxide emissions result directly from producing and consuming transportation fuels.[3] Ethanol can provide a clean solution on two levels.

First, plants grown for ethanol production absorb carbon dioxide during growth, which reduces atmospheric levels of this greenhouse gas. If 4 billion gallons of ethanol were consumed annually, about 26 million metric tons of carbon dioxide emissions would be eliminated.[4]

Second, ethanol reduces the carbon monoxide produced by combusting gasoline. As an oxygenate, ethanol stimulates more complete combustion, reducing the amount of carbon monoxide that is formed. And the reductions are significant. Tests at the National Center for Vehicle Emissions Control and Safety at Colorado State University document a 25% to 30% reduction in carbon monoxide emissions when automobiles burn a 10% blend of ethanol. EPA figures reveal similar results. In 1992, 21 new oxygenated fuel program areas—implemented nationwide—experienced a 95% reduction in carbon monoxide violations.[5]

Oak Ridge National Lab/PIX01749; Warren Gretz, NREL/PIX00259

National Fuels Corporation/PIX05137

A 10% blend *of ethanol* raises *the octane rating of gasoline by* 2.5 points.

Fiction: Ethanol does not perform well in conventional vehicles

Fact: Ethanol is a proven performer in internal combustion engines

Ethanol blends have been approved for use by every automobile manufacturer that does business in the United States. A primary advantage of ethanol for engine performance is octane enhancement: a 10% blend of ethanol in gasoline raises the octane number by 2.5 points.

Years ago, when ethanol blends were first marketed, fuel line freeze-up became a problem because water in underground storage tanks "attached" itself to the fuel alcohol. The gasoline industry has eliminated water from storage tanks, thus overcoming this problem. Now the use of ethanol is advantageous because it will stop small amounts of water from collecting in an automobile's fuel system.

Some critics say that ethanol contains less energy per unit volume than unblended gasoline. This is true—a 10% ethanol blend minimally reduces miles per gallon compared to pure gasoline. To overcome this deficiency, engines are being designed that take advantage of the high-octane benefits of ethanol while increasing fuel efficiency.

Fiction: The ethanol industry has been subsidized long enough

Fact: Government stimulus—in the form of tax incentives—is a positive investment in America's energy needs

Today, 40,000 jobs *contribute over* $1 billion *in household income. Potentially, an additional* 108,000 jobs *would increase farm income by* $1 billion.

With gasoline prices at a historic low, ethanol production tax incentives are critical to allow for market penetration. At the federal level, tax incentives reduce the cost of ethanol blends by around 50 cents per gallon. Congress recently extended these incentives through the year 2007. Although in the past large corporations dominated the ethanol market, today more than 50 production facilities comprise corporate entities, farmer-owned cooperatives, and private ventures. These facilities account for more than 40,000 jobs and contribute more than $1 billion in household income. According to the U.S. Department of Agriculture (USDA), if ethanol production reached 5 billion gallons annually, farm income would increase $1 billion. In addition, as many as 108,000 jobs would be created, primarily in rural areas of our country.[6]

Many state governments realize the potential for rural development embodied by the industry. For the top 10 corn growing states, USDA estimates a $464.8 million increase in tax receipts resulting from ethanol production. Presently, 16 states have their own incentives, ranging from direct subsidies to tax incentives.[7]

Fiction: Ethanol is made only from food crops such as corn

Fact: Food crops and nonfood crops play an important role in ethanol production

The amount of corn used each year to produce ethanol represents only about 5% to 7% of current annual production. After the corn is used to produce ethanol, the by-products of this process are a major source of animal feed.

As the ethanol industry continues to grow, the use of waste products and alternative crops will expand. Already, agricultural crops such as sorghum and food processing waste materials are used to produce ethanol. And new research is proving that biomass products such as pulpwood, rice straw, switchgrass, corn stover, and municipal solid wastes, will be used for ethanol feedstocks.

Research is proving that a variety of nonfood products *will be used to produce ethanol.*

Switchgrass

Hybrid cottonwood

Municipal solid waste

Corn stover

Warren Gretz (all), NREL/PIX00305, 00241, 00332, 04391

Ethanol

Fiction: The ethanol fuel cycle yields a negative energy balance

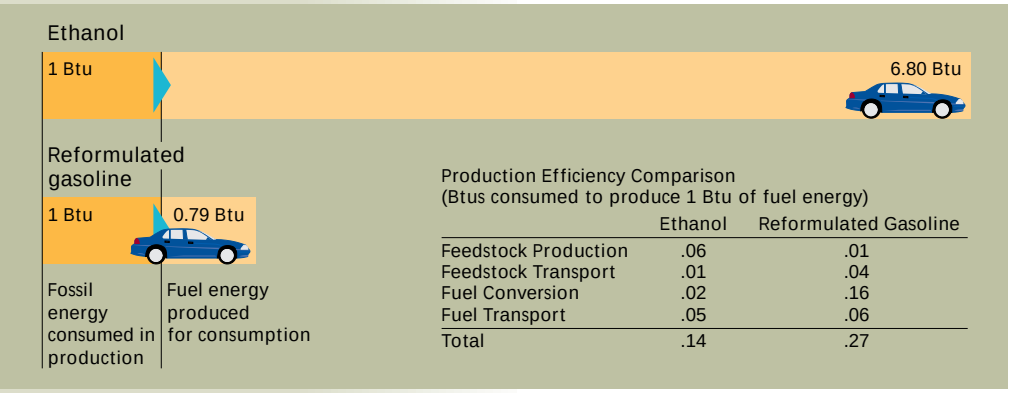
Fact: Ethanol is a renewable resource that yields a positive energy balance

Whether it is produced from corn or other biomass feedstocks, the ethanol fuel cycle generates more energy than it consumes.

Compared with just 10 years ago, the efficiency of producing ethanol from corn has improved tremendously. Several factors contribute to this, including higher yielding corn varieties, efficient production and use of fertilizers and pesticides, and rapid advances in fuel conversion technologies.

A recent economic analysis that examined all phases of ethanol production concluded that ethanol made from corn outperformed gasoline by using less energy and producing fewer greenhouse gases.[8] When other biomass feedstocks are considered—such as hybrid poplars and switchgrass, which require little energy to produce and harvest—the energy savings are even greater. Because biomass utilization requires fewer production inputs and yields energy by-products to help fuel ethanol production, ethanol made from biomass feedstocks yields much more energy. According to a fuel cycle evaluation conducted by the U.S. Department of Energy, the fuel cycle of ethanol produced from biomass feedstocks generates 6.8 Btu for every Btu of fossil energy consumed. The production of reformulated gasoline, which is used in many urban areas of our country, generates only 0.79 Btu of fuel energy for every Btu of fossil energy consumed.[9]

Ethanol from biomass feedstocks *yields* much more energy *than reformulated gasoline.*



Production Efficiency Comparison
(Btus consumed to produce 1 Btu of fuel energy)

	Ethanol	Reformulated Gasoline
Feedstock Production	.06	.01
Feedstock Transport	.01	.04
Fuel Conversion	.02	.16
Fuel Transport	.05	.06
Total	.14	.27

Once the facts are revealed, it becomes clear that using and producing ethanol for transportation is good for our country's economy, environment, and energy future.

Produced for the U.S. Department of Energy (DOE) by the National Renewable Energy Laboratory, a DOE national laboratory.

DOE/GO-10099-736
April 1999

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 20% postconsumer waste

[1] U.S. Department of Energy Biofuels Program, paper presented to the President's Committee of Advisors on Science and Technology, June 12, 1997.

[2] "The American Farm," produced for the U.S. Department of Energy by the National Renewable Energy Laboratory, March 1994.

[3] "Biofuels for the Global Environment," National Renewable Energy Laboratory, November 1997.

[4] U.S. Department of Energy Biofuels Program, paper presented to the President's Committee of Advisors on Science and Technology, June 12, 1997. Conversion from carbon equivalent to carbon dioxide: National Renewable Energy Laboratory. (Also see footnote 3).

[5] U.S. Environmental Protection Agency, Oxygenated Fuels Program.

[6] "Ethanol and Agriculture: Effect of Increased Production on Crop and Livestock Sectors" (ERS-AER-667) and "Ethanol Production and Employment" (ERS-AIB-678), USDA-ERS.

[7] "Clean Fuels," Clean Fuels Development Coalition, in cooperation with the Governors' Ethanol Commission and the U.S. Department of Energy.

[8] "Fuel-Cycle Fossil Energy Use and Greenhouse Gas Emissions of Fuel Ethanol Produced from U.S. Midwest Corn," Center for Transportation Research, Argonne National Laboratory, December 1997.

[9] "Fuel Cycle Evaluation of Biomass-Ethanol and Reformulated Gasoline," Biofuels Systems Division, U.S. Department of Energy, July 1994.