

Jack Venrick

From: "Jack Venrick" <jacksranch@skynetbb.com>
To: "AJack R. Venrick" <jacksranch@skynetbb.com>
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<http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/06/27/MNG1VDF6EM1.DTL>

UC scientist says ethanol uses more energy than it makes

A lot of fossil fuels go into producing the gas substitute

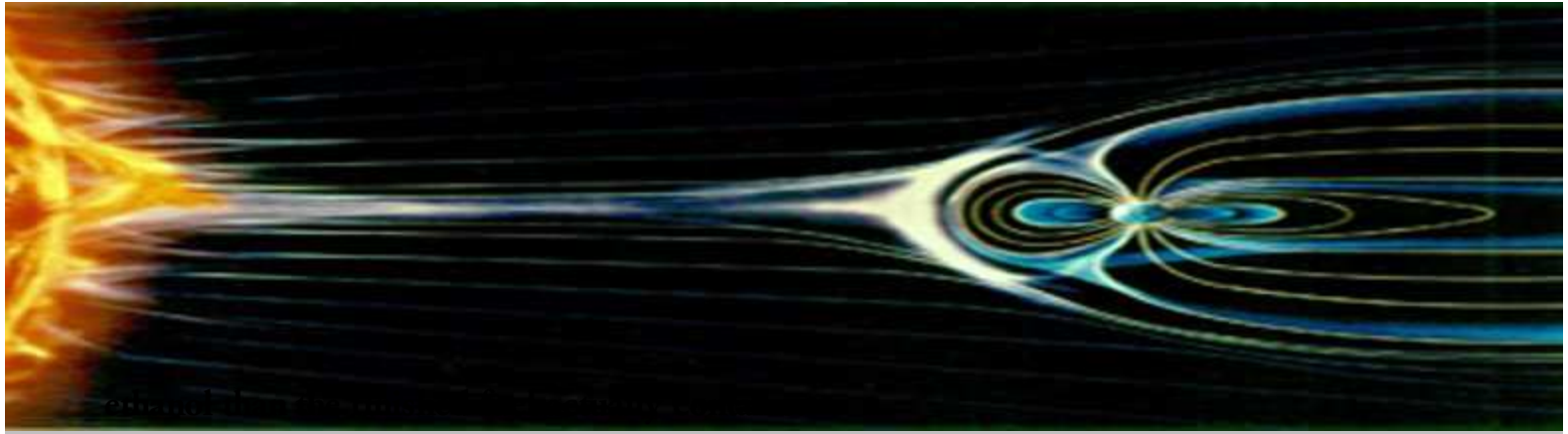
Elizabeth Svoboda, Special to The Chronicle

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Ethanol, touted as an alternative fuel of the future, may eat up far more energy during its creation than it winds up giving back, according to research by a UC Berkeley scientist that raises questions about the nation's move toward its widespread use.

A clean-burning fuel produced from renewable crops like corn and sugarcane, ethanol has long been a cornerstone of some national lawmakers' efforts to clear the air and curb dependence on foreign oil. California residents use close to a billion gallons of the alcohol-based fuel per year.

But in a recent issue of the journal *Critical Reviews in Plant Sciences*, UC Berkeley geoenvironment professor Tad Patzek argued that up to six times more energy is used to make



The fossil energy expended during production alone, he concluded, easily outweighs the consumable energy in the end product. As a result, Patzek believes that those who think using the the "green" fuel will reduce fossil fuel consumption are deluding themselves -- and the federal government's practice of subsidizing ethanol by offering tax exemptions to oil refiners who buy it it is a waste of money.

"People tend to think of ethanol and see an endless cycle: corn is used to produce ethanol, ethanol ethanol is burned and gives off carbon dioxide, and corn uses the carbon dioxide as it grows," he he said. "But that isn't the case. Fossil fuel actually drives the whole cycle."

Patzek's investigation into the energy dynamics of ethanol production began two years ago, when when he had the students in his Berkeley freshman seminar calculate the fuel's energy balance as as a class exercise.

Once the class took into account little-considered inputs like fossil fuels and other energy sources sources used to extrude alcohol from corn, produce fertilizers and insecticides, transport crops and dispose of wastewater, they determined that ethanol contains 65 percent less usable energy than is consumed in the process of making it.

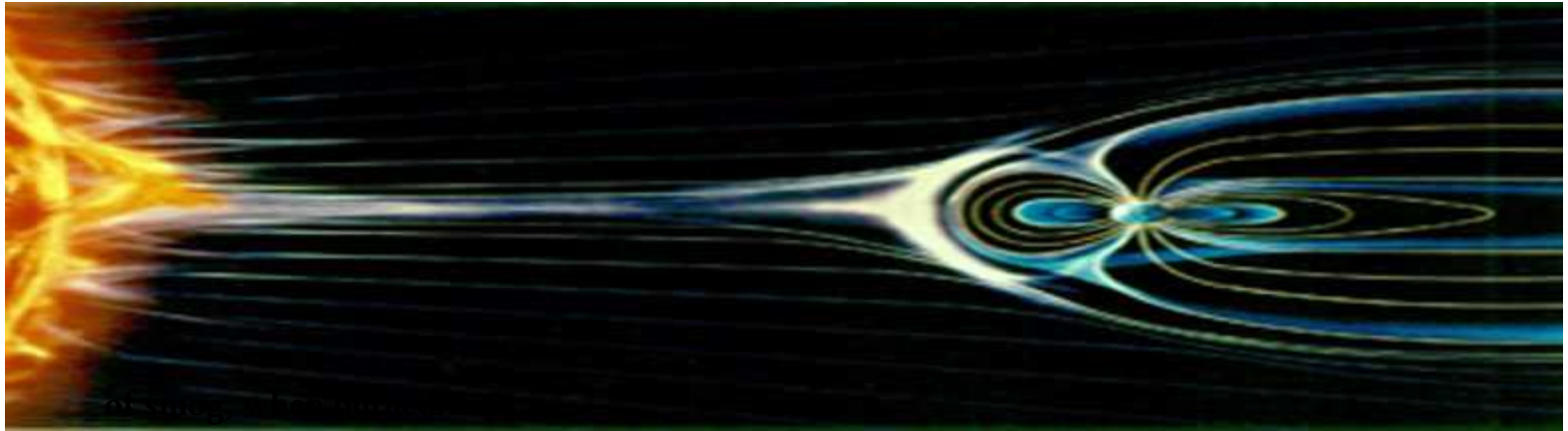
Surprised at the results, Patzek began an exhaustive analysis of his own -- one that painted an even bleaker picture of the ethanol industry's long- term sustainability.

"Taking grain apart, fermenting it, distilling it and extruding it uses a lot of fossil energy," he said. "We are grasping at the solution that is by far the least efficient."

Patzek's report also highlights the potential environmental hazards of ethanol production.

"When you dump nitrogen fertilizer on corn fields, it runs away as surface water, into the Mississippi River and Gulf of Mexico," he said.

The excess nitrogen introduced into the water causes out-of-control algae growth, creating an oxygen-poor "dead zone" where other marine plants and animals cannot survive. And while ethanol produces fewer carbon monoxide emissions than regular gasoline, some researchers have have found that ethanol releases high levels of nitrogen oxide, one of the principal ingredients of



Ethanol has long been touted not just for its promise as a renewable fuel, but for its usefulness as a gasoline additive. Fossil fuels blended with it produce fewer carbon monoxide emissions than regular gasoline and have a higher octane rating, meaning they burn more evenly and are less likely to cause engine knocking. While most gasoline sold in the United States now contains approximately 5 percent ethanol, some cars -- such as the Ford Explorer and Chevy Silverado -- can run on fuel blends containing up to 85 percent.

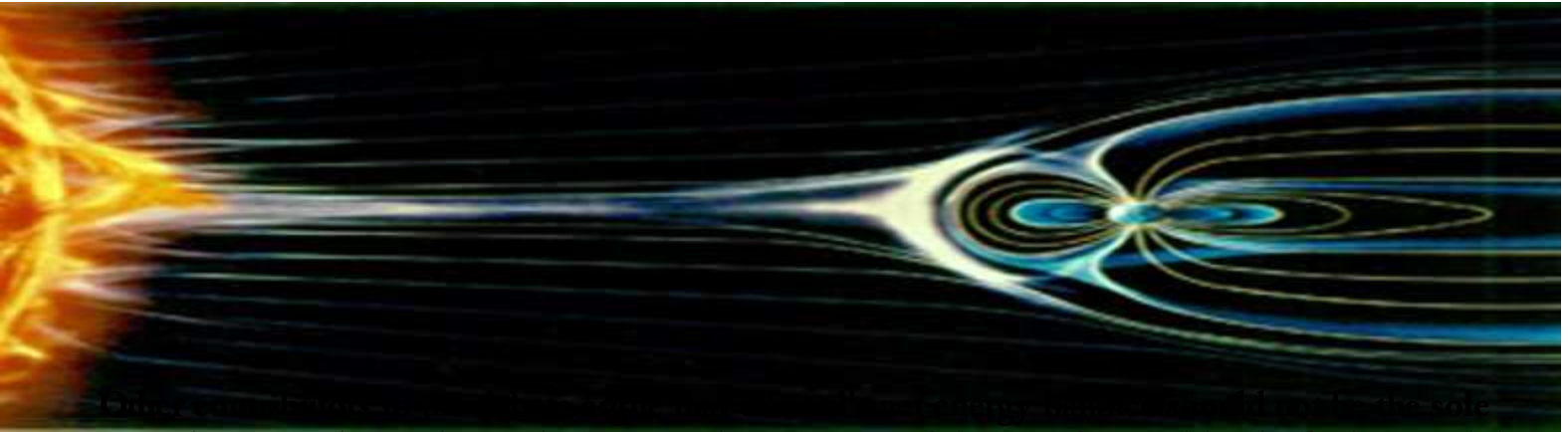
Though his work has been vetted by several peer-reviewed scientific journals, Patzek has had to deflect criticism from a variety of sources. David Morris, an economist and vice president of the Minneapolis-based Institute for Local Self-Reliance, has attacked the Berkeley professor's analysis because he says it is based on farming and production practices that are rapidly becoming obsolete.

"His figures (regarding energy consumed in fertilizer production) are accurate for older nitrogen fertilizer plants, but newer plants use only half the energy of those that were built 35 years ago," he said. He also cited the increasing popularity of no-till farming methods, which can reduce a corn farm's diesel usage by 75 percent. "With hydrogen fuel, people are willing to say, '25 years from now it will be good.' Why can't we also be forward-looking when it comes to ethanol?"

Hosein Shapouri, an economist at the U.S. Department of Agriculture, has also cracked down on Patzek's energy calculations.

"It's true that the original ethanol plants in the 1970s went bankrupt. But Patzek doesn't consider the impact new, more efficient production technologies have had on the ethanol industry," he said.

Shapouri's most recent analysis, which the USDA published in 2004, comes to the exact opposite conclusion of Patzek's: Ethanol, he said, has a positive energy balance, containing 67 percent more energy than is used to manufacture it. Optimistic that the process will become even more efficient in the future, he pointed out that scientists are experimenting with using alternative sources like solid waste, grass and wood to make ethanol. If successful on a large scale, these techniques could drastically reduce the amount of fossil fuel needed for ethanol production.



consideration when policymakers are evaluating its usefulness -- factors like the fuel's portability portability and lower carbon monoxide emissions need to be considered as well.

"So what if we have to spend 2 BTUs for each BTU of alcohol fuel produced?" reads an editorial editorial in the Offgrid Online energy newsletter. "Since we are after a portable fuel, we might be be willing to spend more energy to get it."

Cornell University ecology Professor David Pimentel, however, sides with Patzek, calling production of ethanol "subsidized food burning."

"The USDA isn't looking at factors like the energy it takes to maintain farm machinery and irrigate fields in their analysis," he said, adding that the agency's ethanol report contains overly optimistic assumptions about the efficiency of farming practices. "The bottom line is that we're using far more energy in making ethanol than we're getting out."

Patzek thinks lawmakers and environmental activists need to push ethanol aside and concentrate concentrate on more sustainable solutions like improving the efficiency of fuel cells and hybrid electric cars or harnessing solar energy for use in transport. If they don't, he predicts economics will eventually force the issue.

"If government funds become short, subsidies for fuels will be looked at very carefully," he said. said. "When they are, there's no way ethanol production can survive."