



American Coalition for Ethanol – www.ethanol.org

ETHANOL 101: Frequently Asked Questions

ETHANOL DEFINED

What is ethanol?

Ethanol is ethyl alcohol, essentially 200-proof grain alcohol. An ethanol production facility, a “plant” or “biorefinery,” produces pure fuel-grade ethanol, and then that ethanol is blended in a percentage with gasoline to create a finished motor fuel. A small amount of gasoline is blended into the ethanol at the plant to denature it, or make it unfit for human consumption.

ETHANOL-BLENDED FUELS

What kinds of ethanol-blended fuels are available?

Ethanol can be blended into varying percentages in gasoline, the two most common blends being 10% and 85%.

- E10 – 10% ethanol and 90% unleaded gasoline – is the most common way ethanol is available to motorists. All automakers approve ethanol blends up to this 10% level by warranty, no matter the make or model of the vehicle. About 99% of America’s ethanol is retailed as E10.
- E85 – 85% ethanol and 15% unleaded gasoline – is an alternative fuel for use in Flexible Fuel Vehicles (FFVs). FFVs can use unleaded gasoline or any blend of ethanol up to this 85% level.

Some areas of the country use ethanol blends in other percentages; for example, gasoline in California contains 5.7% of ethanol instead of the more common 10% blend.

Will my vehicle run on ethanol-blended fuel?

All vehicles are “ethanol-capable” and can use a blend of up to 10% ethanol. Since the 1980s all automakers have covered up to 10% ethanol-blended fuel by warranty, no engine modifications necessary.

Can ethanol blends be used in small engines, such as boats, lawnmowers, or chainsaws?

Yes – manufacturers of small engines realize that up to a 10% blend of ethanol is very common in gasoline, so they make their engines compatible with this fuel.

What is E85? How do I know if my vehicle can use it?

E85 is an alternative fuel comprised of 85% ethanol and 15% unleaded gasoline for use in Flexible Fuel Vehicles (FFVs). FFVs are truly flexible in that they can operate on gasoline or any blend of ethanol up to the 85% blend. On some vehicles this E85-compatibility comes as an option, sometimes as a standard feature.

To identify whether a vehicle is flex-fuel, check the owners manual and inside the fuel cap. Visit www.ethanol.org/e85.html to link to a complete list of available FFV models. There are approximately 6 million FFVs on America’s roads today, and manufacturers are increasing these numbers each year.

Can my vehicle run on E85 even if it’s not an FFV?

If your vehicle is not an FFV, use of any percentage of ethanol higher than 10% is not covered by warranty. People have reported that they use higher percentages of ethanol in regular, unmodified vehicles. A pilot study conducted in mid-2006 suggests that up to 30% ethanol could be used in a non-flex fuel vehicle, but more research is required on this subject – ACE does not endorse this practice until further study is done.

Can I convert my vehicle to use E85?

In theory, it is possible; in reality, it is difficult. A vehicle could be converted to operate on E85, but the challenge would be converting it to be a truly flexible fuel vehicle, one that could operate on any blend of fuel up to the 85% ethanol. The good news is that automakers are increasing their lineups of FFVs each model year, so whether you're looking for a new or used vehicle, they are available.

Are other blends of ethanol possible besides 10 and 85 percent?

There has been some testing and experimentation done with blends of ethanol between 10 and 85 percent. For example, some gas stations in South Dakota have installed blender pumps that dispense regular unleaded, E10, E20 (20% ethanol), E30 (30% ethanol), and E85. The pumps feature two underground tanks, one for unleaded and one for E85, and it mixes the various blends according to what the customer chooses. Because warranties for standard autos currently cover only up to 10% ethanol, these higher blends are for use in Flexible Fuel Vehicles.

A study conducted by ACE in mid-2006 suggests that up to a 30% blend of ethanol could be used in a standard, unmodified vehicle, but more research on the long-term effects of this practice are needed before it can be endorsed. Because so many parties would need to come to the table on the topic of higher ethanol blends – the automakers on warranties, the U.S. EPA on federal regulations, and the retailers on availability – it is important to begin this conversation now and move the process forward so higher ethanol blends can be available in the future.

ETHANOL AVAILABILITY

How much ethanol-blended fuel is sold in the United States?

Ethanol is blended into 46% of America's gasoline, most in the form of the E10 blend. Ethanol-blended fuel is available from nearly Coast to Coast. In 2006, the U.S. produced and consumed about 5 billion gallons of ethanol.

If gas contains ethanol, is it labeled that way on the pump?

E85 is always labeled at the pump because it is an alternative fuel for use only in Flexible Fuel Vehicles. Because up to 10% ethanol can be used in any vehicle, labeling of this fuel is a decision made locally or by state. Some states require labeling of ethanol blends, and some states say it is not required or that it is voluntary.

The American Coalition for Ethanol supports the consumer's right to know what their gasoline contains, but we do not favor labels that appear more like warning labels. If labeling is not done in an attractive way that shows ethanol's benefits, it can appear more like a warning label and people who are unfamiliar with ethanol will shy away from purchasing this fuel that they believe looks potentially harmful.

Where can I buy E85 in my area?

A link to a complete list of gas stations offering E85 can be found online at www.ethanol.org/e85.html. This site has a searchable map that gives E85 pump locations by state. The number of stations offering E85 is increasing at a rapid pace – today in the U.S. there are more than 1,000 gas stations that offer E85. The number of stations carrying E85 has approximately doubled in the last 24 months, so good progress is being made; however, because the U.S. has about 168,000 gas stations, there is significant work yet to be done.

Is there any funding available to add E85 to my gas station or convenience store?

Yes, sometimes there is. The National Ethanol Vehicle Coalition is a non-profit association that promotes the development of E85 vehicles and infrastructure. Contact them through www.e85fuel.com or by phone at (877) 485-8595.

The Energy Policy Act of 2005 contains a new federal tax credit to assist with the installation of equipment and infrastructure to dispense E85 at retail outlets. This new incentive provides a 30 percent federal income tax credit, up to a maximum of \$30,000, to assist with the establishment of alternative fuel infrastructure, including equipment necessary to dispense E85. This tax credit became effective in 2006 and is scheduled to expire December 31, 2008. Contact the Internal Revenue Service for more information about this tax credit.

What storage and dispensing conversion procedures should I consider before offering E85 at my gas station?

The technology for storing and dispensing gasoline can be applied to alcohol fuels such as E85 because alcohols and alcohol blends, like gasoline, are liquid fuels at ambient pressures and temperatures. However, only E85-compatible materials should be used in the storage and dispensing systems. Most operating problems with ethanol-fueled vehicles have been traced to contaminated fuel. Consequently, choosing the right materials for fuel storage and dispensing systems and following proper fuel handling procedures are crucial for successfully operating ethanol-

fueled vehicles. Although material research and testing is expected to continue, the parts and materials discussed in this guidebook have performed well with E85. They can be obtained from your usual supplier.

ETHANOL PRODUCTION

What is ethanol made from?

The majority of ethanol is made from corn, but ethanol can also be made from many other crops including wheat, barley, milo/sorghum, potatoes, etc. New technology allows ethanol to be made from “cellulosic” feedstocks such as corn stalks, grain straw, paper pulp, municipal solid waste, switchgrass, and other sources.

How is ethanol made?

Ethanol is produced by taking the starch of the corn and fermenting it. The fermented starch is then distilled into alcohol. The excess water is removed so the resulting ethyl alcohol (ethanol) is very pure – 200 proof.

Only the starch portion of the corn, which is about 70% of the kernel, is made into ethanol. The remaining parts of the corn kernel – the fats, proteins, oils, and minerals – are left over in a co-product called distillers grain. Distillers grain is a highly nutritious animal feed that can be incorporated into the food rations of beef and dairy cattle, swine, and poultry.

How many gallons of ethanol can be made from a bushel of corn?

With today’s technology, one bushel of corn yields 2.8 gallons of ethanol, and that number continues to increase. Just a few years ago, that number was closer to 2.5 gallons per bushel of corn, an illustration of the industry’s continual push for efficiency and progress.

How many bushels of corn are needed for a typical ethanol plant? How many acres of corn would be needed to satisfy that demand?

Ethanol plant capacities are measured in millions of gallons per year, or mgy. A typical ethanol plant size today might be 50 mgy, and a plant this size would require approximately 18 million bushels of corn. At the national corn crop average yield of 140 bushels per acre, approximately 128,500 acres of corn would be needed to supply the ethanol plant in this example.

How much of the nation’s corn crop is used for ethanol production?

In 2004, 1.26 billion bushels of corn went to ethanol production, about 12% of the nation’s total crop. For the 2005 corn crop, 14% or 1.6 billion bushels of a record 11.1 billion bushel crop went to produce ethanol. For the 2006 corn crop, it is expected that about 20% will go for ethanol production.

Grain sorghum or milo is also used as a feedstock for ethanol production, especially in drier areas on the periphery of the Corn Belt such as Kansas and western Nebraska. In 2004, about 11% of the nation’s grain sorghum crop was used to produce ethanol.

How much ethanol will the U.S. produce this year? What do the historic production levels look like?

It is expected that the U.S. ethanol industry will grow to an annual capacity of 6 billion gallons in 2007. Here is how production has lined up in previous years:

2006: 5 billion gallons
2005: 4 billion gallons
2004: 3.4 billion gallons
2003: 2.8 billion gallons
2002: 2.12 billion gallons
2001: 1.77 billion gallons
2000: 1.63 billion gallons
1999: 1.47 billion gallons
1998: 1.40 billion gallons
1997: 1.30 billion gallons
1996: 1.10 billion gallons

It took 20 years for the U.S. to grow its first billion gallons of ethanol production capacity – now the industry is growing by approximately a billion gallons annually.

CELLULOSIC ETHANOL

What is cellulosic ethanol?

Cellulosic biomass, dubbed the most abundant material on earth, holds tremendous promise as a feedstock for ethanol production due to its widespread availability and potential for high fuel yields.

Examples of sources for cellulosic ethanol include corn stover (the stalks and husks left over after harvest), wheat and barley straw, sugarcane or rice bagasse, sawdust, paper pulp, small diameter trees, dedicated energy crops such as switchgrass and other perennial grasses, and even municipal waste or household garbage.

How is cellulosic ethanol made?

As with producing ethanol from grain, processing cellulosic sources extracts the fermentable sugars from the feedstock and distills them into alcohol. Unlike in grain, the sugars in cellulose are locked in complex carbohydrates called polysaccharides, or long chains of simple sugars. Separating these complex structures into fermentable sugars is essential to the efficient and economical production of cellulosic ethanol.

Is the ethanol from corn and cellulose the same?

Yes, the ethanol produced from corn or milo and the ethanol produced from cellulose are chemically identical.

What is switchgrass? Why is it a good potential source for ethanol?

Switchgrass, a perennial prairie grass, is one source likely to be tapped for ethanol production because of its potential for high fuel yields, hardiness, and ability to be grown in diverse areas. Switchgrass' long root system – actually a fifty-fifty split above ground and below – helps keep carbon in the ground, improving soil quality. It is drought-tolerant, grows well even on marginal land, and doesn't require heavy fertilizing.

How close is cellulosic ethanol to being commercialized?

The technology to create cellulosic ethanol is available today and is in the early stages of commercialization. Though most of the pieces are in place, the key is to continue to make it more cost-effective and economically competitive. One key is having enzymes that are strong enough to convert the complex carbohydrates into alcohol, yet cost-effective enough to allow efficient commercial-scale production. Pilot-scale cellulosic ethanol production is in place, and many companies are progressing toward commercial-scale production levels. Estimates chart the full-scale commercial production of cellulosic ethanol within 2 to 10 years.

ETHANOL & PUBLIC POLICY

What is the Renewable Fuels Standard?

The Energy Policy Act of 2005, passed in July 2005 and signed into law by President Bush in August 2005, contained a historic provision – the Renewable Fuels Standard (RFS). The RFS dictates that the U.S. will use an increasing amount of renewable fuels, both ethanol and biodiesel, each year between 2006 and 2012. The RFS schedule begins with a minimum of 4 billion gallons of annual renewable fuel use in '06 and grows to a minimum of 7.5 billion gallons of annual renewable fuel use in '12. The U.S. Environmental Protection Agency is charged with implementing the RFS and is working closely with the ethanol industry to finalize the rulemaking process.

What is the ethanol incentive?

The federal ethanol incentive is actually the Volumetric Ethanol Excise Tax Credit (VEETC), or the Blender's Credit. This 51 cent per gallon tax credit is an incentive not to ethanol producers, but to the petroleum industry to blend ethanol into its gasoline. The 51 cents would equate to a 5.1 cent credit on a gallon of E10.

This benefit is a lower tax which not only serves as an incentive for oil companies to blend ethanol with gasoline, but it also enables ethanol to compete with gasoline, even if it is higher priced. The benefit to petroleum marketers is that they can offer a higher-quality, higher-octane fuel containing ethanol at a competitive price. The benefit to taxpayers is that this tax credit is usually passed on to the consumer in the form of lower pump prices for higher octane, ethanol-enriched fuel.

Which states require the use of ethanol-blended fuel?

Seven states now require the use of ethanol-blended fuel. Minnesota was the first state to do so, enacting a 10% ethanol mandate in 1997. Montana and Hawaii followed suit in 2005, passing requirements for E10 fuel use; Hawaii's law went into effect in April 2006, and Montana's will go into effect 12 months after the state has 40 million gallons of annual ethanol production capacity.

In 2006, four states passed ethanol requirements. Washington passed a 2% by volume renewable fuels standard for ethanol and biodiesel and Missouri passed a 10% ethanol requirement that will go into effect in January 2008. Iowa passed a Renewable Fuels Standard that requires ethanol and biodiesel to make up 10% of the state's fuel in 2009 and 25% of the state's fuel by 2019. Louisiana passed a 2% by volume renewable fuels requirement that will go into effect six months after the state has 50 million gallons of annual ethanol production capacity.

ETHANOL OWNERSHIP & INVESTMENT

What companies control ethanol production?

Ethanol is a very diverse industry, not controlled by any one company. Taken together, farmer-owned and locally-owned ethanol facilities make up about 40% of the U.S. ethanol industry. Other companies – such as VeraSun, Cargill, US BioEnergy, Aventine, and others – make up about 35% of the industry. Archer Daniels Midland (ADM), which in ethanol's early days controlled much of U.S. ethanol industry, today retains about one-quarter of the total production capacity.

How can I invest in ethanol?

A few ethanol companies are publicly traded. Archer Daniels Midland is a large agribusiness that has several ethanol plants in addition to a wide range of other ag processing businesses. They are listed under "ADM" on the New York Stock Exchange. Pacific Ethanol is a California-based company that recently obtained listing on the NASDAQ – their ticker symbol is "PEIX."

During the summer of '06, two ethanol production companies launched Initial Public Offerings and are now listing on the NYSE. VeraSun, an ethanol producer headquartered in South Dakota, is listed as "VSE". Aventine Renewable Energy, an ethanol production and marketing firm based in Illinois, is listed as "AVR." In December 2006, ethanol producer and marketer US BioEnergy launched its IPO and is now listed under "USBE" on the NASDAQ.

Much of the growth in the ethanol industry to date has been through farmer-owned cooperatives. These ethanol plants are owned by groups of farmers and other local investors, and their stock is not listed publicly. However, sometimes these ethanol producers do have stock available. If they do, it may be listed on www.agstocktrade.com. Alerus Securities also lists available stock on www.alerusagcoopstock.com.

ETHANOL & OTHER FUELS

What is MTBE? How is it different from ethanol?

MTBE is methyl tertiary butyl ether, a gasoline additive. Like ethanol, it is a fuel oxygenate, meaning it adds oxygen to the gasoline to help it burn more cleanly. Unlike ethanol, MTBE is a toxic substance and even small spills or leaks of the product have been found to contaminate ground water supplies. The use of MTBE has been banned in more than 25 states.

MTBE and ethanol were the two oxygenates of choice under the former Clean Air Act of 1990, but the use of MTBE went by the wayside in 2006 when its manufacturers did not receive the product liability protection they had hoped for in the Energy Policy Act of 2005. Ethanol, just as effective at adding octane and oxygen, has moved in to many former MTBE markets due to its beneficial properties and increasing availability.

What is the relationship between ethanol and biodiesel?

Ethanol and biodiesel are both domestically produced renewable fuels that seek to add to the fuel supply and reduce dependence upon petroleum-based fuels. The Renewable Fuels Standard, passed in the 2005 Energy Bill, requires that the use of both ethanol and biodiesel increase between 2006 and 2012. Like ethanol and gasoline, biodiesel can be blended in varying percentages into diesel – (2% biodiesel), B5 (5% biodiesel), B20 (20% biodiesel), etc. B100, or pure biodiesel, can also be used as a fuel. Biodiesel is typically made from soybeans, though it can be made from other renewable sources. Visit the National Biodiesel Board at www.biodiesel.org to learn more.

What is butanol?

Butanol is a 4-carbon alcohol, similar to ethanol, that has been produced on an industrial scale since World War I. Butanol is certified by the EPA as a blending component in gasoline up to 11 percent. The alcohol is currently made from petroleum and sells for upwards of \$3 per gallon, but its promoters say it can also be made from biomass sources, much like ethanol, and could be used as an alternative fuel. BP and DuPont are teaming up to research butanol and its potential as an alternative fuel.

ENVIRONMENT, ECONOMY & ENERGY SECURITY

How does ethanol-blended fuel benefit the environment?

Ethanol is a much cleaner burning fuel than gasoline. There is a significant reduction in both carbon monoxide and hydrocarbon tailpipe emissions when ethanol is blended and used with gasoline in automobiles. Many cities and states across the nation take advantage of the environmental benefits of ethanol, including Chicago, Denver, Milwaukee, Minneapolis, New York, and Los Angeles.

According to the Department of Energy's Argonne National Laboratory, ethanol-blended fuels reduced CO₂-equivalent greenhouse gas emissions by 7.8 million tons in 2005, which has the effect of removing the annual greenhouse gas emissions of over 1 million automobiles from the road.

What is ethanol production's impact on the environment?

Ethanol plants are clean and efficient, with top-of-the-line technology in place to take care of any harmful emissions. The majority of ethanol plants in the U.S. fall under the "minor source" category by the EPA, meaning their emissions are less than 100 tons per year. This is exponentially less than the emissions from a refinery, power plant, or even a large university.

How does the production and use of ethanol impact our economy?

Ethanol production has a large positive impact on the U.S. economy, especially in the rural areas where most ethanol production takes place. An ethanol plant makes a large difference to the economy of its local area. A study conducted in 2002 found that an average sized ethanol plant (40 mgy) would:

- Cost of approximately \$60 million to build with construction taking about a year; the construction generates a one-time boost of \$142 million as spending circulates throughout the economy.
- Spend more than \$56 million annually on goods and services, ranging from corn to labor to utilities.
- Expand the economic base of the local economy by \$110.2 million.
- Generate an additional \$19.6 million in household income.
- Support the creation of as many as 694 new permanent jobs.
- Generate at least \$1.2 million in new tax revenue for state and local governments.
- Generate additional revenue for local farmers by increasing demand, which in most cases results in increasing the average local basis by at least 5-10 cents per bushel.

How much oil can ethanol displace?

Every gallon of ethanol we produce here in the U.S. means that less gasoline will need to be used, thereby reducing our demand for crude oil. Research has determined that 1 barrel of ethanol (1 barrel = 42 gallons) can displace 1.2 barrels of petroleum at the refinery.

In 2006, the U.S. produced about 5 billion gallons of ethanol. The nations' annual consumption of gasoline is high, approximately 140 billion gallons annually. Given the reality of this large number, ethanol does make up a small percentage at this time – a small, but critically important percentage. Every gallon makes a difference, and the U.S. ethanol industry is ramping up to help give the U.S. energy options.

MISCONCEPTIONS ABOUT ETHANOL

What does "net energy balance" mean? What is ethanol's energy balance?

Net energy balance is a term used to describe how much energy is needed to produce a product versus how much energy that product provides. Two professors that are long-time critics of ethanol claim that ethanol has a negative energy balance, but this is simply not true and has been debunked again and again by science. Scientific study after study has proven ethanol's energy balance to be positive. The latest USDA figures show that ethanol made from the drymill process provides at least 77% more energy as a fuel than the process it takes to make it. The bottom line is that it takes about 35,000 BTUs (British Thermal Units) of energy to create a gallon of ethanol, and that gallon of ethanol contains at least 77,000 BTUs of energy. The net energy balance of ethanol is simply a non-issue.

What impact does ethanol have on gasoline prices?

Ethanol adds to the overall supply of motor fuel in the U.S. and helps keep pump prices competitive and affordable. The blender's tax credit is usually passed down to consumers in the form of more competitive prices at the pump. According to the Consumer Federation of America, consumers who purchase gasoline blended with 10 percent ethanol could be saving as much as 8 cents per gallon compared to straight gasoline.

What about ethanol's impact on fuel economy?

Critics of ethanol often allege that because ethanol contains fewer British Thermal Units (BTUs) of energy, ethanol-blended fuel has a negative impact on gas mileage. In reality, variables such as speed, stop-and-go driving, tire pressure, and the weather's effect on driving conditions have a much greater impact on fuel economy than what fuel you use in your engine.

In 2005, ACE conducted a study comparing gas mileage between unleaded and E10, E20, and E30. On average, the difference between straight unleaded and E10 was only 1.5% - a negligible amount. Some believe that lower BTU value has a one-to-one impact on fuel economy – this research proves that is not the case. In light of this finding, more research is underway to examine the fuel economy of E85.

Is ethanol using up corn that should be used for human food?

In the "food vs. fuel" debate, one major misconception is that the majority of the corn grown in the U.S. goes directly for human consumption. This is not the case. Actually, only about 9 percent of U.S. corn is used for human consumption in products like cereals, sweeteners, etc. The main uses for U.S. corn are for livestock feed or for export, with the industrial uses category – including ethanol – making up a smaller percentage.

In 2005, 14 percent of the U.S. corn crop went for ethanol production, and for the '06 crop that figure is expected to rise to 20 percent. By no means is the U.S. ethanol industry using up all the corn, and by no means is the U.S. ethanol industry going to create a food shortage. Certainly there is a world hunger problem, but vocal critics are painting a doomsday scenario that just simply isn't true. Corn and ethanol are commodities, and as with other commodities, the market will determine how much and when.

PARTICIPATION IN THE ETHANOL INDUSTRY

We'd like to construct an ethanol plant. Where do we begin?

Ethanol plants need to be built where they make sense, so there are many necessary pieces that need to come together to make a plant successful. Rules of thumb:

- *Grain availability:* How many bushels of grain are available within 50 miles, 100 miles, 150 miles?
- *Grain pricing:* What is the local grain price for corn? What is the historic basis (difference between local price and Chicago price)?
- *Natural gas or coal availability:* What is the most economical fuel? A nearby pipeline is needed to use natural gas and coal requires expensive handling facilities. Figure about 35,000 BTUs per gallon of ethanol produced. Estimate delivered cost of each.
- *Power:* Calculate about 1 kWh of electricity per gallon of ethanol produced.
- *Site issues:* Site needs rail access, road access, and availability of 3.5 gallons of water for each gallon of ethanol produced.
- *Distillers grain:* Dried distillers grain can be sold by rail, but wet distillers grain should be used within 100 miles of the plant. DDG can be used for hogs, poultry, and cattle; WDG can be used for cattle. How many livestock are within 100 miles of the plant? Check historic prices for distillers grain in the area.
- *Financing:* There are many possible ownership and financing structures, but most require between 30%-50% equity. Ethanol plant costs decrease on a per gallon basis as plants get larger.
- *Feasibility studies:* There are many reputable firms and consultants that can help you conduct a feasibility study. It is crucial to determine whether you have all the necessary pieces in place before you begin.
- *Design-build firms:* Always use a reputable design-build firm that has experience in the ethanol industry. Check the "Parts & Service Providers" section on the ACE website to see a list of companies providing these services.

How can I get a job in the ethanol industry?

One place to look for ethanol industry job listings is www.ethanoljobs.com.

Can I support ethanol in other ways?

Yes, definitely. If your local gas station does not carry ethanol-blended fuel, talk to the manager and encourage them to do so. Visit the ACE website, www.ethanol.org, to see what ethanol-related bills are being debated by Congress and use the Legislative Action Center to send a letter to your Senators and Representative to express your views. If you are not already, become an ACE member to show your grassroots ethanol support and to receive the latest ethanol-related information through *Ethanol Today* magazine and other ACE resources.