

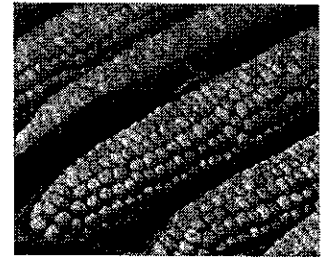


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## An Earful on Ethanol: Rising Food Prices, Inefficient Production and Other Problems

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Just a year ago, ethanol was the renewable fuel of the moment. Derived mostly from corn grown in America's heartland, ethanol was promoted as a home-grown ticket to energy independence for the U.S. and other oil-importing nations. It played a feature role in the Energy Independence and Security Act (EISA) of 2007, passed by the U.S. Congress in December, which called for a five-fold increase in ethanol production by 2022 and provided tax incentives and grants to ethanol producers.



Today, however, ethanol's prospects look somewhat cloudy. Critics around the world are crying foul over rising food prices. Others contend that it takes more resources to create ethanol than the alternative fuel provides. According to experts at Wharton and elsewhere, ethanol underscores the hazards involved in the development of any new energy source, where failure to understand the broader impact of production can result in unintended consequences.

Anyone who ever drank grain alcohol at a college fraternity party is familiar with ethanol. It is derived from the fermentation of starches in organic matter; corn starch, found only in corn kernels, is the most popular source in the domestic ethanol industry today. But other so-called second generation ethanol sources are gaining favor as new technologies ease their fermentation process. Of the 36 billion gallons of ethanol mandated in EISA by 2022, 21 billion would come from those second generation sources, such as corn stalks, switchgrass (a tall grass native to the North American prairie) and even garbage.

EISA's passage, of course, delighted the fast-growing ethanol industry. The Biotechnology Industry Organization, which represents many biofuel producers, called the act "a game-changing moment in ... the history of transportation fuels development [that] can be compared to the transition from whale oil to kerosene to light American homes in the 1850s."

But like that early application of fossil fuel, the transition to ethanol brought unintended consequences. At about the same time that ethanol production was ramping up in the United States, so did food prices around the world. With government support in the form of tax credits and grants boosting demand, and oil prices on the rise, acreage that might have been allocated for food was sowed with corn slated for ethanol. EISA provided companies that make ethanol from corn with a tax credit of 51 cents for every gallon they produce. As food prices climbed and shortages occurred in some of the world's poorest nations, Jean Ziegler, former United Nations Special Rapporteur on the Right to Food, called ethanol and other biofuels "a crime against humanity."

In February, a report in the journal *Science* concluded that corn-based ethanol would nearly double greenhouse gas emissions over 30 years, compared to fossil fuels. In March, *Time* magazine devoted a cover story to ethanol's unintended consequences, calling it "The Clean Energy Myth." *The Wall Street Journal*, which opposed the subsidies from the start, said that "corn ethanol can now join the scare over silicone breast implants and the pesticide Alar as among the greatest scams of the age."

In the farm bill that Congress approved over President Bush's veto this month, the subsidy for production of corn-based ethanol was rolled back to 41 cents a gallon, and a new tax credit of \$1.01 per gallon was instituted for producers of ethanol derived from second generation sources.

### High Food Prices

Not everyone agrees that demand for corn-based ethanol is the key driver of global price increases for food. "Food prices are high for a couple of reasons," says Matthew White, a business and public policy professor at Wharton.

"Government subsidies for growing corn for ethanol is just one." He and many other economists say most of the blame likely goes to the surge in demand from the newly powerful economies of India and China, and to skyrocketing energy prices.

Still, a flurry of recent reports concluded that the new demand for ethanol is at least partly to blame.

- A World Bank study estimated that corn prices "rose by over 60% from 2005-07, largely because of the U.S. ethanol program" combined with market forces.
- An Iowa State University analysis of Chicago Board of Trade data found that implied volatility of corn prices had reached 35% by February 2008, up from 32% in 2007, nearly 29% in 2006 and 22% from 1997 to 2005. The gains were attributed in the Iowa State study to "increased demand for corn from the ethanol industry."
- The International Monetary Fund estimated recently that the shift of crops out of the food supply to produce biofuels accounted for almost half the recent increases in global food prices. The IMF estimates that global food prices rose 43% in the 12 months ending in March 2008.

Like many economists and energy experts at Wharton and elsewhere, White hopes the debate over ethanol's effect on food prices will rekindle what he thinks is a more important debate: whether "ethanol is a good idea from a purely energy standpoint."

Food crops such as grains "are terrible sources of raw material for biofuels," says Kari Ulrich, a Wharton professor of operations and information management. "Every analysis I have seen shows that grain-based biofuels such as ethanol require more energy to produce than they provide." Ulrich, who in 2005 devised a system called Terra Pass to allow individuals to buy carbon offsets, notes that "about four calories of energy, usually from fossil fuels, are required to create one calorie of food energy. That is, 100 calories of carbohydrates in corn requires about 400 calories of coal, natural gas, or oil for fertilizer, planting, harvesting, processing, and transportation. As a result, the more likely cause of rising food prices is the rising cost of energy."

Ulrich says he sees far more promise in the second generation ethanol sources.

But they, too, could have their own unintended consequences, according to Ulku G. Oktem, a senior research fellow at Wharton who has taught a course called Environmental Sustainability and Value Creation. "If you use the whole [corn] plant ... you do not return any part of the plant back into the soil, which means you have to feed more nutrition to the crops -- and that means more fertilizer. More fertilizer means you have to use more energy to create it. One has to look at the full life-cycle of ethanol production."

More consequences may be on the horizon. "One question that I have not seen discussed in the media is what ethanol is doing to the supply of water," says Wharton management professor Witold J. Henisz, who is working with the World Economic Forum's Global Risk Network to assess the impact. According to a 2007 study at Arizona State University, a gallon of corn-based ethanol requires 785 gallons of water just to irrigate the corn. By comparison, a gallon of gasoline uses 2 to 2.5 gallons of water in its refining process. Gasoline's water use does not include water pumped into oil wells to make the oil easier to pump as the well runs dry.

"The demand on water supplies for corn is frightening," says Henisz.

### **The Wrong Horse?**

Unintended consequences lurk at every stage in the development of new energy sources. And that's a good reason for the government not to be focused on one particular alternative energy source, says White.

"Success of the ethanol market is dependent on three factors: global oil prices, tariffs on imported ethanol, and subsidies," White notes. Two of those three factors -- tariffs and subsidies -- are controlled by the government. "Government actions are the linchpin of the ethanol economy." And, he says, "it is remarkably difficult for politicians and bureaucrats to pick winning technologies from multiple options."

White's conclusion about this government bet? "We may have picked the wrong horse as a source for alternative energy."

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A tax strategy, rather than subsidies, might have been a better way to encourage the development of alternative energy sources, states Ulrich. "Government incentives for corn-based ethanol are quite perverse," he says. "They stimulate the creation of a fuel that requires more fossil fuel to create than it conserves. A more prudent policy would be a carbon tax which would increase the cost of fossil fuels. Then, biofuels that provide net benefits would have an inherent advantage and would not require economic stimuli in the form of subsidies."

Another strategy that might have been superior to subsidies is a national renewable energy portfolio standard (RPS), requiring electric utilities to get a minimum portion of the energy they sell from renewable sources, according to Daniel M. Kammen, a professor of energy at the Goldman School of Public Policy in the University of California, Berkeley. That strategy had been part of EISA, but was discarded in the final version.

Supporters of the ethanol tax incentives point out that encouraging the development of that fuel will speed the development of those second-generation ethanol sources. In a letter to *The New York Times*, which recently called for a rollback of government incentives and mandates for ethanol use, Archer Daniels Midland chief executive Patricia Woertz wrote that "ensuring demand for today's ethanol creates the conditions necessary for large-scale investments in infrastructure and technology required to realize the promise of tomorrow's even better biofuels.... We see a bright future where policies that advance ethanol production today also drive investments that speed our progress to the next generation of biofuels. We hope that future is not undermined by shortsighted approaches that penalize consumers and discourage investment."

Ethanol's supporters also point to a study by the University of California at Berkeley that found that ethanol can generate higher energy content than petroleum while producing 10% to 15% fewer greenhouse gas emissions.

A significant pullback from EISA's incentives and mandates -- especially if the alternative is the imposition of new carbon taxes -- is unlikely given their popularity among Midwestern agricultural and ethanol production interests, and the aversion to new taxes at the White House and in Congress.

"One reason it was politically popular was that it moved wealth from [Democrat dominated] Blue States to [Republican dominated] Red States," White says. Providing taxpayer-financed subsidies to the corn-belt, where there are far fewer taxpayers than on the two coasts, is "a net transfer from California and East-coast states to the Midwest."

In a note to ethanol industry investors earlier this month, Chris L. Shaw, a UBS investment research analyst, acknowledged the controversy over ethanol's role in higher food prices. "We believe that, despite all the recent talk and news coverage of the food vs. fuel debate, it is unlikely that the [ethanol] subsidy will be repealed or waived anytime soon," he wrote. "Although it is very likely that the rapid build up of the ethanol industry has helped to contribute to higher food prices globally, it is unlikely in our view that the industry will now be dismantled by the government that helped build it."

Whatever mix of alternative energy sources the government chooses to support, it would be wise to keep in mind the principles of change management, says Oktem. "Change management should always be the overarching methodology. All these ideas can be very good, but one has to recognize their broad impact."

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