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AMERICA'S ALTERNATIVE ENERGY SOURCES

Ethanol

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Current State of Ethanol Industry

How Much is Used and Where?

Most of the world's ethanol is currently derived from petroleum. As a renewable fuel source, it can be produced from numerous feedstocks. Corn represents the vast majority of the feedstock used in United States bioethanol. [1] [2] Both personal and commercial consumers of ethanol fuels typically reside in the Midwest, where corn grows in surplus.[3]

In 2004, the U.S. produced 3.4 billion gallons of ethanol from 101 production facilities. In 2005, output topped 4.8 billion gallons, with another 2.4 billion gallons per year output expected from new production facilities coming on-line.[4] [5] In the United States, rather than being used as a discrete fuel source, most of this is blended with gasoline at various concentrations, ranging from E10 (10% ethanol) to E85 (85% ethanol).

As of September 2006, the local ethanol plant proposed by York-based Penn-Mar Ethanol, LLC for the Cumberland Valley Business Park in Franklin County will not be built. Penn-Mar could not secure the financing necessary to purchase the site prior to the expiration of the purchase agreement.[6] This represents their second failure to secure a site, after public opposition and the discovery of additional and expensive engineering difficulties precluded building the plant in Conoy Township, Lancaster County.[7]

Cost

The cost of ethanol production varies greatly, depending upon the feedstock and production method employed, but the 2002 industry average was about $0.9574 per gallon, including by-product sales credits.[8]

Outlook for Ethanol

Pros, Cons, Barriers and Incentives

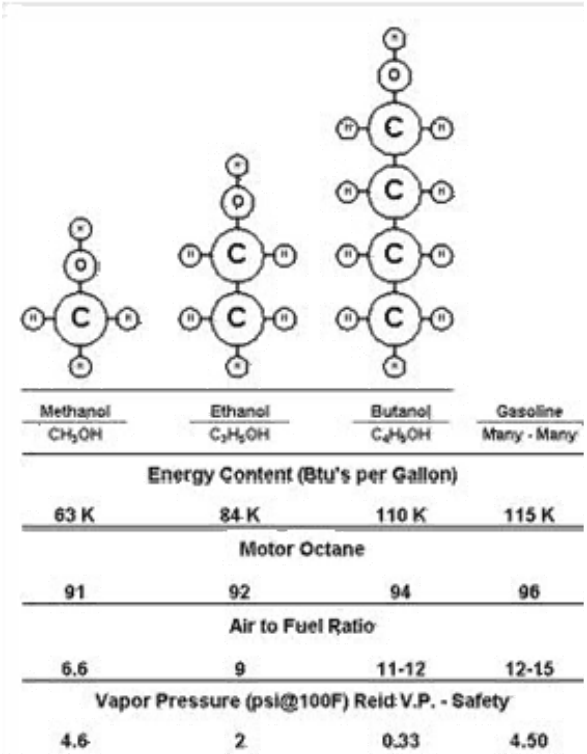
Using ethanol fuel has a number of benefits, beyond being a renewable resource. Corn ethanol production helps to support crop prices. With another market for their crops, corn growers could rely less upon federal subsidies, and more on market economics. This could be done without significant adverse effect to food prices, using land that is currently left fallow under subsidy programs, combined with a reduction in corn exports.[9]

Cellulosic materials, especially native prairie grasses such as switchgrass, show promise of producing far greater net energy balance (approximately +2.62) than have been achieved to date with corn (approximately +1.38),[10][11][12] and have the added benefit of growing in poorer soils than can support food crops.

"Flex-Fuel Vehicles" (FFVs) can be produced for about $30 more than a comparable gasoline-only vehicle, making adoption very cost-effective for new production vehicles.[13] However, the cost of retrofitting existing vehicles to run on concentrations stronger than E10 can be prohibitive to the consumer.

Another disadvantage to ethanol is that it cannot be transported by pipeline due to its chemical volatility and sensitivity to contact with water. This requires energy-intensive transportation methods such as truck, train, or ship.[14]

While the net energy balance of ethanol could be improved with alternative feedstocks such as switchgrass, it still contains a much less energy density (approximately 84,000 BTUs/gallon), than does gasoline (approximately 115,000 BTUs/gallon).[15][16] This reduces the theoretical fuel economy of an E85-powered vehicle by about 33% versus a gasoline-only vehicle,[17] requiring either larger fuel tanks, or more frequent refueling of such vehicles.



One potential solution to these problems would be the production of butanol, a close cousin of ethanol. Blended fuels containing as much as 11.5% Butanol can run in existing vehicles without modification,[18] can be transported by

pipeline, and contain much more energy per gallon than ethanol (more than 104,000 BTUs per gallon).[19] [20]

BP and DuPont are partnering to build the production infrastructure necessary to bring a butanol/gasoline blend to the UK market by 2007.[21] [22] BP will contribute its fuel production and transportation expertise to the project, while DuPont will contribute its bioengineering expertise. With this partnership, they plan to ferment butanol from sugar beets using an advanced bioengineered microorganism as the catalyst.[23] [24] [25]

Recommendations

Combining current trends in alcohol fuel technologies, it appears that the United States could well benefit from cellulosic biobutanol fermented from a mixture of corn and switchgrass crops. This would allow not only productive lands, but also the fallow to produce a fuel, which could power current, unmodified vehicles with better than 90% of gasoline's performance and fuel economy,[26] while supporting the American agricultural economy and reducing agriculture subsidies.

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[1] Lorenz, David and David Morris. *How Much Energy Does It Take to Make a Gallon of Ethanol?* Institute for Self Reliance, 1995. http://www.carbohydrateeconomy.org/library/admin/uploadedfiles/How_Much_Energy_Does_it_Take_to_Make_a_Gallon_.html accessed 12/19/06

[2] American Coalition for Ethanol. http://www.ethanol.org/production.html

[3] U.S. EPA Consumer Ethanol Fact Sheet. March 2002. http://www.epa.gov/OMS/consumer/fuels/altfuels/420f00035.pdf accessed 8/7/06

[4] American Coalition for Ethanol. http://www.ethanol.org/production.html accessed 12/19/06

[5] Renewable Fuels Association. August 7, 2006. http://www.ethanolrfa.org/industry/locations/ accessed 12/19/06

[6] Patriot News – Court Ruling Goes Against Ethanol-Plant Proposal. September 6, 2006. http://www.pennlive.com/business/patriotnews/index.ssf?/base/business/1157506816102240.xml&coll=1 accessed 12/19/06

[7] REDDI – Energy Plant Heads West. February 8, 2005. http://www.reddionline.com/latest_news.asp?id=108&archive=1 accessed 12/19/06

[8] U.S. Department of Agriculture Agricultural Economic Report Number 841. July 2005. http://www.usda.gov/oce/reports/energy/USDA_2002_ETHANOL.pdf accessed 12/19/06

[9] Khosla, Vinod. *BioFuels: Think Outside the Barrel*. Google TechTalks, March 29, 2006. http://video.google.com/videoplay?docid=-570288889128950913 accessed 12/19/06

[10] U.S. Department of Energy BioMass Program. http://www1.eere.energy.gov/biomass/net_energy_balance.html accessed 12/19/06

[11] Lorenz, David and David Morris. *How Much Energy Does It Take to Make a Gallon of Ethanol?* Institute for Self Reliance, 1995. http://www.carbohydrateeconomy.org/library/admin/uploadedfiles/How_Much_Energy_Does_it_Take_to_Make_a_Gallon_.html accessed 12/19/06

[12] Khosla, Vinod. *BioFuels: Think Outside the Barrel*. Google TechTalks, March 29, 2006. http://video.google.com/videoplay?docid=-570288889128950913 accessed 12/19/06

[13] Khosla, Vinod. *BioFuels: Think Outside the Barrel*. Google TechTalks, March 29, 2006. http://video.google.com/videoplay?docid=-570288889128950913 accessed 12/19/06

[14] Environmental Energy, Inc. August 7, 2006. http://butanol.com/ accessed 12/19/06

[15] Environmental Energy, Inc. August 7, 2006. http://butanol.com/ accessed 12/19/06

[16] Lorenz, David and David Morris. *How Much Energy Does It Take to Make a Gallon of Ethanol?* Institute for Self Reliance, 1995. http://www.carbohydrateeconomy.org/library/admin/uploadedfiles/How_Much_Energy_Does_it_Take_to_Make_a_Gallon_.html accessed 12/19/06

[17] ((84000 BTUs*85%) + (115000 BTUs*15%)) / 115000 BTUs=77.1%
[18] Potential near-term improvements in technology could allow up to 16% blends without vehicle modification. http://www.dupont.com/ag/news/releases/BP_DuPont_Fact_Sheet_Biobutanol.pdf accessed 12/19/06
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[22] http://www.usatoday.com/money/industries/energy/2006-06-20-butanol_x.htm?csp=34 accessed 12/19/06
[23] http://www.usatoday.com/money/industries/energy/2006-06-20-butanol_x.htm?csp=34 accessed 12/19/06
[24] http://bioage.typepad.com/.shared/image.html?/photos/uncategorized/bpdupont.png accessed 12/19/06
[25] http://www.greencarcongress.com/2006/07/dupont_scientis.html accessed 12/19/06
[26] 104000 BTUs / 115000 BTUs = 90.4%