

New Fuel Source Grows on the Prairie

With Oil Prices Up, Biomass Looks More Feasible

By [Justin Gillis](#)

Washington Post Staff Writer

Thursday, June 22, 2006; Page A01

IMPERIAL, Neb. -- Just outside this town in the middle of the great American prairie, 37 miles from the nearest traffic light, stands a huge pile of cornstalks and leaves. It looks like a 35-foot mountain of yard trash, yet black cables snake into the pile, attached to sensors that monitor its vital statistics by the minute.

If ambitious plans taking shape in Washington and in state capitals come to fruition, this pile of stalks and many more like it will become the oil wells of the 21st century. The idea is to run the nation's transportation system largely on alcohol produced from bulk plant material, weaning America from foreign oil and the risks that go with it, including wars, global warming and terrorism.

Farmers have pushed for years to get more people using gasoline mixed with ethanol made from corn kernels, but so far such ethanol has replaced only about 3 percent of the nation's gasoline, and by most estimates, the country would never be able to grow enough corn to replace more than 10 or 12 percent of its fuel supply.

Now many scientists -- and eager Silicon Valley venture capitalists -- are focusing on a new type of ethanol made from agricultural wastes and other plant residues, a potentially vast supply of material known as biomass.

While ethanol made from cornstalks may sound a lot like ethanol made from corn, the technology required is markedly different. The technique was long considered too expensive to compete with gasoline produced from oil, but the cost is declining rapidly just as oil prices hit record highs.

Experts say that soon, those trends will open the possibility of a vast new industry in this country producing a homegrown fuel.

If the notion that a country the size of the United States could power its vehicle fleet on what amounts to moonshine seems crazy, consider this: Brazil is already well on its way to running a fleet on rum. After a 30-year campaign, Brazil has replaced 40 percent of its gasoline with alcohol produced from sugar cane. With new oil wells coming on line this year, the country is expected to declare independence from foreign oil producers.

The sugar-cane plan won't work in the United States -- only a few states have the right climate. But the country has vast supplies of wood chips, sawdust, wheat straw, waste paper and many other materials that could be turned into liquid fuels, and it has millions of acres that could be devoted to growing special energy crops like the switchgrass President Bush has mentioned repeatedly this year.

"If you think we're heading towards a future where oil prices are going to stay relatively high, \$50-plus a barrel, then the energy cost delivered in plant biomass is much, much less than the energy cost delivered in oil," said Bruce E. Dale, head of the Biomass Conversion Research Laboratory at Michigan State University. "I'm completely convinced that this industry is going to happen on economic grounds alone. The demand for liquid fuels is so high and rising that we're going to convert an awful lot of stuff to liquid fuels."

Speculative investment capital and even money from some of the big oil companies is moving into the field. A handful of biomass-ethanol companies have built pilot plants, and some are scouting locations for bigger facilities. Politicians are trying to hurry the industry along, with Congress dangling potential loan guarantees to pioneer companies.

Yet fundamental questions about the biomass alternative have yet to be answered. The economics of making ethanol from biomass remain unproven on a commercial scale. Simply collecting all the necessary straw, cornstalks, wood chips and other waste would be a vast logistical problem, and growing energy crops would require big changes in U.S. agriculture.

Nobody is even sure how to store most types of biomass -- an elementary problem in producing a year-round fuel from a seasonal feedstock. That's the question the pile of cornstalks in Nebraska is meant to answer.

Scientists have projected that in the long run, ethanol made from biomass could be cheaper than gasoline or corn ethanol, costing as little as 60 cents a gallon to produce and selling for less than \$2 a gallon at the pump. But right now it would be more expensive than gasoline, and the low prices are likely to be achieved only after large plants have been built and technical breakthroughs achieved in operating them.

Perhaps the biggest issue is this: Time and again, the country has grown interested in alternative fuels only to drop the subject as soon as oil prices fell. Will the United States be able to make a plan and stick with it for the long haul?

Big Oil Needs Ethanol

The oil and coal and natural gas that people use today was itself plant residue, millions of years ago. That residue got buried before it could fully decompose, and heat and pressure within the Earth cooked it into its present form: fossil fuels rich in carbon compounds. In essence, modern society is trying to develop a technology that skips the burial step, converting biomass directly to fuel. "We want to speed it up a bit," Dale said.

The benefits could be substantial. Burning fossil fuels releases buried carbon back into the air in the form of carbon dioxide, and since the industrial revolution the concentration of that gas in the atmosphere has jumped to levels unseen on the planet in more than 600,000 years. The elementary laws of physics -- carbon dioxide is a "greenhouse gas" that traps heat -- suggest that it will warm the Earth, though how fast is uncertain.

In contrast, a system that converted biomass directly to transport fuel would be potentially neutral as far as greenhouse gases. Plants would suck carbon dioxide out of the air in, say, May, and cars burning the resulting fuel in October would re-emit the same carbon dioxide.

In addition, many people believe that such a system would improve the nation's security, given that two-thirds of the world's oil reserves are in the unstable Persian Gulf region.

Two former directors of central intelligence, R. James Woolsey and John M. Deutch, have become advocates of biomass as a fuel source. The basic insight, Woolsey said in an interview, is to realize that global warming, the geopolitics of oil, and warfare in the Persian Gulf are not separate problems -- they are aspects of a single problem, the West's dependence on oil. Woolsey throws fundamentalist Muslim terrorism into the mix, noting that funds for the schools that turn out Islamic radicals come from Persian Gulf states enriched by oil money.

"This is the only war the U.S. has ever fought where we pay for both sides," Woolsey said.

Scientists have long known that the carbohydrates in plants could be converted to the hydrocarbons in fuel and other valuable chemicals. But inefficient conversion techniques couldn't compete, on price, with an industry that obtained its valuable chemicals by poking holes in the ground.

Since the oil crises of the 1970s, companies and farm cooperatives have been making ethanol from corn kernels. They fought a tooth-and-nail battle with the petroleum industry, which funded much research attempting to discredit ethanol, but lately a truce has been declared. The oil companies need ethanol to stretch tight gasoline supplies and to replace a gasoline additive that causes environmental problems, and the corn ethanol business, buoyed by federal subsidies and mandates, is booming.

The basis of that industry is a simple sugar called glucose that corn plants pack into long, loosely knit molecules called starch. Turning the starch into sugar and then fermenting it into alcohol is easy, but there's a limit on how much ethanol can be produced from the nation's corn harvest without hurting the food supply.

For 30 years, some scientists have believed the ultimate feedstock for transportation fuel would be something called cellulose--for the elementary reason that it is the most abundant organic molecule on the planet.

Cellulose, like starch, is made up of glucose molecules, but packed so tightly they're extremely hard to break apart. Plants use cellulose chiefly as a structural material -- it helps trees and grasses stand upright. If efficient ways were developed to break open the molecules, a wide variety of agricultural wastes or specially planted energy crops could feed the new industry.

Scientific progress has been slow, but now it seems to be accelerating. Enzymes needed for the process used to cost more than \$5 per gallon of ethanol, but biotechnology companies, under government research contracts, have reduced that to 30 cents per gallon. A handful of small companies, exploiting the drop, are already making small amounts of ethanol from biomass, and

claim that they are close to doing so at competitive prices. Not only are they shopping for locations for bigger plants, they are also signing contracts with farmers to supply raw material.

A remarkable variety of groups, ranging from the Natural Resources Defense Council to conservative national-security hawks, have endorsed plans for biomass ethanol. "I've never seen anything with this many interest groups lining up behind it," said Brent Erickson, a vice president at the Biotechnology Industry Organization, which supports the efforts. A study by the government's Oak Ridge National Laboratory has estimated that the United States could replace more than 30 percent of its imported oil with fuel and chemicals made from biomass. Coupled with domestic oil, more corn ethanol and improved automobile efficiency, that would take the nation a long way toward energy independence.

Now a new set of questions is dawning in farmhouses across the land. If the industry takes off, what would be the practical realities of gathering hundreds of millions of tons of bulk material to feed the ethanol factories of the new age?

Waste to Energy

The high, dry, volcanic plain of eastern Idaho may be America's answer to Brazil's equatorial sugar-cane fields. There, under brilliant sunshine, farmers pull plentiful snowmelt off the Tetons to produce bumper crops of wheat, barley and potatoes.

It's an agricultural system that creates so much waste straw that orange flames sometimes lick the desert air as farmers burn off the excess. "That's energy that should be going to run cars," said Corey W. Radtke, a scientist at Idaho National Laboratory.

In a few years, it may be doing just that.

Iogen Technologies LLC, a Canadian company in the vanguard of those trying to turn biomass into liquid fuel, is eyeing Idaho's Snake River Valley. The company operates a pilot plant in Canada and claims that it could make biomass ethanol in a bigger plant for about \$1.30 a gallon, comparable to the production cost of corn ethanol. Royal Dutch Shell PLC, the big oil company, is among the early investors. Canada and Germany are wooing Iogen, but if the U.S. government comes through with loan guarantees, many people expect the company to build its first big plant in Idaho.

Ray Hess is more than ready. A prominent Idaho farmer with ruddy skin and bushy white eyebrows, he sat at a restaurant table the other day gazing at the Snake River and outlining the high yields and other assets that make the area so attractive to companies like Iogen. "They've been through 900 counties in the U.S., and this is the one that works the best," he said.

Hess has helped Iogen line up hundreds of farmers as potential straw suppliers. They're confident that they can deliver many tons of straw a year, in neat bales, for the company to shred and turn into ethanol.

But they also realize they're a special case -- there may be no cleaner, more accessible form of biomass in the country than the wheat and barley straw in the Snake River Valley. If ethanol made from biomass is to grow into a huge business, it will need to spread far beyond Idaho, using wood chips, waste paper, rice hulls and other materials that are harder to handle than straw.

The single biggest source, in the near term, is likely to be the leaves, stalks and stubble left over when corn is harvested -- a material known as corn stover. A group of young farmers in Imperial, Neb., is far ahead of the rest of the country in thinking about how to handle stover.

Members of Imperial Young Farmers & Ranchers hope to land a biomass ethanol plant for their area, but -- like farmers everywhere else -- they lack elementary information about how such an industry might work. They've won federal and private grants exceeding \$3 million to help them find out.

With help from scientists, they're studying how much stover can be pulled from farms without damaging the soil. Baling the stuff is difficult, so the farmers have built a mountain of stover outside town to see if it can be stored for months in big, damp piles. Farmer Rod Johnson and his sons have lent some of their property for testing; a weather station in the middle of one of their fields beams data back to the nation's scientific establishment. "We're young farmers, and we're optimistic," one of the sons, Curtis Johnson, said the other day.

Yet questions like these may need to be answered county-by-county across the country, and the work has barely begun. With the nation vulnerable to oil shocks from abroad, with oil prices spiraling higher, and with scientific evidence of global warming mounting, many people feel a sense of urgency.

Bryan M. Jenkins, a professor at the University of California at Davis, said a more intensive effort is needed to solve the scientific and economic problems standing in the way of greater use of biofuels in the United States.

"We're going to need to make this transition fairly soon," he said. "I don't think we can afford to wait another century before we do something."