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Positioning Brazil for **biofuels** success

The country now produces ethanol more cheaply than anywhere else on Earth, but that may not be true for long.

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As higher oil prices drive global demand for biofuels, Brazil's ethanol industry—including both local and multinational companies—seems well positioned for profitable growth. The country has the world's lowest production costs for ethanol, is its leading global exporter, and has plenty of available land to increase production.

But the forces unleashed by surging demand will challenge the industry. A McKinsey study shows that ramping up export capacity will require as much as $100 billion in new investment, depending on international demand. Brazil's fragmented network of ethanol producers and limited distribution infrastructure will struggle to keep pace. Meanwhile, the growth prospects for biofuels are generating worldwide research efforts that seem likely to yield technologies that will lower the cost of production in other countries, making them more competitive with Brazil. In this uncertain environment, industry participants will have tough decisions to make about where, when, and how much to invest.

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Article at a glance

As higher oil prices drive global demand for biofuels, Brazil's well-established ethanol industry—including both local and multinational companies—seems well positioned for profitable growth.

Although annual global ethanol exports now total only about 6.5 billion liters, McKinsey research suggests that by 2020 they could reach 50 billion to 200 billion liters.

To supply that demand, Brazil's companies will have to ramp up their export capacity significantly, which would require investments of as much as $100 billion in land, distribution infrastructure, and new mills.

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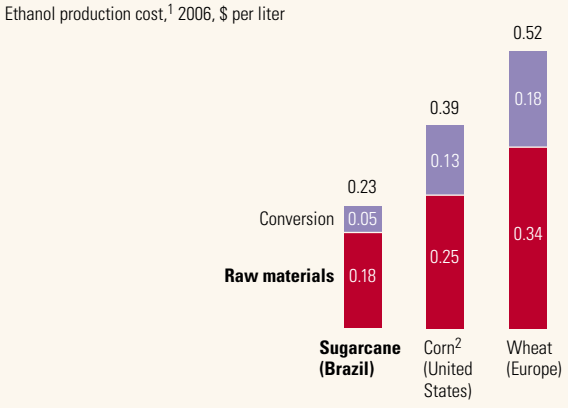
of regulatory regimes around the globe. Let's say that Brazil will provide 160 billion liters—all (or nearly all) of the world's ethanol exports—in 2020. That is an extreme assumption, but an economically rational one if the country could leverage the strength of its sugarcane industry, the world's largest, to defend its position as the lowest-cost producer (Exhibit 1). If companies want to play a role in Brazil's biofuel boom, they will have to boost their current output substantially. At present, Brazil's annual ethanol output is nearly 17 billion liters, roughly 14 billion of them consumed domestically. Productivity gains from better irrigation and fertilization and from the mechanization of harvests should raise output by 30 percent over the next 15 years. The rest must come from additional investments in land, distribution infrastructure, and above all, mills.

In such a scenario, players in Brazil's ethanol industry would need to make the following investments:

1. *Land.* Brazil currently has 6 million hectares of sugarcane under cultivation. Increasing ethanol production to supply the country's domestic needs (roughly 30 billion liters) and to meet the export target of 160 billion liters would require a further 11 million hectares to be brought onstream by 2020. In fact, as many as 24 million additional hectares of land could realistically be available for sugarcane production. In that case, even the total of 30 million hectares for sugarcane would equal just 3.5 percent of Brazil's landmass (Exhibit 2). Although converting some pastureland to sugarcane cropland implies that less land will be available for cattle ranching, that wouldn't affect overall food production significantly. However, let's say that only a further 11 million hectares come onstream for sugarcane. We project that Brazilian sugar companies, or millers, will in all likelihood directly own 3.3 million of them—30 percent—at a total cost of $8 billion. The remainder will

EXHIBIT 1

The lowest production cost

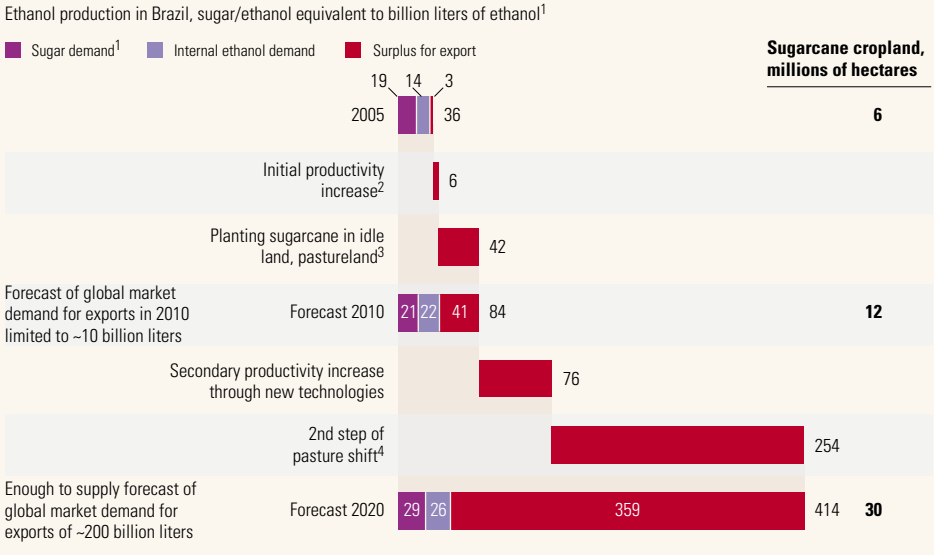


[1]Excluding any subsidies; assumes current technology.
[2]Figures do not sum to total, because of rounding.

Source: Expert interviews; National Renewable Energy Laboratory (NREL); SRI; McKinsey analysis

EXHIBIT 2

Expansion will meet demand



[1]A ton of sugarcane can produce either 130 kg of sugar or 82 liters of ethanol; forecasts based on 2006 data.
[2]Assumes São Paulo state's 95 tons of sugarcane per hectare as benchmark.
[3]Recovery of land near production zones that had shifted to pasture in past 10 years.
[4]Includes transfer of extra 5% of current pastureland to sugarcane crops.

Source: Instituto Brasileiro de Geografia e Estatística (IBGE), 1996; FNP, 2006; McKinsey analysis

either be leased by the millers or cultivated by smaller third-party farmers. This arrangement is already in use today. By owning part of the cropland, millers secure some access to feedstock; by leasing some of their cropland, they reduce the total amount of capital employed. Finally, by processing sugar from third-party farmers as well as their own, they are mitigating their agricultural risk.

2. *Distribution infrastructure.* The industry can store and transport four billion liters of exports a year, mainly between the southeast region and nearby ports. As companies expand northward, transporting ethanol from the center-west regions to the coast will require an additional 1,000 to 2,000 kilometers of pipelines and railways. Brazil will also require at least ten billion liters of additional storage capacity at refineries to hold several months of inventory produced during the harvest period from April to November. The cost of these storage and transportation investments could be $2 billion or more.

3. *Mills.* The biggest investments will be for new cane-processing mills. Currently, around 350 of them annually process 460 million tons of sugarcane, half for ethanol. With current market conditions and technologies, each additional billion liters of ethanol will require 5 new mills at a current cost of $120 million each. However, because of productivity gains from new milling technologies—mainly the hydrolysis of sugarcane stalks (or bagasse)[1]—we estimate that about 600 new mills, at a total cost of about $90 billion,[2] would be needed to produce the 2020 export total of 160 billion liters. Already Brazilian and multinational companies have begun to construct new mills, mostly for domestic supply, costing $5 billion to $6 billion, and have announced plans to make comparable further investments.

It remains to be seen whether investments of this magnitude are feasible. Small and midsize ethanol producers (mostly families) lack the clout—especially in Brazil's relatively undeveloped capital markets—to raise the needed funds. One plausible outcome would be for these millers to persuade ethanol importers, such as logistics operators and fuel distributors in destination countries, to accept long-term supply contracts with price floors, thereby reducing the risk of the producers and helping them to raise money domestically. Otherwise, the economic fundamentals of Brazilian ethanol seem strong enough to attract investment from

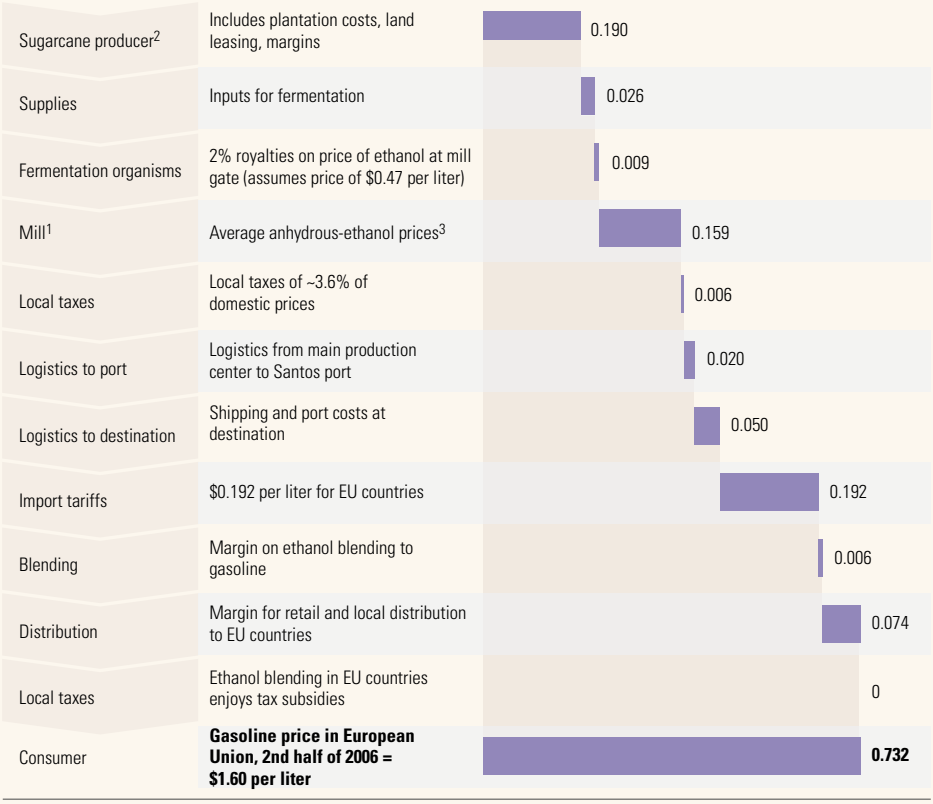
[1] That is, the use of enzymes to break down bagasse into cellulose (the primary structural component of plants), which can then be converted into ethanol. This "cellulosic" technology would make it possible for Brazil to produce up to 400 billion liters of ethanol per 30 million hectares of land.

[2] Although the cost per mill will increase as technology advances, each mill's production capacity will increase at a higher rate, therefore decreasing the overall cost per liter of production capacity.

EXHIBIT 3

The economic fundamentals

2020 scenario: cost to produce 1 liter of ethanol in Brazil and export to Western Europe,[1] $ per liter



[1] At 2006 prices; assumes simultaneous use of cellulosic technology and current technology.
[2] In state of São Paulo.
[3] Assumes 2020 gross margin per ton of sugarcane similar to that of 2010.

Source: Interviews; Centro de Estudos Avançados em Economia Aplicada (CEPEA), University of São Paulo; FNP; National Renewable Energy Laboratory (NREL); McKinsey analysis

multinational companies. Our research suggests that by 2020, the cost of producing a liter of ethanol in Brazil, shipping that liter to Western Europe, paying all relevant tariffs and taxes, and delivering it to the consumer will be roughly $0.73—far less than today's prevailing price of $1.60 for a liter of gasoline in the European Union (Exhibit 3).

But building and operating a distribution infrastructure could be problematic. These investments will be less profitable than, say, mills—as well as more challenging politically, since pipelines will cross state lines and cut through rainforests. Petróleo Brasileiro (Petrobras), Brazil's state-owned energy company, is one logical participant.

Above all, the ability of Brazil's biofuels industry to move ahead will hinge on its continued cost competitiveness. The country's cost advantage stems

almost entirely from the use of sugarcane rather than corn or other plants as a feedstock. The sugarcane plant, which flourishes only in tropical climates like those of Brazil, produces 6,000 liters of ethanol per hectare, compared with only 3,500 liters from corn.[3]

Emerging technologies will probably make it possible to produce ethanol more cheaply with cellulose derived from other feedstocks, such as switchgrass (which can grow in a broader range of habitats, including relatively inhospitable ones) or residues from other agricultural crops. In China it may be possible to produce ethanol from rice straw at a cost of about $0.16 a liter. If companies in Brazil can supplement today's fermentation techniques with new technology to produce ethanol from sugarcane bagasse, production costs are likely to remain competitive. If other regions can bring down production costs significantly, however, Brazil's role as an exporter will be materially smaller. Q

[3] Brazilian companies have also improved on sugar's natural superiority as a feedstock by developing advanced soil cultivation techniques and even more productive plant varieties.

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