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BRIEF ANALYSIS

The Environmental Costs of Ethanol

by Max Borders and H. Sterling Burnett

There is growing bipartisan political support for increased use of ethanol. An energy bill recently passed by the U.S. Senate would increase mandated ethanol use in blended fuels from 8 billion gallons to 36 billion gallons. Concern about global warming and the desire to improve air quality are stoking the demand for government action. Studies show that burning ethanol reduces the release of the greenhouse gas CO_2; but ethanol has mixed effects on air quality. Increased ethanol use could pose other environmental problems, including decreased fuel economy and a loss of forests and wetlands. When all of the environmental harms are accounted for, ethanol's costs may outweigh its benefits.

Problem: Ethanol Reduces Fuel Economy. Congress is debating raising fuel economy standards for vehicles to reduce energy consumption and air pollution. However, ethanol, or grain alcohol, produces 35 percent less energy per gallon than gasoline; thus the fuel economy of vehicles burning ethanol is lower. For instance, *Consumer Reports* tested a Chevrolet Tahoe running on E85 — a blend of 85 percent ethanol and 15 percent gasoline. [See the figure.] Fuel economy fell from 21 miles per gallon (m.p.g.) to 15 m.p.g. on the highway and from 9 to 7 m.p.g. in the city. As a result, when E85 was $2.91 a gallon in August 2006, for example, it would have taken $3.99 of E85 to equal one gallon of gasoline.

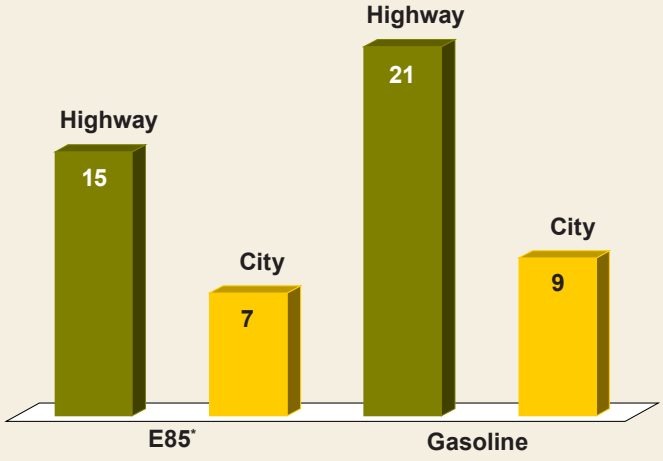
In addition, poorer fuel economy means vehicles will use more gallons of fuel, which could negate any air quality gains due to fuel economy improvements.

Problem: Ethanol Corrodes Pipelines, Storage Tanks and Engines. Ethanol absorbs water and cannot be shipped through existing pipelines used to transport unblended gasoline. The water can separate, causing pipelines and fuel lines to freeze and, perhaps, burst during cold weather. Under the right conditions, the water can damage car engines. Furthermore, ethanol corrodes soft metals, and contaminants from corrosion can damage vehicle fuel systems.

Thus, in order to use more than 5 percent to 10 percent ethanol blended with gasoline will require building a new generation of vehicles to use it, in addition to new storage tanks and pipelines. As a result, expanding the use of ethanol means using more natural resources, not less.

Problem: Ethanol Production Diverts Land from Other Uses. American farmers can meet the congressionally created demand for more ethanol by taking steps to increase production, such as: 1) devoting more cropland to corn and less to other crops, 2) diverting more of the corn crop from human and animal food supplies to fuel production, 3) increasing corn yields by using more chemical fertilizers and pesticides, and 4) converting fallow fields, forests, wetlands and wild lands to agriculture. The third and fourth options have environmental consequences. For example, ethanol boosters are already pushing to allow corn production on millions of acres farmers have been paid to set aside for environmental protection under the Conservation Reserve Program.

Fuel Economy of a Chevrolet Tahoe Using Gasoline and Ethanol
(miles per gallon)



* 85 percent ethanol, 15 percent gasoline.

Source: "The Ethanol Myth," *Consumer Reports*, October 2006. Available at http://www.consumerreports.org/cro/cars/new-cars/ethanol-10-06/overview/1006_ethanol_ov1_1.htm.

Dallas Headquarters: 12770 Coit Rd., Suite 800 • Dallas, TX 75251• 972-386-6272 • Fax: 972-386-0924 • Web site: http://www.ncpa.org
Washington Office: 601 Pennsylvania Ave., N.W., Suite 900, South Building • Washington, D.C. 20004 • 202-220-3082• Fax: 202-220-3096
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The first and second options are already having human consequences:

- The increased use of ethanol in the United States has caused the price of corn to double, raising livestock and wildlife feed prices.
- Corn prices have also risen beyond U.S. borders — for instance, in Mexico, where a dramatic increase in the price of corn tortillas led to riots in early 2007.
- Prices for meat and vegetables have also increased and, in June 2007, the United Nation's food envoy, Jean Ziegler, warned that the diversion of crops from food to biofuels could result in hundreds of thousands of deaths from hunger worldwide.

Furthermore, land uses will have to change dramatically to meet future increases in the ethanol mandate. For instance:

- If every acre of corn were used to produce ethanol, it would supply the equivalent of only 12 percent of current gasoline use, according to researchers at the University of Minnesota.
- Displacing just 5 percent of the U.S. demand for gasoline and diesel with ethanol would require more than 21 percent of U.S. cropland, according to the International Energy Agency.
- If all the cars in America were fueled with 100 percent ethanol from corn, it would require 97 percent of the 1.9 billion acres of land in the United States to grow the feedstock, according to Cornell University scientist David Pimentel.

Senators apparently recognize the impact ethanol demand has had on food prices and the limits of corn-based production because the Senate bill requires that a majority of ethanol eventually come from switchgrass. Switchgrass could yield much more fuel per acre than corn, but the technology to convert switchgrass to ethanol at affordable prices does not yet exist. However, even 300 million acres of switchgrass — using all of the land currently devoted to crop production in the United States — couldn't supply current gasoline and diesel demand, according to researchers at the Polytechnic University of New York. Furthermore, the demand for gasoline and diesel is expected to double by 2025.

Problem: Ethanol Production Endangers South American Rainforests. For years, Brazil has subsidized the production of ethanol from sugar cane, which is why ethanol has appeared to be a renewables success story. In the past, farmers have turned to clear-cutting the Amazon jungle for soybean production. Currently most sugar cane is grown in the South Central region of Brazil — away from Amazonia. But the rainforest could be in greater peril if Congress clears the way for ethanol imports under a new agreement between the Bush Administration and the Brazilian government.

Soon, Brazil could be facing deforestation similar to that occurring in the tropical forests of Southeast Asia, where jungles are being cleared for palm oil plantations to fill Europe's increasing demand for biodiesel.

Problem: Ethanol Pollutes the Air. Ethanol reduces overall emissions of CO_2, though the amount is debated. The crops grown for ethanol remove CO_2 from the atmosphere, and ethanol-blended gasoline reduces CO_2 emissions by 18 percent to 29 percent. However, some of those gains are lost because ethanol production is more energy-intensive than refining gasoline, leading to higher CO_2 emissions from burning fossil fuels in the ethanol distilling process.

In order to meet congressional mandates for ethanol in fuels, the Environmental Protection Agency has relaxed clean air regulations on ethanol production facilities, allowing 250 tons of emissions per year before regulations are triggered, whereas other industrial facilities violate clean air rules if their emissions top 100 tons per year.

While ethanol reduces some air pollutants, it increases others. Ethanol is blended with gasoline in some cities to reduce carbon monoxide (CO) emissions to meet clean air requirements. However, ethanol increases emissions of volatile organic compounds (VOCs) and nitrogen oxides (NO_x), which are components of smog. As a result, some cities that achieved compliance for CO levels could violate the EPA's VOC and ozone standards if ethanol use is mandated nationwide. Under current mandated use:

- Ethanol is increasing ozone-forming emissions on hot days by 72 percent in Southern California, 48 percent in Sacramento and 55 percent in San Jose, according to the California Air Resources Board, jeopardizing the state's ability to comply with federal air quality standards.
- Ethanol will increase ozone-forming NO_x emissions in Wisconsin by twice as much as the emissions reduction achieved through vehicle inspection and maintenance programs, says the state's Department of Natural Resources.

E85, used in some areas, reduces levels of carcinogenic benzene and butadiene, but increases two other carcinogens — formaldehyde and acetaldehyde. E85 also produces peroxyacetyl nitrate, which damages plants.

Conclusion. Ethanol's known environmental effects should give Congress pause before continuing to mandate and subsidize it. Whether or not ethanol makes sense economically, it may well be a loser from an environmental perspective.

Max Borders is a policy analyst and media coordinator at the Civitas Institute. He is also an adjunct scholar, and Sterling Burnett is a senior fellow, with the National Center for Policy Analysis.