Big Sugar envisions its future powered by ethanol

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By Michael Burnham

Greenwire: SOUTH BAY, Fla. — It looks like a mirage in the humid haze of summer.

In a place where the flat line between soil and sky is seldom broken, a mountain two shades of brown juts from a sea of emerald sugarcane. Reaching still higher is an industrial tangle of steel pipes, conveyor belts and smokestacks.

Here, amid what was a vast Everglades marsh a century ago, is North America's largest biomass power plant. Its massive boilers vaporize hulking piles of wood and sugarcane waste into steam and up to 140 megawatts of electricity — enough to power an adjacent sugar mill, refinery and 60,000 homes.

"We're growing our fuel every day," boasts Gaston Cantens, vice president of Florida Crystals Corp., the sugar complex's owner.

And one day soon, Cantens hopes to grow a new source of fuel for Americans' cars and revenue for a sugar industry with an uncertain future.

The West Palm Beach-based company and Florida International University are embarking on research aimed at converting sugarcane waste — known as bagasse — into cellulosic ethanol. The clean-burning biofuel is not yet produced or sold commercially, but President Bush and agribusiness interests are promoting it as a home-grown hedge against volatile international oil markets and climate change.

Florida, the nation's No. 9 agricultural state by volume, could produce perhaps 100 million tons of biomass per year from its sugarcane fields, citrus groves, pine forests and vegetable farms. That's enough feedstock for about 10 billion gallons of fuel, estimates Lonnie Ingram, a University of Florida microbiology professor.

"Florida is very good at growing things," adds Ingram, who hopes to break ground this fall on the state's first cellulosic biorefinery. "We have water. We have sun. We're just growing all of the time."

An intriguing potential site for the more than 2-million-gallon-per-year demonstration refinery, he notes, is adjacent to Florida Crystals' Okeelanta operation — deep in the heart of the 1,200-square-mile Everglades Agricultural Area (EAA).

But for all the haste to commercialize cellulosic ethanol, the effort faces formidable financial and environmental hurdles. Scientists debate whether it would take more fossil energy to make cellulosic fuel than it displaces. And Florida's biggest and oldest sugar

producer, U.S. Sugar Corp., views the effort to turn tough plant waste into ethanol with skepticism.

But for every misgiving, there's moxie.

"I don't think we would be getting into this if we didn't know it could be done in the end," says Stephen Clarke, Florida Crystals' industrial research director. "We understand the growing of cane."

An industry in flux

In the wake of Fidel Castro's takeover of Cuba in 1959, the leftist government seized thousands of acres of farmland. Alfonso and Pepe Fanjul, scions of four generations of Cuban sugar producers, fled to Florida to plant anew.

The brothers started growing cane on 4,000 acres of muck soil south of Lake Okeechobee in 1960. Within five decades the Fanjuls' holdings in the EAA grew to 150,000 acres, making Florida Crystals the state's No. 2 sugar producer.

Ironically, the flagship subsidiary of the Fanjuls' Flo-Sun Inc. owes much of its clout to Castro.

The Marxist dictator's seizure of Havana at the height of the Cold War spurred the United States to embargo Cuban sugar and repeal Sugar Act restrictions on domestic producers. Almost overnight, farmland south of Lake Okeechobee — which was already home to U.S. Sugar — became the United States' "sugar bowl."

The United States is the world's No. 2 importer of raw sugar, bringing in 1.5 million tons per year from 41 countries. But imports total 15 percent of U.S. consumption, notes Dalton Yancy, executive vice president of the Florida Sugar Cane League, a trade group for growers and processors. The remaining 85 percent of the market is divided among domestic producers of sugar beets and states that grow cane.

Florida is allotted about 1.7 million tons per year under the U.S. sugar program. Florida Crystals and Clewiston-based U.S. Sugar split 80 percent of the state's production pie. The remaining 20 percent is allotted to the Sugar Cane Growers Cooperative of Florida.

The complex quota and allotment system has helped keep the average wholesale price for U.S. refined sugar at about 25 cents per pound during the past 25 years, according to the Agriculture Department. And while guaranteed market access has been sweet for the $10-

billion-per-year industry, producers say a confluence of global forces has steadily eroded their profit margins.

Rising costs for machinery, labor and fuel have spurred U.S. producers to shutter more than 30 beet and cane factories in the past decade, according to the industry. The EAA today has four working mills — half its peak number.

The horizon is even hazier. North American Free Trade Agreement tariffs expire at the end of the year, opening U.S. borders to subsidized Mexican sugar.

The question is how much the U.S. market can handle.

“There’s a lot of uncertainty ahead of us,” warns Patrick Westhoff, a sugar economist with the Food and Agriculture Policy Research Institute, a joint program of the University of Missouri and Iowa State University.

The cartel of U.S. sugar producers is notoriously opaque, but Yancy claims that its revenue stream has dried to the “nonprofit level.”

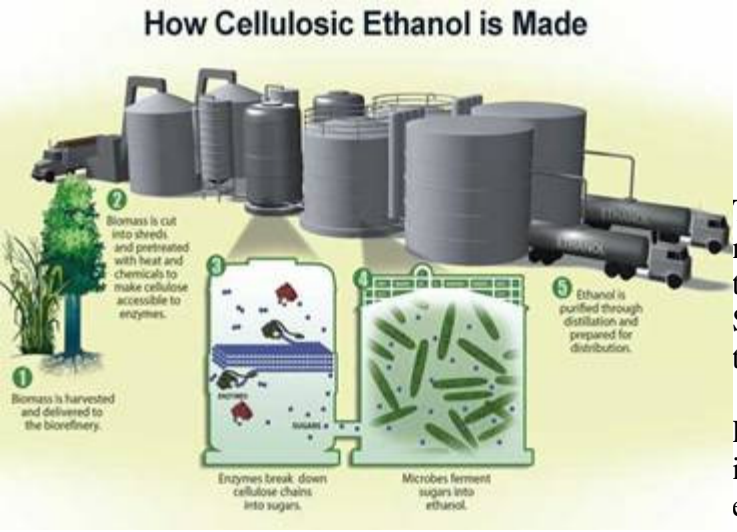
“We’re having trouble keeping farmers interested in growing sugarcane,” he says, “because they can’t make any money at it.”

Investment risk

Florida Crystals and U.S. Sugar officials declined in interviews to disclose their profit margins. But the producers concede that turning waste into energy is essential to their industry’s survival.”In today’s environment … you have to be very lean,” underscores Robert Coker, a senior vice president at U.S. Sugar. “Since we cannot increase production, we have to lower the cost of doing business.”

U.S. Sugar is spending tens of millions of dollars to make its 1927 Clewiston Sugar Mill one of the largest and most efficient such facilities in the world. By October, the remodeled plant will be capable of producing 42,000 tons of sugar per day from bagasse-fired boilers, Coker says.

The veteran sugar and citrus producer is also treading carefully into the ethanol business. Citrus Energy LLC plans to break ground this fall on a cellulosic ethanol refinery in Clewiston adjacent to a citrus processing plant owned by a U.S. Sugar subsidiary, Southern Gardens Citrus. The citrus plant would provide the refinery with orange peels, seeds and other waste as fuel feedstock.



The commercial-scale refinery should be able to make about 4 million gallons per year of fuel from the waste, says Citrus Energy's CEO David Stewart, who hopes to build additional refineries throughout citrus country.

For now, U.S. Sugar has no plans to go directly into the biofuels business. "We've looked at the ethanol issue extensively, but we've been unable to make a business plan that assures we can get a reasonable return on our investment," Coker says.

Westhoff and other industry experts point out that sugar itself is worth far too much to turn directly into fuel. The catch is that there is plenty of cane waste and other biomass, but the nation's first biorefineries will require significant public and private investments.

"There's an awful lot of people who want to build the second plant," Stewart says. "It's a classic venture-capital risk scenario."

But with the sugar industry's future uncertain, Florida Crystals says it needs to explore ethanol. The company could build a refinery or ink a feedstock deal with a refiner, notes Cantens.

"We're looking at our options," he adds. "In the cellulosic ethanol business everyone is dancing, but no one knows who to dance with yet."

A decade or more away

The dance itself is a hot and sweaty affair that starts with Florida's rich, black soil and heavy air.The cane harvest begins in October when the fields are set afire to burn away weeds. Mechanical harvesters then ply the fields, cutting the thick cane stalks just above the root.

At Florida Crystals' Okeelanta mill, 10-inch cane segments are shredded and pressed. Every drop of sweetness is wrung from the plant and crystallized into sugar.

In any given year, the Okeelanta mill produces about 400,000 tons of raw sugar. About 850,000 tons of leftover bagasse is combined with urban wood waste and fed into the biomass power plant's massive boilers.

"One of the advantages of making ethanol from bagasse is we in the sugar business have already collected it and ground it up," Florida Crystals' Clarke notes.

Yet another advantage of using bagasse, he continues, is that its lignin remnants could be burned in boilers after the ethanol-making process. That prospect has many farmers dreaming about harvesters running on fuel made from their crops.

But first, no less than an Apollo mission for the new millennium may be necessary, experts say.

Moonshine to moonshot

Even with hefty government support, cellulosic ethanol is still at least a decade away from making a splash in the marketplace, the Energy Department says.In the meantime, an academic debate rages over the environmental benefits of cellulosic versus corn ethanol.

“I think we should research [cellulosic fuels],” says David Pimentel, an agricultural sciences professor at Cornell University. “But if we’re talking about diving in and making a quick profit, I would be hesitant.”

The vast majority of the ethanol burned in U.S. vehicles today comes from corn, he points out. Converting corn into ethanol is not all that unlike making moonshine.

Brewing biomass is far more complicated. It first requires softening the plant’s tough, cellulosic structure. Enzymes or other catalysts must be added to degrade biomass’ sugar into shorter, fermentable sugar strands.

The moonshot for the sugar industry is establishing efficient, affordable pre-treatment and enzymatic processes.

“Mother Nature has made several layers of protection in cellulosic material that we have to defeat,” says Bruce Dale, a professor of chemical engineering and materials science at Michigan State University.

Later this summer, Florida Crystals and Florida International University plan to test several bagasse pre-treatments, including steam and hydrogen peroxide, says George Philippidis, associate director of FIU’s Applied Research Center in Miami.

For cellulosic ethanol to be cost-competitive with gasoline, researchers must reduce biomass pre-treatment costs by a third, to less than 10 cents per pound, Philippidis says.

Meanwhile, University of Wisconsin researchers will attempt to improve sugar yields from pre-treated biomass. Enzymes, such as those found in termites and rotting trees, are the most effective catalysts today. But producing enough for a large ethanol refinery is extremely expensive, says Tim Donohue, a Wisconsin professor and director of the DOE-funded Great Lakes Bioenergy Research Center in Madison.

“This is like being challenged to go to the moon,” Donohue says. “We know where to go, but we don’t know how to get there yet.”

Energy endgame

Reducing the energy consumed in making sugar ethanol could also prove to be a sticky proposition.Bagasse that remains after sugar juice has been extracted is about 50 percent water. And even after fermentable sugars have been freed from their cellulosic prison, the leftover lignin is dissolved in water.

The challenge is finding an efficient way to burn the leftover lignin in a refinery's or power plant's boilers. The lignin could be dried in a centrifuge or sprayed wet into a boiler, but both require a lot of energy, Cornell's Pimentel says.

He figures it takes about 1.5 gallons of oil to make a gallon of cellulosic ethanol. It also takes roughly twice as much cellulosic material as corn to yield an equal amount of fermentable sugar, Pimentel wrote in a 2005 article in the peer-reviewed journal, *Natural Resources Research*.

But Michigan State's Dale and University of California-Berkeley professor Alex Farrell published a paper last year that says cellulosic ethanol displaces more fossil energy than it consumes. What's more, cellulosic ethanol produces about 88 percent fewer greenhouse gas emissions than gasoline.

The caveat is that the leftover lignin must be burned efficiently in a refinery's boilers.

Bottom line: Researchers have a lot to learn.

"Tomorrow's technology may look very similar to today's, with small changes," Wisconsin's Donohue concedes. "But as a taxpayer, I hope that tomorrow's technology looks radically different than today's."

It's a moonshot that Florida Crystals' Clarke is willing to take.

"We need to have as many complementary activities as possible," he says. "We would be derelict not to look at cellulosic ethanol."