

ts insights

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Cleaning up on Ethanol

As gasoline prices remain around \$3 a gallon, ethanol—once used to power trucks and tractors in the Midwest—is touted nationwide as a viable renewable alternative to fossil fuels. Even without a price crunch, ethanol use is likely to increase because the Renewable Fuel Standard in the Energy Policy Act of 2005 mandates that the amount of renewable and biofuels in regular gasoline nearly double in six years, from 4.0 to 7.5 billion gal./yr. by 2012.

At first glance, ethanol poses some concerns for US investors. The industry is fragmented, with many small producers who derive significant support from federal tax credits. Buyers have relatively strong positions as they oil companies, marketers, or other aggregators of supply. And only an import tariff keeps foreign countries, including Brazil, the world's 2nd largest producer after the US, from exporting sugar cane-based ethanol which is cheaper to produce than ethanol from corn, the principal US feedstock. Despite these concerns, there is more to the ethanol story and more than a few potentially lucrative opportunities for savvy investors.

ECONOMICS OF ETHANOL

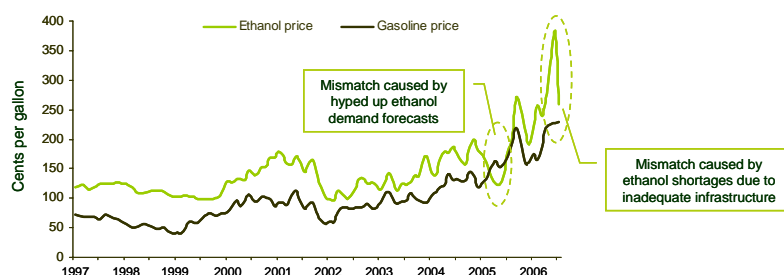
The economic attractiveness of ethanol hinges on three key factors:

- The direct relationship between ethanol and gasoline prices
- The impact of federal tax credits on that relationship
- The price of ethanol feedstocks

As Figure 1 illustrates, the national price of ethanol correlates closely with the price of regular gasoline, averaging 45¢ to 50¢ higher over the past ten years. Historically, supply and demand imbalances have had a limited impact, except at the local level. Despite recent extremes in short term price volatility attributable to infrastructure limitations in newer markets, gasoline prices continue to dictate underlying ethanol prices.

The difference between gas and ethanol prices is

FIGURE 1
Rack ethanol prices and regular unleaded gasoline rack prices: Jan. 1997 – July 2006



Source: Bloomberg, Energy Information Administration

primarily due to the volumetric ethanol excise tax credit (VEETC), the principal federal subsidy for ethanol since 1978. Ethanol blenders receive a 51¢ tax credit for every gallon of ethanol mixed with gasoline. "Small producers" making less than 60 million gallons a year can claim an additional 10¢ per gallon credit on the first 15 million gallons they make.

High corn yields and low feedstock prices during the last two years have further buoyed the ethanol market. Between April 2004 and November 2005, the price of corn fell from \$2.89 to \$1.77 a bushel and has not risen above \$2.20 since. This gave corn ethanol producers record margins of 60¢ to 80¢ per gallon, making them highly profitable without the VEETC¹.

Attractive economics are just the beginning. Across the country, research is underway on cellulosic sources of ethanol that lie outside the human food chain and include switch grass, waste beverage and corn husks, rather than corn grain currently used. While feedstock prices could fall even lower if any of these bets pay off, the consensus is that production of cellulosic ethanol is a decade away from becoming cost effective.

Ethanol from sugar cane, the principal feedstock of Brazil and arguably a smarter choice because its production is more energy efficient, has not been fully explored in the US, although a recent USDA study indicates there may be some potential. As with corn, wide swathes of the US would have to be planted with sugar to get even a fraction of the volume needed to make a serious dent in gasoline use.

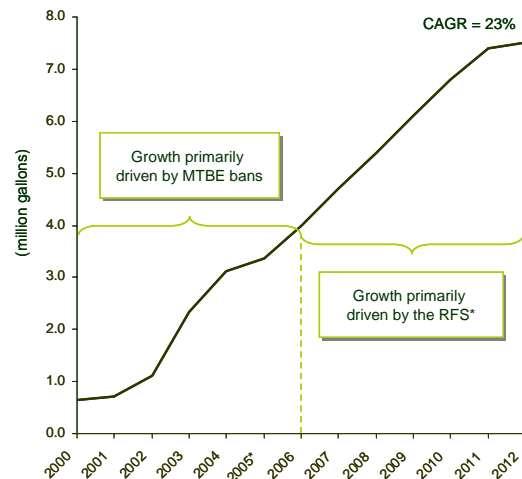
THREE PHASES OF DEMAND

Given its underlying economics and the fact that ethanol is not a new fuel, a key question is why the domestic market is becoming more favorable now. Figure 2 illustrates the three overlapping phases of ethanol growth. The first two are largely driven by legislative mandates and their aftermath, while the third and possibly the most significant hinges on consumer behavior.

Back in 1990, the Clean Air Act required areas of the US with high air pollution levels to use oxygenated fuel. Methyl tertiary butyl ether (MTBE) became the oxygenate of choice in part because gasoline containing MTBE can travel through pipelines along with gasoline. But when MTBE was implicated in groundwater contamination in 1995, ethanol began to replace MTBE, creating the first phase of ethanol

growth. Currently, MTBE replacement accounts for nearly three-quarters of all ethanol use, or upwards of three billion gallons annually.

FIGURE 2
Historical and Projected Ethanol Consumption
2000-2012



* Although the Renewable Fuels Standard mandates the use of both ethanol and biodiesel, industry experts expect most of the volume to be made up by ethanol
Source: Energy Information Administration, Renewable Fuels Association, PwC Analysis

The Renewable Fuels Standard (RFS), part of the Energy Policy Act of 2005, is driving the second phase of ethanol use. The RFS mandates that domestic use of renewable fuels increase from 4.2 billion gallons, or about three percent of total gasoline consumption, to 7.5 billion gallons between 2006 and 2012. Ethanol is expected to constitute about 85 percent of this total, expanding beyond the Midwest where 75 percent of all fuel already contains ethanol, mostly 10 percent blends. The Act also created a credit trading program allowing refiners to use renewable fuels where and when it is most cost-effective to do so.

But arguably the energy act's biggest boon for ethanol involves MTBE. By repealing the requirement to use oxygenated fuel, the act also removed the de facto liability protection MTBE manufacturers have enjoyed since 1992. This provision, which took effect this May, will accelerate the retreat from MTBE.

The third phase of ethanol's growth will be the least predictable but ultimately the most significant as consumers across the country begin choosing environmentally friendly vehicles and fuels. President Bush's optimistic claim that ethanol from wood chips

¹ Peters, Jerry, "Focused on the Fundamentals", *Project Finance*, December 2005. Jerry Peters is managing director of Hudson United Capital.

and switch grass could be competitive in six years, coupled with a flood of support from state governments, and automaker campaigns for flex fuel vehicles (FFVs) have begun to build public awareness of ethanol as a "clean fuel" that helps reduce dependence on foreign oil. FFVs have modified gas engines that can burn E85, an 85 percent ethanol mixture.

Theoretically, the prospect of saving money by buying American is a winning proposition for consumers, small farmers, and major agriculture industry players. However, two factors could limit ethanol use short term: lack of availability and lower than expected cost savings.

Only about 600 of the nation's 120,000 service stations currently sell E85, and 95 percent of these are in the Midwest. That's because all ethanol blends present distribution problems. Ethanol fuels cannot move through pipelines like MTBE blends because ethanol attracts water, typically found in pipelines, which can cause the octane rating to decline. Accordingly, ethanol blends will require major investment in new blending equipment at terminals and storage capacity at service stations, especially in new markets outside the Midwest.

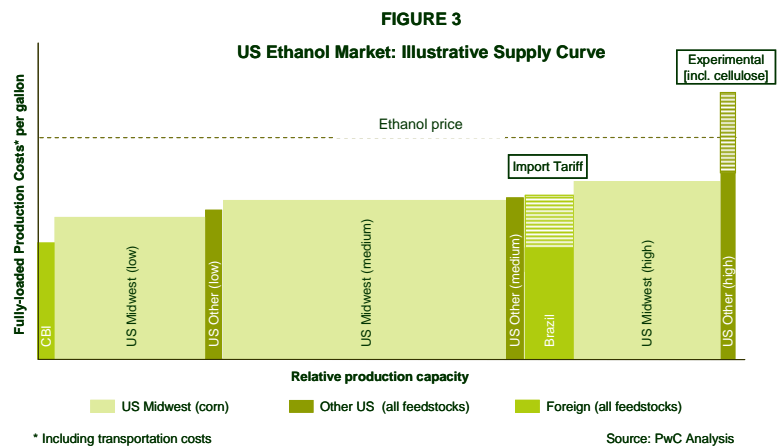
Finally, it is unclear whether ethanol blends will actually save consumers any money. Historically, the pump price of these blends has been marginally less than gasoline because the VEETC more than offset higher ethanol production costs. In fact, a May 2005 report by the Consumer Federation of America claimed that consumers could save up to 8¢ per gallon on a 10 percent ethanol blend.

But savings could be illusory if demand outstrips supply and reported feedstock shortages persist. Infrastructure issues in the Northeast pushed prices above \$4 per gallon in June. Ethanol conversion also places further strain on the nation's refining capacity, putting upward pressure on pump prices. Lastly, because ethanol has 28 percent less energy than gasoline, mileage is generally lower. Bottom line, consumers may save less than expected (and may even lose money), leading some to question whether ethanol's cost and greenhouse gas reduction benefits

justify the added production and distribution costs. This is hardly the message the promoters of renewable fuels want to give!

ETHANOL SUPPLY CURVE

Despite these concerns, ethanol demand should remain robust for the near term. The question is who is going to supply it? Figure 3 presents an illustrative US ethanol supply curve that reflects the basic market dynamics of three major sources: Midwest producers, other US suppliers, and foreign manufacturers, primarily Brazil and CBI (Caribbean Basin Initiative) countries.



Midwest producers are benefiting from very low corn prices and, in our view, will continue to supply the bulk of ethanol to the US market short to medium term. Larger producers have shown they can profitably supply big new markets in California and the Northeast, protected for the time being by a 54¢ per gallon tariff (plus a 2.5¢ ad valorem tax) on imports. However, not all Midwest producers have the same economies of scale and technological sophistication, so our diagram reflects three levels of production efficiency.

Possibly the biggest wildcard in the domestic ethanol supply chain is the growing numbers of small producers across the US who use an array of processes and feedstocks—including all types of biomass from sugar beets to wood pulp—with varying degrees of cost-effectiveness. These feedstocks often supply "destination" plants located near the end user rather than the source of supply.

Manufacturers in the Southeast might make ethanol from Midwest corn, and then sell the coproducts to offset the cost of transporting the corn. Coproducts include dried distillers grains and solubles [DDGS], a feed for livestock, and CO₂, which could be sold to refiners for enhanced oil recovery. This could create "virtuous circles" of production, such as a cattle ranch in Texas that feeds cows DDGS and then uses methane from manure instead of natural gas to power its generators, thus taking the ranch off the grid.

Corn husks, switch grass, and other cellulosic materials outside the human food chain could challenge corn as the principal domestic feedstock. While it currently costs more to make ethanol from cellulose, research continues on many production techniques including enzymes (primarily cellulase) to break down cellulose to a microorganism that ferments CO₂ into ethanol. None of these are cost effective on large scale...yet.

Globally, sugar cane is the principal ethanol feedstock, led by Brazil. While estimates of corn ethanol's net energy value vary, depending on the assumptions made and whether energy savings from the coproducts of ethanol production are factored in, there is little doubt that sugar-based production is far more energy efficient. About the only negative associated with Brazil's ethanol industry is that production methods may not be eco-friendly by US standards, especially the treatment of waste water.

So far, the tariff on Brazilian ethanol has kept a lid on imports, with just over 100 million gallons entering the US in 2005. But pressures mount for Congress to reduce or suspend the tariff to ensure sufficient ethanol supplies.

However, Brazilian ethanol can enter the US market through a back door. The Caribbean Basin Initiative, begun in 1983, allows duty-free imports equal to seven percent of total US ethanol consumption in the prior year, provided 50 percent of feedstocks come from a CBI country. This means a CBI country can import cheap, wet Brazilian ethanol, add local feedstock, dehydrate the combined product, and sell it to the US duty free.

This has not yet posed a major threat to US

producers, perhaps because CBI countries lack access to necessary capital. Farm associations have expressed some concern, but a US giant has partnered with a Brazilian producer to process Brazilian ethanol in El Salvador for export to US markets.

All of these developments suggest the US ethanol industry will become very competitive as it enters a new aggressive growth phase, with some big winners and losers. Over two billion gallons of productive capacity will come online in the next two years putting pressure on an already strained delivery infrastructure, and creating more supply and demand imbalances than existed in the past. As infrastructure catches up with production capacity, pockets of oversupply are likely to crop up, causing price volatility and torpedoing some ill-advised ventures.

MONEY MAKING OPPORTUNITIES

Ethanol is a hot investment. Bill Gates' recent acquisition of a 15 percent stake in Pacific Ethanol and Virgin Fuels' recent interest in renewable energy typify a developing trend of major companies making investments and doing deals in the sector. Private equity and venture capital are also entering the fray, with several funds dedicated to renewable energy springing up in recent years. And this summer's IPOs of VeraSun and Aventine have added to ethanol's momentum. At least one private equity-backed producer is eyeing an imminent entry to the public market, where existing players saw heady gains in the spring dip back down on fears of a capacity glut.

Although estimates vary, billions of new investment in production capacity and infrastructure will be needed to meet the 2012 renewable fuel mandates. To assess investment opportunities, we've looked at the main types of industry players.

ETHANOL PRODUCERS

Production is the primary entry to what is still a very fragmented industry. While Archer Daniels Midland is by far the biggest domestic supplier, the top 10 producers control only 42 percent of production capacity. With barriers to entry low and significant private equity and venture capital money available, virtually anyone with a clear concept of what

feedstock to use and whom to sell to has a fair chance of attracting the necessary funds. Regional producers are seeking financial backers to build plants that will use a variety of feedstocks to produce 40 to 100 million gallons of ethanol a year.

The attractions are clear:

- Solid margins and a favorable medium- to long-term outlook, especially if oil prices remain near historic highs
- The prospect of developing smart, green, integrated methods of producing ethanol and the potential for monetizing by-products such as CO₂ and animal feed (DDGS)

Attractive exit opportunities should arise as the industry consolidates and oil companies become interested in securing a supply of ethanol. Companies with the right model, which may vary by region, are likely to be the winners. Economic success will depend on variables discussed earlier including the choice and price of feedstocks, smart use of ethanol co-products, distribution arrangements, and the proximity of production to feedstocks or end use markets.

ETHANOL MARKETERS

Because production is fragmented, most ethanol producers use one of about ten marketers to get their product to the refinery. Some marketers sell ethanol from other manufacturers as well as their own, charging a commission of about one percent. The benefits of becoming or investing in a marketer include limited capital outlays (depending on specific role), increasing volumes, and good returns for relatively little risk.

PLANT BUILDING CONSULTANTS

The explosion of new plants has driven up demand for experienced plant building consultants. As with marketers, key players make their own product and also offer turnkey plant and biorefinery design, engineering and construction services.

INFRASTRUCTURE

Building the infrastructure needed to efficiently deliver ethanol nationally will require significant investment for many years. Although oil companies are likely to provide the bulk of this funding, there may be

opportunities for other smart investors.

The first step will be preparing the entire network to deliver E10. Because ethanol is hydrophilic and can lose energy value if mixed with the groundwater found in most pipelines, it must be blended with gasoline at the terminal, trucked to service stations, and stored in new facilities. New or adapted storage facilities are necessary because ethanol blends, especially those with a higher ethanol content, are more corrosive than gasoline.

RISKS

The stability of the domestic ethanol economic model depends on many variables including the future of existing tax credits (the VEETC sunsets in 2010), the ability of cheaper feedstocks to undermine prices, and the future price of oil. According to a recent study¹, ethanol should make money so long as oil prices stay above \$32/barrel with the current 51¢ tax credit/gallon in effect, or \$50/barrel without the tax credit.

Looked at another way, while E85 has historically cost more to get to market than gasoline and thus needed the tax credit to remain competitive, it actually has sold for up to 30¢/gallon less in parts of the Midwest because of low corn prices and government subsidies. So it's currently profitable to be in ethanol, and margins could increase if technologies to make ethanol from agricultural waste become more cost-effective.

Many of the risks of investing in ethanol reflect the downside of this rosy scenario:

- Subsidies expire in 2010. The strong farm lobby will push for an extension of the VEETC, but with high gas prices keeping ethanol prices up, this may be unrealistic.
- Ethanol may become a victim of its own growth. Experts estimate the US produces enough corn to make 14 billion gal./yr., or about 10 percent of gas needs. Corn prices are likely to rise as production gets closer to this limit, and corn futures have already risen.
- Tariffs on Brazilian ethanol could be reduced or eliminated in order to put pressure on oil prices and bring more ethanol into the US. Some

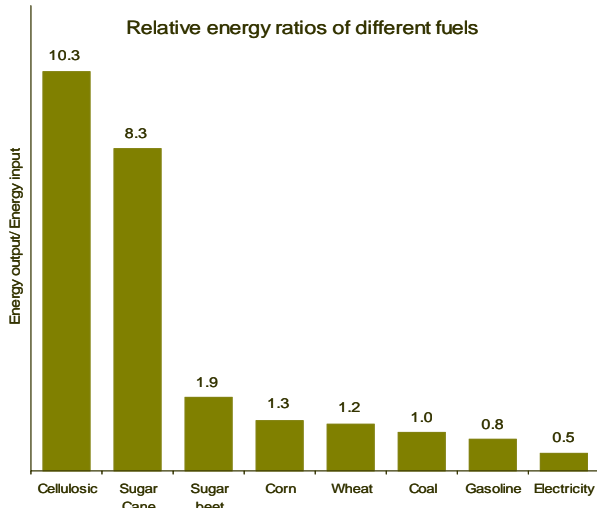
senators and governors—including Jeb Bush—have proposed this option. A rollback is more likely if the price of oil remains at record highs and corn at record lows, and could become a bargaining chip in negotiations to continue ethanol subsidies.

In assessing risk, investors must also consider the long term sustainability of ethanol as an environmental (as opposed to economic or political) solution to the country's fuel woes. The environmental case for ethanol is by no means won, but a few facts are widely accepted:

- It's far more energy efficient to make ethanol from sugar than from corn.
- There's not enough corn to make ethanol a replacement fuel, and cellulosic production is six to ten years away.
- Cars get lower mileage on ethanol because its absolute energy value is nearly 30 percent less than gasoline [83k versus 115k BTUs/gal.]

A key issue is ethanol's net energy value, or whether its production uses more energy than the fuel delivers (Figure 4). Much of the debate centers on how you measure energy input and output. What is the correct

FIGURE 4



* All studies on this topic yield different results, primarily as a result of "system borders" – i.e. how complete the analysis is in terms of accounting for different energy costs incurred – e.g. whether the cost of fertilizer to reduce soil erosion is included.

Source: Unica; Aragonne National Laboratory report, 2005

allocation of energy costs? What technologies is the model based upon? How do you factor in energy saved from substituting coproducts like DDGS and CO2 for the more energy intensive products they displace?

Even as an additive, ethanol is not problem-free because it raises the vapor pressure of E10 blends and thus the volume of fumes evaporating from gas tanks. Because these fumes contain volatile hydrocarbons from gasoline, the clean burning benefits of ethanol are significantly undercut.

CONCLUSION

The fanfare surrounding ethanol is likely to continue so long as pump prices remain high and pressure to reduce dependence on fossil fuel continues. The incentives are there: strong federal government support, potentially large consumer demand, and healthy margins under current conditions. But in a highly fragmented industry with many unknowns, the challenge will be backing the right horses. In evaluating specific opportunities, investors need to estimate the relative risks and rewards of investing in ethanol production, distribution or infrastructure. Similarly, before investing in a production package, investors need to consider how well the pieces fit together in terms of size, location, feedstock, process, proximity to end users, and coproducts.

Investors also need to weigh whether ethanol is a longer or shorter term solution, and that requires taking a hard look at ethanol's place in the broader alternative/replacement fuel market. Can the industry survive without tariff protection and tax credits? How big a threat do developing technologies—from hybrids to biodiesel to fuel cells—pose, and when do they become real? Is there any real danger that environmental arguments against ethanol will trump its political and economic benefits? Savvy investors will get comfortable with all of these factors before jumping into ethanol or any other alternative fuel.

This article was written by David Allen with assistance from Ariadna Khafizova and Ilya Meyzin. TS Insights provides strategic thinking on a wide range of issues that affect the deal community. TS Insights is a publication of the Transaction Services Group of PricewaterhouseCoopers, which includes over 900 professionals in 16 US cities. For more information on the topics discussed in this issue, contact Michael Tuohy at (646) 471-2653 or David Allen at (646) 471-2486.

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