

Ethanol is trendy yet ancient

Burning grain alcohol for fuel is older than you might think

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Ethanol, or ethyl alcohol made from grain and sugar, is in the news as a fuel of the future. Yet alcohol in beer and wine traces to the dawn of civilization. One type of distillation was invented by Arab alchemists, then used to turn wine into alcohol in Europe during the Middle Ages.

Even ethanol's use as fuel is old.

When German inventor Nikolaus Otto built the first four-stroke internal combustion engine in 1876, it ran on an ethanol-gasoline blend.

Almost fuel for the masses

Early U.S. automobiles, including Henry Ford's Model T, had adjustable carburetors, spark advances, and low compression engines that could run on gasoline, alcohol, or a mixture of both.

During Prohibition, Ford himself advocated turning breweries into distilleries to make fuel for cars. According to Ford Motor Company's historical files, Ford, who grew up on a farm, had a strong interest in chemistry and in using farm products to make fuels.

He believed gasoline was on the way out, as he said in this 1916 newspaper interview found by writer and researcher, Ford Bryan, for the Henry Ford Museum:

"Gasoline is going – alcohol is



Photograph: Courtesy of Ford Motor Company

The Ford Model T ran on a variety of fuels, including ethanol. This 1912 photo is of a gathering in Caledonia, Minnesota.

coming," Ford said. "It is coming to stay, too, for it's in unlimited supply. And we might as well get ready for it now. All the world is waiting for a substitute for gasoline. When that is gone, there will be no more gasoline, and long before that time, the price of gasoline will have risen to a point where it will be too expensive to burn as a motor fuel."

Ford was ahead of his time. For a

while ethanol boosted octane in gasoline, but it lost out to leaded gas. It came back in World War II when the federal government distilled ethanol to extend the military fuel supply. At war's end, cheap gasoline flooded back into the nation's gas tanks.

Another gift from Arabs

You can thank the descendants of the Arab alchemists that gave us distillation for helping create the

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Cover: Chippewa Valley Ethanol Company, LLC, in Benson, Minnesota, by Mitch Kezar.

Taking stock in ethanol

Ethanol is hot. At the American Coalition for Ethanol office in Sioux Falls, South Dakota, Brian Jennings is getting phone calls from venture capitalists in New York, Chicago, and San Francisco.

At Renewable Fuels Association in Washington, D.C., "We get a lot of calls with media requests from magazines like *Fortune*," says spokesperson Matt Hartwig.

In the last 10 years, farmers have driven a once-unimagined

growth in ethanol production, just as consumers clamor for more and Congress mandates doubling its use by 2012. Now the character of the industry is changing. Bigger investors are moving in. Ethanol is becoming a global commodity. It's time to take stock. Demand looks strong. Risks remain.

This section will tell you how farmers organize ethanol plants, how the plants work and manage risk, and changes to expect.

modern fuel ethanol industry in the United States.

Angry at the U.S. for its support of Israel in the 1973 Yom Kippur War, Arab nations in OPEC (the Organization of the Petroleum Exporting Countries) embargoed oil exports to our country. In five months, crude oil prices more than doubled, from \$5 a barrel to over \$11 (or over \$50 in today's dollars).

The federal government responded with money for research on biofuels. It imposed a 55-mph speed limit to conserve fuel, and Congress passed the Energy Tax Act of 1978. The law established a 4¢-a-gallon exemption from federal excise taxes on gasohol, a blend of gasoline with at least 10% ethanol. It was, in effect, a 40¢-a-gallon tax subsidy for pure ethanol to help make it competitive in the market. Many people regard this as the start of the modern era of ethanol use in fuel. The tax subsidy exists today, at the rate of 51¢ a gallon.

Shifting forms of support

Such subsidies have drawn criticism. But oil industry control of the fuel market made that necessary, say ethanol advocates.

"Without some public policy directives, we would not be able to enter the market," says Brian Jennings, executive director of the American Coalition for Ethanol (ACE) in Sioux Falls, South Dakota, a group that represents farmer-owned plants.

Bob Dinneen, president and CEO of the Renewable Fuels Association in Washington, D.C., has seen a lot of changes in his 18-year career of lobbying for ethanol. He divides ethanol production into four different time periods based on how the fuel was used.

1. The gasohol era began in 1979 when major oil companies started blending ethanol as a fuel extender, thanks to the 1978 tax subsidy. The first national ethanol survey in 1980 showed 10 plants making 50 million gallons of ethanol a year (what one typical plant makes today).

By the mid-1980s, oil prices collapsed, almost to pre-embargo levels, and ethanol makers went through a shakeout. By the end of 1985, only 74 of 163 commercial plants remained, making nearly 600

million gallons. "When the price of oil fell, its utility as a gas extender wasn't all that important," Dinneen says. "There wasn't a good focus on building a market."

2. Octane boosters created a new market and a second era. In 1986, when lead was banned from gasoline, retailers had to find ways to boost octane to prevent engine knocking. Independent dealers found ethanol competitive, Dinneen says. "You saw the next generation of ethanol demand coming from that segment of the oil industry."

3. Clean Air Act amendments of 1990 took advantage of another benefit from ethanol – cleaner emissions with less carbon monoxide. The law required winter use of oxygenates like ethanol and MTBE in 39 areas with severe carbon monoxide. A 1995 requirement for reformulated gasoline led to year-round ethanol use in urban areas with a smog problem, Dinneen says.

MTBE (methyl tertiary butyl ether) was cheaper for oil companies to mix with gasoline, and it dominated the reformulated fuel market until the late 1990s when it started showing up in groundwater. By 1999 states began banning MTBE in gasoline, and ethanol demand grew more.

4. Energy Policy Act of 2005 sets the stage for a fourth era of rapid growth. While maintaining air quality standards, it abandons reformulated gas. It replaces that with a renewable fuel standard (RFS) requiring the oil industry to use ethanol and other renewable fuels.

The RFS starts this year, requiring 4 billion gallons of renewables in the nation's fuel supply. It ramps up by 700 million gallons a year until 2011 when the RFS hits 7.4 billion gallons. By 2012 it hits 7.5 billion. Dinneen expects the RFS to help move ethanol from being blended into 30% of gasoline today to 75% or more by 2012.

Brian Jennings of ACE also sees a turning point. "The renewable fuels standard is one of the most profoundly significant pieces of legislation that has ever passed for the ethanol industry," he says. "It's already brought more farmers to the table and enabled them to form new co-ops or LLCs or to expand ethanol production." □

Ethanol time line

- **1876-1908:** Ethanol fuel powers early engines and Model T's.
- **1917-18:** U.S. wartime ethanol use hits 60 million gallons a year.
- **1920s:** Under Prohibition, gasoline passes up ethanol as fuel. Oil companies still add ethanol to boost octane and cut knocking.
- **1930s:** Cheap, Depression-era corn keeps ethanol in Midwest fuel but, in spite of public health concerns, leaded gas controls the octane market by 1939.
- **1940s:** The federal government takes over distilleries to make ethanol for synthetic rubber and aviation and submarine fuel in World War II. Production hits 600 million gallons a year.
- **1945-1978:** Grain-ethanol fuel virtually disappears. 1973 oil embargo revives interest in ethanol.
- **1978:** Modern ethanol industry begins with Energy Tax Act's 40¢-per-gallon subsidy. Oil companies blend gasohol. Production hits 50 million gallons by 1980.
- **1985:** Oil price crash brings ethanol industry shakeout. Production is nearly 600 million gallons. ADM and other wet millers dominate ethanol production
- **1988:** Denver mandates oxygenates like ethanol in gas in winter to cut CO emissions.
- **1990:** Clean Air Act amendments create new demand for oxygenates like ethanol and MTBE. Farmer-owned expansion accelerates in mid-1990s. MTBE phaseout begins at decade's end, increasing ethanol demand.
- **2005:** Energy Act's Renewable Fuel Standard mandates 4-billion-gallon biofuels use in 2006. Industry capacity is at 4.2 billion gallons. Farmers own 40%. California ethanol price hits record near \$2.70/gallon in September.