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## Brazil's Road to Energy Independence

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Alternative-Fuel Strategy, Rooted in Ethanol From Sugar Cane, Seen as Model

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SAO PAULO, Brazil -- Record oil prices have made the world's energy landscape a darkly foreboding place this year, inhospitable to optimism and celebration. Except in Brazil.

It has been something of a banner year here, full of milestones. The government predicts that for the first time in its history, Brazil will achieve energy equilibrium, exporting as much oil as it imports. The production of sugar cane-based ethanol is expected to reach an all-time high. And just three years after the introduction here of flex-fuel vehicles -- cars that run on either ethanol or gasoline -- several major automakers predict that such vehicles will represent 100 percent of their production by the end of the year, eliminating gas-only models.

Pull up to most service stations in this country of 185 million people and you will find fuel pumps offering three choices: ethanol, gasoline or premium gasoline. The labels are slightly misleading: The gasoline varieties are blends that contain at least 20 percent ethanol. The pure ethanol is usually significantly cheaper -- 53 cents per liter (about \$2 per gallon), compared with about 99 cents per liter for gasoline (\$3.74 per gallon) in Sao Paulo this past week.

"I buy gasoline only if I can't get anything else," said Alexandre Rigueirra, 28, a Sao Paulo taxi driver who modified his flex-fuel Chevrolet to also use natural gas, which is sold at many locations throughout the country. "Gasoline is always the last option."

Since President Bush this year emphasized ethanol as one possible solution to U.S. oil dependence, Brazil has become a destination of choice for curious U.S. lawmakers and venture capitalists searching for a crystal ball in which to glimpse America's future. Ethanol is not solely responsible for Brazil's newfound energy independence -- domestic oil exploration has exploded in recent years -- but it has replaced about 40 percent of the country's gasoline consumption, according to Caio Carvalho, an analyst with Cambridge Energy Research Associates in Rio de Janeiro.

"It's amazing how sharply the level of interest in our experience here has jumped in recent months," said Eduardo Pereira de Carvalho, president of Sao Paulo's sugar cane producers union. "We receive visiting politicians from the U.S., and we get invitations to speak to the Senate Foreign Relations Committee and to leaders of investment funds. They know that Brazil's ethanol program exists, but beyond that, most of them have very little information about our actual experience."

That experience has been a sometimes painful 30-year evolution, marked by plenty of foresight and numerous false starts. It was born of a uniquely Brazilian political and economic environment, but industry analysts say it nevertheless provides lessons for a fledgling U.S. ethanol program that is already on pace to dethrone Brazil's as the largest in the world.

### Subsidies and Mandates

Brazil's military dictatorship launched the national ethanol program in 1975, when about 90 percent of its fuel consumption depended on foreign oil. The government offered subsidies to sugar cane growers and forced service stations in every town of at least 1,500 people to install ethanol pumps. By the early 1980s, almost all new cars sold in Brazil ran on 100 percent ethanol.

But as the decade progressed and the military government was replaced by democracy, oil prices plummeted and the subsidies granted to ethanol producers were eliminated. Sugar processing plants turned from ethanol to edible sugar, creating a shortage of supplies at service stations. The auto industry, which had dedicated itself to ethanol-only cars, stopped producing them almost entirely.

"It was as if from one day to the next, the people who had ethanol cars had a problem on their hands, because no one wanted to buy them," said Henry Joseph Jr., head of the engineering program for Volkswagen of Brazil. "Ethanol cars went all the way from more than 90 percent of sales to less than 1 percent."

Through it all, the Center for Sugarcane Technology in Sao Paulo state -- a research facility created in the early 1970s and funded by the sugar industry -- continued working to improve efficiency in ethanol production by tinkering with almost everything from the genetic structure of sugar cane varieties to the industrial components of extraction. By the time oil prices began to rise steadily in the early years of this decade, ethanol producers had reduced production costs of a liter of ethanol from about 60 cents to about 20 cents.

Surrounded by fields of sugar cane that stretch in all directions, the center today boasts nearly 300 scientists, led by a research and development manager, Jaime Finguerut. Although he said the sugar growers recoiled when their subsidies were taken away, the move ultimately forced the industry to become more efficient. The subsidies offered U.S. farmers might be their own worst enemy, he suggested.

"A protected agriculture industry doesn't mean it's an efficient one, but if you have lots of money available for research, you can find good solutions," said Finguerut, who began working at the center in 1979. "We didn't have that investment money, and we went through some very tough steps to eventually arrive at a better situation."

Because most service stations still offered ethanol at the pumps to serve the remaining ethanol-burning cars from the industry's early days, ethanol suddenly seemed economically viable again by early 2003. That's when Volkswagen introduced the first flex-fuel vehicle to the Brazilian market, and other companies -- including General Motors and Ford -- eventually followed suit.

Some of those same companies are preparing to attempt a similar, though perhaps less extensive, transformation in the United States. Ford announced this year that it was scrapping plans to expand its fleet of gasoline-electric hybrids to focus instead on increasing flex-fuel production.

"Today, we're living in the moment between the internal combustion engine and a future of electric engines, and how to best get from here to there is difficult for any country to decide," said Joseph, the Volkswagen engineering manager. "Flex-fuel is one of a thousand ways to do that. It's simple to implement because it uses the same distribution model for supplying the market with fuel, and if you ever have supply problems, you can simply switch from one fuel to another."

In Brazil, the transition to the new fleet has changed the habits of many drivers and, in many cases, sharpened their math skills. Many drivers are keenly aware that ethanol has about 70 percent of the fuel efficiency of gasoline, which means they perform quick, pump-side calculations to determine whether the price of ethanol is at least 30 percent less than the price of gas. Some plot the distance of their trips and choose gasoline if it means the difference between filling up once or twice.

### **Facing Challenges**

The rapid increase in the use of ethanol already has stretched existing resources thin, and that stress has highlighted environmental threats that represent some of the industry's most daunting challenges.

Earlier this year, Brazil's Agriculture Ministry dropped the mandatory content of ethanol in all gasoline

products from 25 percent to 20 percent because of concerns about shortages. The growing season for sugar cane lasts seven months, leaving a production gap between December and April. But this year, some producers began harvesting immature sugar cane as early as late March. The result was a less efficient crop, and evidence that demand was threatening to overtake supply.

To compensate, about 40 to 50 new production plants are to join the existing 340 within the next year. That means more land likely will be cleared for growing sugar cane, exacerbating the already divisive issue of land preservation in Brazil.

Recent studies in the United States have suggested that the entire American corn crop would provide enough fuel to replace only about 12 percent of U.S. gasoline demand. To help plug that potential gap, some in the United States have advocated importing ethanol from Brazil. Though Brazil currently provides about 5 percent of U.S. ethanol, a duty of 54 cents per gallon -- a measure designed to protect American farmers -- makes a large-scale trade relationship unlikely.

"We would never be able to supply the United States with any substantial quantity of ethanol," said Carvalho, of the producers union. "But we could offer an equilibrium supply if the consumers in the U.S. had a voice in the matter. But it's the Midwest corn producers that are holding it up."

Comparing sugar cane ethanol with corn-based fuel in terms of the reduction of carbon dioxide and greenhouse gases is one that Brazilians such as Carvalho love to make. The ethanol extracted from corn yields only about 15 to 25 percent more fuel than the fossil fuels that were used to produce it. In Brazil, according to industry studies, the sugar-based ethanol yields about 830 percent more.

However, many experts in all aspects of Brazil's industry agree that the future of ethanol resides neither in sugar nor corn, but in cellulosic ethanol, a biofuel that theoretically could be extracted from almost anything from switch grass to scrap paper. The United States is leading research into developing cellulosic technology, and the Energy Department this month announced it was dedicating \$250 million for two new research centers dedicated to the cause.

At the sugar plants in Brazil, operators say they believe the future is already on display: Most of the plants burn bagasse, the leftover tissue from the sugar cane stalks, to power the production facilities. Because Brazilian cane has been genetically bred to yield more sugar throughout the years, the stalks are particularly weak -- which makes them easy to break down, and ideal for converting to energy.

"I believe that if cellulosic ethanol becomes accepted as the best idea for the future," said Finguerut, the research manager, "Brazil will be the best place to demonstrate that, as well."

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