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Next-generation sugarcane ethanol a sweet alternative to gasoline; Second-generation production may hold answer to making Brazil's ethanol industry more efficient

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As the world prepares to wean itself from fossil fuels, many eyes are turning to Brazil with its land mass nearly equal that of Canada, plentiful sunshine, history of sugarcane plantations dating to colonial times, and decades of experience producing and burning ethanol. The South American giant's principal feedstock is considerably more efficient than crops that predominate elsewhere, such as corn in the United States.

Domestic demand for ethanol is expected to double from its current level to 54.5 billion litres by 2022, according to the Brazilian Sugarcane Industry Association (UNICA).

The biofuel sector fell on hard times beginning in 2008. Now, despite the severe downturn in Brazil's economy over all, it witnessed a series of important investments during the second half of 2016 – including some by big names such as agribusiness multinational Cargill Inc. and domestic conglomerate Odebrecht. "They must see things as positive if they're making those moves," said **Usha Haley**, an emerging markets energy expert and professor of management at the University of West Virginia. "At least in terms of serving the large Brazilian market."

Brazil first embarked heavily on ethanol production during the oil crisis of the 1970s. Thanks to a national program called Proálcool, by 1986, 80 per cent of automobiles built in Brazil ran exclusively on ethanol produced from sugarcane, and the mixture in petroleum-based gasoline topped 20 per cent.

Pure ethanol engines were gradually phased out, notably as petroleum became more affordable again, but flex fuel vehicles now account for 90 per cent of the country's new-car sales, and the percentage of the mixture in petroleum-based gasoline was raised this year from 25 per cent to 27 per cent. As a result, Brazil has replaced an estimated 40 per cent of its gasoline needs, according to sugarcane.org, a website about the industry created by UNICA in partnership with a government trade promotion agency.

Nevertheless the sector is emerging from one of its worst downturns ever with sundry plant closures and job losses estimated at 300,000 since 2008. Some unemployment came from increased mechanization, but industry analysts tend to point their fingers primarily at the artificially low prices for gasoline by the state-owned petroleum giant Petrobras as part of the federal government's anti-inflation drive. Sugarcane mills couldn't compete.

"One problem is the very high level of debt among companies in the sector," said Marcos Fava Neves, professor of strategy at the Business School of the University of Sao Paulo, in Riberão Preto. "This is due to several factors, but one was the subsidies given to gasoline by the government and Petrobras in recent years."

When Petrobras announced a price increase in September, flex-fuel consumers suddenly found ethanol more attractive.

The ethanol industry was also hit by what Dr. **Haley** called "stochastic factors – things that no one can predict." She cited the shale-gas revolution, especially in the United States, which helped drive down oil prices, and the severe droughts that have plagued many parts of Brazil, notably in São Paulo state, one of the most important sugarcane growing regions.

Brazil's energy policy makers also seemed to be sidetracked by the discovery of a huge off-shore pre-salt petroleum deposit in 2006. "The illusion that the pre-salt would be a true blessing for Brazil wound up dampening the motivation for investment in the alcohol sector," said Roberto Teixeira da Costa, a member of the board of SulAmerica, a Sao Paulo-based insurance company. "Now that things have changed, we are coming to the conclusion that we need to revive the sector."

If renewed investment seems to coincide with the readjustment in fuel prices, several factors seem to indicate a brighter long-term future. Dr. Fava Neves cited more than a dozen: They range from natural barriers to ethanol and petroleum imports, to prospects for co-generation and optimism about better relations between producers and the government. "The outlook is positive," he said. "There is renewed hope, for all of those reasons."

Yet as investments increase, biofuels have come under greater scrutiny from sources such as the United Nations Food and Agriculture Organization for their use of water, energy, fertilizer and other inputs, and their environmental impact, as well as for competing with food production and potentially raising food prices. Even though greenhouse gas emissions from ethanol are lower than from gasoline, questions remain about the tradeoffs.

Alcides Faria is executive director of Ecoa, a Brazilian non-governmental organization that conducted a study of sugarcane plantations and land use in central Brazil. "In Brazil the biggest problem is that they always occupy the best land," he said. "This is the same land sought after by producers of ... principally soybeans and corn."

A new technology may help address some of these concerns by increasing the efficiency of biofuel production. Called cellulosic ethanol, it involves making ethanol from sugarcane waste products. It is commonly referred to as 2G production, as in second generation. Conventional first generation (1G) production uses sugarcane juice that is extracted by crushing the stalks. By using both procedures sequentially, mills can considerably increase production from the same amount of feedstock. At least two companies have announced substantial investments in 2G production.

"The investment required is still high, and 1G sugarcane ethanol is very competitive, of superior quality, and still has room to grow," said Dr. Fava Neves. "But the prospects are good as long as the global community continues to be concerned about global warming and environmental issues."

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