EPRINC
formerly PIRINC

Note:
April 4 revision

You may be interested

EPRINC has prepared the enclosed report, ***Ethanol Part II: Is a Home-Grown Fuel Policy Undermining U.S. Energy Security?****

The Bush administration rolled out several initiatives to bolster U.S. energy security in early 2007. The most important feature of the administration's proposed energy policy is a proposal to substantially expand the use of ethanol and other renewable fuels for the U.S. transportation sector. The administration's proposal would raise annual U.S. consumption of ethanol and related bio-fuels to 35 billion gallons by 2017. In a best-case outcome, this proposal would reduce petroleum imports by 1.5 million barrels/day (mbd) when fully implemented. More importantly, the administration views the plan as an effective policy response to a domestic fuel market that has experienced substantial price volatility and spikes in recent years.

The federal government currently provides financial and regulatory incentives to refiners and fuel blenders for the production and use of ethanol as motor fuel. Existing law mandates a production level of 7.5 billion gallons/year by 2012. With the elimination of the additive MTBE from the gasoline pool in 2006, ethanol has become the substance of choice for boosting octane and oxygen. MTBE's departure from the market drove ethanol consumption to an annualized rate of 6 billion gallons by the end of 2006. Existing incentives for the production of ethanol are assuring 2012 ethanol production goals will be realized much earlier. EPRINC estimates that the combined output from existing ethanol production facilities and those under construction will rise to 10 to 12 billion gallons within the next three years.

Ethanol now extends supplies of gasoline in a market with little excess domestic refining capacity, and also provides octane and oxygen content. Although oxygenates are added to gasoline in many localities where reformulated gasoline (RFG) is required, EPRINC estimates that the United States' capacity to absorb ethanol into the gasoline pool is limited to no more than 15 billion gallons over the next several years. This is attributable to the fact that most on-the-road vehicles are unable to use gasoline containing more than 10% ethanol. This 15-billion-gallon figure assumes all gasoline would be blended with 10% ethanol, but this is not currently possible. The transportation and distribution infrastructure—unless significantly expanded—will not be able to assure universal distribution of ethanol to all areas of the country, which will limit the amount of ethanol blending that can actually take place.

Large-scale ethanol production of 15 billion gallons/year—and possibly even less—is likely to produce eroding ethanol margins. Calls for increased producer subsidies may result, as new plant owners seek protection from financial jeopardy.

* See PIRINC publication, ETHANOL UPDATE, July 2006

Although existing law extends the 51-cent per gallon ethanol fuel blender tax credit (the equivalent of $21.42 per barrel of gasoline) through 2010, it is likely that Congress will extend this tax protection, as many facilities will be under financial stress without the blender credit. The costs of this program to the U.S. Treasury are not trivial, however. Assuming the blender credit remains in place, it will cost the federal government about $30 billion between 2007 and 2012, as the tax credit payout rises from $2.5 billion in 2006 to $6 billion in 2012. These are direct tax losses to the U.S. Treasury and do not include the indirect costs to consumers. During 2006, indirect consumer costs from higher corn and other agricultural product prices impacted by growing ethanol consumption amounted to about $5 billion, twice the cost of the tax credit itself to the U.S. Treasury.

Note that for the U.S. gasoline pool, about 6 billion gallons of ethanol annually is both essential and complementary to the domestic production of gasoline. The U.S. petroleum refining industry would likely have difficulty meeting gasoline needs without this level of ethanol blending. However, at substantially higher levels of consumption, additional supplies of ethanol essentially supplant a portion of the need for new refinery capacity. Refiners, already facing substantial regulatory and financial obstacles to the construction of additional domestic capacity, are likely to look upon rapidly rising ethanol output in the coming years as adding more risk to investments in capacity expansion.

In 2006, the Department of Energy (DOE) forecast that domestic refiners were likely to add 1.5 mbd of expanded capacity between 2005 and 2010. Based on current perceptions of ethanol market developments, EPRINC estimates that capacity expansion in domestic refining is likely to be constrained to 1 mbd through 2010, though it may be less. The expected surge in ethanol output will likely pressure domestic refiners (and some foreign refiners supplying the United States) to postpone new investment in increased petroleum refining capability.

Another security issue regarding supply stems from the increased reliance upon corn production, which is subject to periodic disruptions from weather-related events. Imported oil may well have security issues of its own, but becoming dependent on a commodity (corn) that can be severely impacted in a number of uncontrollable ways (drought, storm, heat waves, etc.) adds a new dimension of uncertainty to energy supply reliability. More importantly, the ethanol program is moving into direct conflict with the administration's initiatives to enhance U.S. energy security. In the end, a home-grown program to enhance U.S. energy security may do just the opposite.

If you have any questions or comments please contact Larry Kumins, Lucian Pugliaresi or Larry Goldstein.

EPRINC

formerly PIRINC

Ethanol Part II: Is a Home-Grown Fuel Policy Undermining U.S. Energy Security?

Note:

April 4 revision

April 2, 2007

Ethanol for Gasoline Blending—Policy and Perspective

Although ethanol has been used in U.S. motor fuel supply since the 1970s, various government efforts to promote broader use never gained traction until this decade. With the enactment of the Energy Policy Act of 2005 (EPAct 05), a mandate to use increasing amounts of ethanol blended with gasoline (up to 7.5 billion gallons in 2012) was established. One year later, with the sudden phase-out of MTBE (an oxygenate and octane enhancing substance), ethanol stepped into a role as an essential gasoline component. Rapid growth during 2006 saw ethanol end the year at an annualized consumption rate of about 6 billion gallons, approaching the EPAct 05 mandate for 2012.

The large scale and seemingly successful integration of ethanol into the motor fuel mix has been followed by a new proposal by President Bush, which calls for the use of 35 billion-gallons/year of renewable fuels (primarily ethanol) by 2017. How this 35-billion gallons/year might be produced by the nation's existing corn-based ethanol industry is an unanswered question.

Additionally, it is unclear how a vehicle base that is currently unable to use even half this amount could consume this much ethanol. In order to use all of the proposed 35 billion-gallons/year of ethanol production, far-reaching replacement of the 237 million vehicles now on the nation's roads with flexible fuel vehicles (FFV) would need to take place. This would suggest that a large portion of the 17.5 million new vehicles sold annually must transition to FFVs' quickly if ethanol use is to grow to levels envisioned by the president.

Numerous other challenges must be overcome before this much ethanol could be integrated into the U.S. fuel supply. Among them are the lack of a robust transport system to provide universal distribution, the availability of an estimated 13 billion bushels of corn to manufacture this amount of ethanol, and a needed technology breakthrough to manufacture ethanol from cellulosic plant material.

If the 35-billion gallon/year goal was reached, it would, by volume, replace 2.25 mbd of imported oil with domestically manufactured fuel. But since ethanol has only two-thirds the energy content as petroleum, the oil import savings could be as little as 1.5 mbd. This would not appreciably alter the nation's dependence on foreign oil, which the DOE forecasts to be 12.9 mbd in 2017.

Background and History

The use of ethanol as an additive in U. S. motor fuels really had its antecendents in 1978 Energy Tax Act (PL 95-618)—a Carter Administration measure exempting ethanol blends from the (then) 4-cent per gallon federal excise tax. Subsequently, it was raised to 5.2 cents per gallon of blended gasoline (the 90% gasoline, 10% ethanol mix often called gasohol). The American Jobs Creation Act of 2004 (PL 108-357) changed this to a tax credit of 51 cents per gallon for ethanol used in blending gasoline. The company that actually blends the fuel is eligible for this tax credit.

Despite tax benefits, ethanol gained little traction in the national motor fuel market until very recently. Even local popularity in farm states did not amount to a significant fuel market share. This began to change with the Clean Air Act (CAA) amendments of 1990, which mandated the use of an oxygenate in many gasoline blends.

MTBE Phase-out Creates Ethanol Opportunity

During the 1990s, the most commonly used oxygenate was MTBE. Despite boosting oxygen content and octane as well as MTBE, ethanol's role was initially limited because of availability, cost, and incompatibility with existing petroleum fuels.

As MTBE use became widespread, concern arose that the chemical was finding its way into ground water. Its distinctive taste and smell caused public concern in a number of states. By 2000, some localities and states enacted MTBE bans. Fear of potential product liability legal action resulted in the halt of MTBE use by refiners and fuel blenders.

But the need for an oxygen-boosting and octane-enhancing additive still remained, even after the mandate requiring oxygenated fuel was repealed by EPAct 05. This became effective in May 2006 and accelerated demand for ethanol as refiners and marketers began an almost total MTBE phase-out early in 2006. The withdrawal of MTBE also resulted in a volumetric gasoline supply shortfall, amounting to about 400,000 barrels/day, which had to be made up for in a market with very little incremental petroleum supply. Automatically, ethanol demand grew.

EPAct 05 Solidifies Place for Ethanol in the Fuel Mix

EPAct 05 also contained the Renewable Fuel Standard (RFS), which called for 4 billion gallons of ethanol to be blended into gasoline in 2006. The amount of ethanol used is scheduled to increase each year through 2012, where it is targeted to reach 7.5 billion gallons. Table 1 shows the RFS schedule.

By December 2006, ethanol consumption was running at a rate of 399,000 barrels/day, equivalent of an annual consumption rate of 6.1 billion gallons. This reflects rapid growth in demand for ethanol during the year, as it established its role in the motor fuel supply mix. At year-end rates of consumption, ethanol comprised about 4.3% of the gasoline pool.

Table 1:
Renewable Fuel Mandate — EPAct 05

YEAR	BILLION GAL.
2006	4.0
2007	4.7
2008	5.4
2009	6.1
2010	6.8
2011	7.4
2012	7.5

Actual use patterns outpaced the EPAct 05 ethanol mandates. This success suggested that policy makers may have underestimated its inherent potential. This could have provided the context for President Bush's proposal to greatly expand the government renewable fuels mandate, leading to the president's call for the consumption of 35 billion gallons of renewables in 2017. A far-reaching measure, it would likely place ethanol use at nearly 22% of projected 2017 gasoline demand. This would grow ethanol consumption from current levels of about 400,000 b/d to 2.25 mbd, a 6-fold leap.

Ethanol Is Not Petroleum

Ethanol had to overcome a number of difficulties in order to gain its present position in the fuel supply chain. To some extent, these challenges have not been surmounted. Because it can only remain dispersed in gasoline for short periods (ethanol can separate from fuel over time), it cannot be transported through pipeline systems or by other conventional, mixed-use infrastructure. As a result, it must be blended near the point of distribution. Most ethanol is transported by railcar or truck at costs ranging up to 15 cents per gallon. This is substantially more than gasoline, most of which is shipped by pipeline for only a few cents per gallon.

About 80% of ethanol is made in five mid-western states. As a consequence of high transport costs and transport that is limited in geographic scope, ethanol is not available in all parts of the nation. Universal ethanol availability is not expected in the near future.

Ethanol contains one-third less energy per unit of volume than gasoline. Gasoline holds 115,000 Btu/gal compared to 76,000 for ethanol, meaning three gallons of ethanol is needed to displace two gallons of gasoline. As a result, motorists realize lower gas mileage using ethanol-blended fuel, and the reduction in imported oil stemming from ethanol displacing petroleum is less than it might appear.

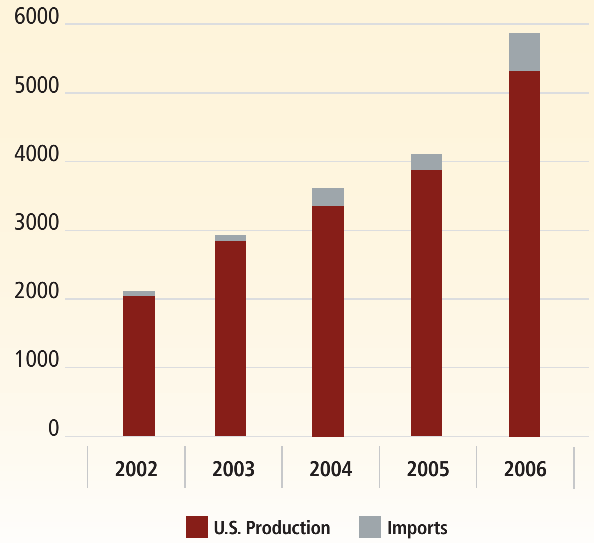
Ethanol Consumption Ramps

Ethanol consumption remained a background issue, trending at around 50,000 barrels/day until summer 2002, when demand began to rise. By fall of the same year, more than 100,000 barrels/day were being blended into the gasoline pool. Ethanol use doubled during 2003, trended up somewhat during 2004 and 2005, and then doubled again during 2006 when MTBE use abruptly halted. During summer 2006, strong demand for motor fuel attracted as much as 100,000 barrels/day of imported ethanol. Much of the imports are from Brazil; some comes from each of a number of Caribbean Basin Initiative nations that are exempt from the 54-cent import levy.

Figure 1 shows gains in ethanol consumption from both domestic production and imports between 2002 to 2006. Demand in early 2007 stands at about 414,000 barrels/day, which comprises about 4.5% of the gasoline pool for this year.

Figure 1

U.S. Fuel Ethanol Consumption: 2002-2006 (million gallons)



Source: Renewable Fuels Association

Ethanol and Gasoline Prices

Energy prices have generally been very volatile for the past several years. Ethanol prices have been just as volatile as gasoline prices, perhaps more so. But what does this mean? It means ethanol prices may possibly be driven by the supply and demand for motor fuel components, and the demand for corn may be driven by its own supply and demand considerations, both for use in agricultural products and motor fuels.

Figure 2 tracks the front-month ethanol futures prices for Chicago Board of Trade (CBOT) ethanol and New York Mercantile Exchange (NYMEX) reformulated gasoline blendstock for oxygen blending (RBOB) from January 2006 through February 2007. This period saw rapid growth of ethanol demand stemming from the hurried MTBE phase-out, the need to replace octane and oxygen content in gasoline, and the additional need to offset the loss of physical fuel volumes.

Figure 2

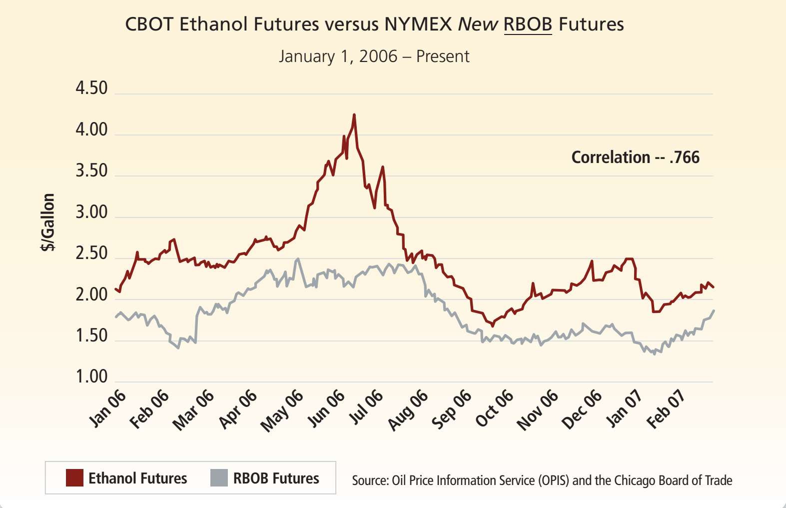


Figure 2 (right), taken from the Chicago Board of Trade Chartbook, February 2007, shows the rapid rise in motor fuel prices during the May-August period, when MTBE replacement demand was initially recognized in the marketplace. The impact of tight ethanol supply is clear from the shape of the spike to $4 per gallon. However, at the end of the summer driving season, ethanol prices began to fall from peak levels, as they were tempered by increased domestic production and significant imports.

The graph of RBOB—itself reflecting generally tight oil markets—shows the same increased prices into the MTBE phase-out and summer driving season in the same time frame, but not at the same price spike ethanol experienced during the same period. And similarly, RBOB prices declined as summer demand relaxed and gasoline imports arrived in August and September.

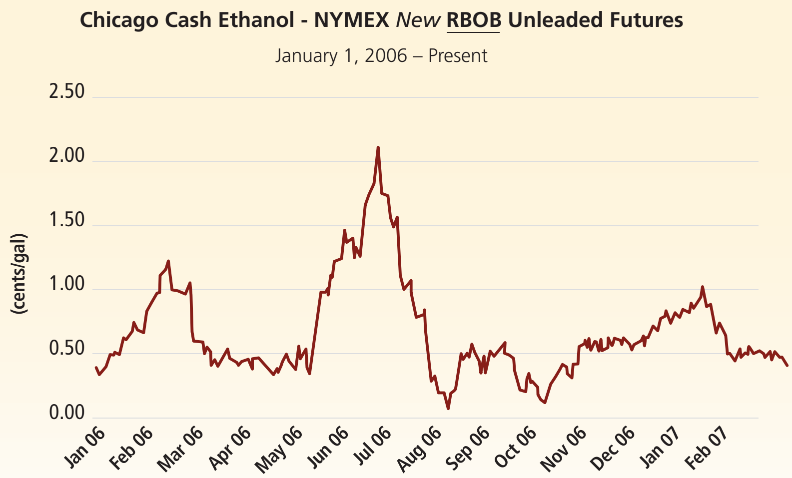
During the time frame on Figure 2, RBOB and ethanol adopted a well-correlated relationship. The CBOT staff found the relationship with gasoline prices explained 76.8% of the variation in ethanol prices. In other words, ethanol prices vary with gasoline prices, although ethanol prices "overshoot" gasoline in this time frame by 23%.

Ethanol prices remained above RBOB prices (despite having a lower Btu value) with more "upside" volatility, likely due to the tax credit and blending component shortage during the MTBE transition. In Figure 3 (following page), the CBOT staff charts the differential between ethanol and RBOB prices.

Setting aside the summer price anomaly and allowing for a great deal of normal volatility, the center point of this data set is in the 50-cent per gallon area. This differential likely reflects the 51-cent per gallon ethanol tax credit, as the economics of this measure played out in the broader market. The tax credit, which effectively reduces the cost of ethanol, facilitating fuel blenders paying 51 cents more for a gallon of ethanol than a gallon of gasoline.

In the marketplace, ethanol prices are determined by supply and demand. But the 51-cent per gallon tax credit is also a factor that impacts ethanol's market clearing price. In other words, while fuel blenders receive the tax credits directly, they can pass all or part of the credit along to ethanol producers by bidding a higher price than they might otherwise be able to pay. Without the tax credit, fuel blenders would cease bidding when ethanol pricing exceeded their revenue from the sale of that last gallon of ethanol. Fuel blenders could have, on balance over this time period, effectively passed their tax benefits on to ethanol producers.

Figure 3



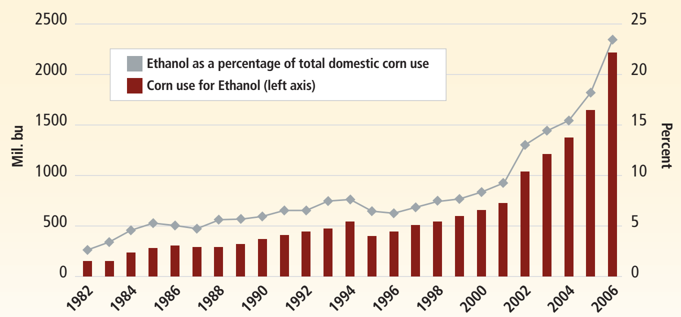
Source: Oil Price Information Service (OPIS)

Corn Prices

Demand for corn for use in ethanol production has increased sharply, transforming agricultural markets. Figure 4: Record Ethanol Production Drives Domestic Corn Use[2] shows the sharp run-up in the amount of corn used for making ethanol. About 2.15 billion bushels—or 25% of production—was used in 2006.

Figure 4

Record Ethanol Production Drives Domestic Corn Use

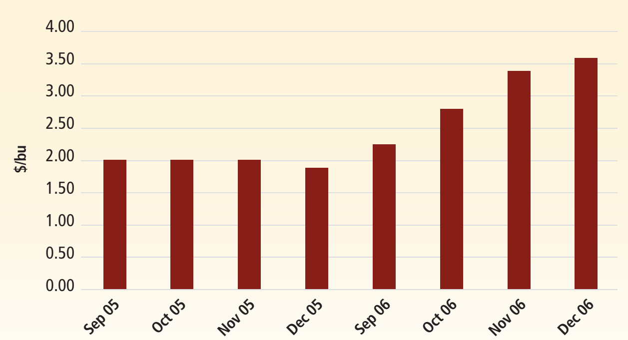


Source: USDA, World Agricultural Outlook Board, *WASDE*.

With this demand increment, it is not surprising that prices escalated. Figure 5 shows how benchmark corn prices rose during the crop harvest months of 2005 and 2006. Note the big increase starting with the 2006 harvest. Subsequent trading in early 2007 has seen corn prices in the $4 and above range.

Figure 5

Corn Prices 2005 and 2006



Source: Calculated by USDA, Economic Research Service. From Feed Outlook, February 2007.

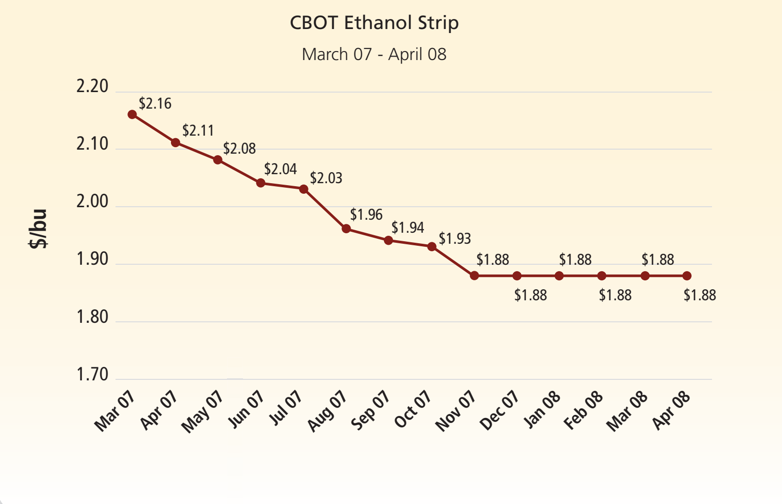
[2] Feed Outlook, USDA Economic Research Service, Feb. 13, 2007.

In a price environment such as this, the structure of commodity prices for 2007 and beyond should be impacted in a consistent manner. Figure 6 (below) shows the structure of future prices. One conclusion which can be drawn is that ethanol's demand-pull on the corn harvest is perceived as pervasive by market participants. Additionally, it appears as if corn prices have ratcheted up in a durable way to levels double what they were before ethanol demand escalated.

CBOT staff found there was almost no correlation between ethanol futures and corn futures[3]. Figure 6 shows the ethanol strip with high near-term prices, declining as 2007 progresses. Market participants are betting that increased ethanol supply will cause prices to decline, but increased ethanol demand tends to hold corn prices up.

It is noteworthy that the strip flattens out at $1.88 from December 2007 through December 2009. This suggests that market participants see a durable decline in ethanol prices as supply increases, reducing the scarcity premium for ethanol relative to gasoline.

Figure 6



[3] See CBOT Chartbook, page 26.

The Outlook for Ethanol, Gasoline (RBOB) and Corn Prices

Based on futures contracts traded on the NYMEX and the CBOT, this section discusses the price paths over time of RBOB gasoline, ethanol, and the corn feedstock[4] from which ethanol is manufactured. The futures contracts represent energy and agricultural market participant's collective estimates of what the prices of these commodities will be over time. Generally speaking, some insight about relative prices can be distilled from the data shown in Figure 7 below. With regard to:

Corn — Using food to make fuel has altered the corn market fundamentally. The $2 per bushel prices that prevailed as recently as 2005 have now ratcheted up to the $4 per bushel range, in what may be a paradigm shift. Would prices remain at these high levels under a high demand scenario?

On March 30, 2007, the U.S. Department of Agriculture published Prospective Planting, a survey of acreage to be planted in various crops for the 2007 growing season. The publication headlined that:

- Corn Acreage was up 15% over 2006 and 11% compared to 2005
- Soybean acreage was down 11%
- Cotton was down 20%

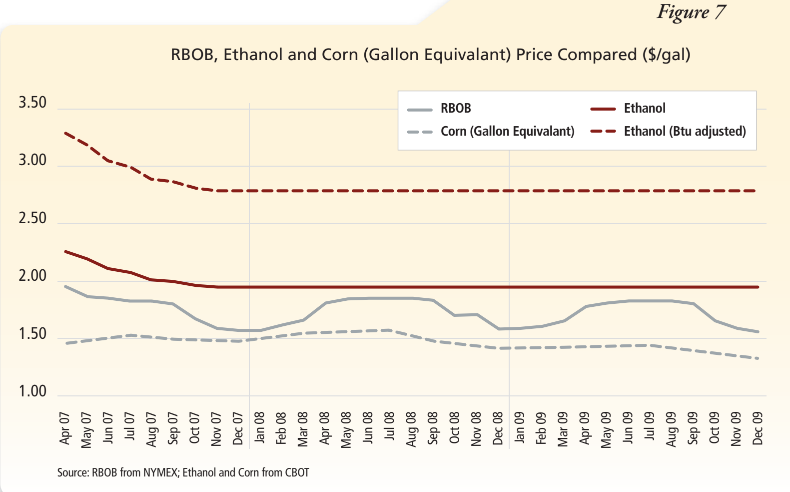
Farmers appear to be diverting acreage from soybeans and cotton to increase corn panting, the report noted.

Reaction on the CBOT was immediate, as the front month (May) corn contract fell sharply, dropping from the $3.90 per bushel area on Friday (3/31) to settle at $3.46 on Tuesday (4/4). Certainly higher prices will elicit greater supply, but it remains to be seen if corn supply can keep up with ethanol demand, which would grow six-fold under recent proposals.

RBOB Gasoline — The marketplace estimates that gasoline prices will slowly decline over time, falling from the current $1.93 per gallon level to $1.66 at the end of 2009. On a price per gallon basis—and on a price per energy content adjusted gallon—ethanol's market price is higher than gasoline. A gallon-to-gallon comparison finds ethanol now about 25-cents per gallon higher than RBOB. This will decline to a 20-cent per gallon spread in subsequent periods.

Ethanol — Seen as declining throughout 2007, falling from $2.18 to $1.89 by year-end as a result of added capacity. It will maintain that level in the outyears, likely propped up by the cost of corn feedstock, which is seen as not declining over time.

Figure 7



Ethanol Adjusted for Btu Content — When ethanol's role in the gasoline pool exceeds the amount of octane booster and oxygenate needed by fuel blenders, it becomes a direct competitor to gasoline and must be evaluated on the basis of energy content, in contrast to its volumetric energy equivalency. As Figure 7 suggests, it becomes (and remains over the years) vastly more expensive that gasoline on its value as a fuel. Markets tend to be great equalizers, and it is questionable how the differential between gasoline and energy-content adjusted ethanol prices can be maintained over time. Were the market to completely rationalize the gasoline-ethanol price situation, relative prices would tend to equalize. Price signals sent by commodity markets currently do not show this happening yet, suggesting that the story is not complete and further resolution of the pricing dichotomy is forthcoming. It may well result in ethanol prices continuing to decline (relative to gasoline prices) in the future, as production capacity under construction comes on line.

[4] An incremental bushel of corn yields about 2.75 gallons of ethanol. The gallon equivalent corn feedstock price is obtained by dividing the bushel price by this figure.

Blended Motor Fuel Demand — The Next 10 Years

During 2006, U.S. gasoline consumption amounted to 9.3 mbd (the equivalent of 144 billion gallons). Energy Information Administration (EIA) projections[5] for 2017 forecasts gasoline use growing by about 13% to 10.5 mbd, or the equivalent of 161 billion gallons. Assuming all gasoline sold in the country was blended to E-10, the implied use of ethanol would be 16.1 billion gallons.

The current automotive fleet is engineered to use gasoline containing up to 10% ethanol. It is constrained by manufacturer's warrantees and regulations prohibiting consumers from operating on fuel blends having a higher proportion of ethanol. The slow up-take of FFVs—only 6 million of which are able to burn gasoline-ethanol blends up to E-85—suggests that few of the nation's current 237-million-vehicle fleet can presently use gasoline blends containing more than 10% ethanol.

The government's own directives to acquire FFVs have not been widely adopted. Executive Order 13149, issued by President Clinton in 2000, called for federal agencies to reduce their oil consumption 20% by 2005, and an Energy Policy Act of 1992 mandate required newly acquired state vehicle fleets to contain 75% alternative fuel vehicles by 2001. But despite these significant mandates and directives, most government vehicle fleets are still unable to use significant amounts of high-percentage ethanol fuel. Basically, FFV goals are so unrealistic that the regulations have basically been ignored.

The U.S. vehicle fleet has been growing at over 2% annually, bolstered by new conventional vehicle sales amounting to 17.5 million cars, trucks, sport utility, and other motor vehicles during 2005[6]. By 2017, over 280 million vehicles could be on the road. Greater use of ethanol in the 2017 motor fuel market can only be predicated on the notion that substantially greater numbers of FFVs will enter the on-the-road fleet during ensuing years. The Big 3 U.S. automakers have pledged that half their output in 2012 will be FFVs. Were this target to be realized, 4 million FFVs would be produced annually, less than one-quarter of those sold. As a percentage of the stock of vehicles on the road, new FFV production would constitute less than 2% of the rolling stock.

If the president's proposal is to be realized, the limited availability of E-85 ethanol (only 1158 retail outlets carry E-85), a limited supply of attractive FFV vehicles (despite Corporate Average Fuel Economy (CAFE) credits for manufacturers[8]), and general disinterest among would-be fleet operators are factors that must be overcome.

[5] Annual Energy Outlook 2007, Table 11.

[6] U.S. Bureau of Economic Analysis.

[7] National Ethanol Vehicle Coalition Web site at: http://www.e85refueling.com.

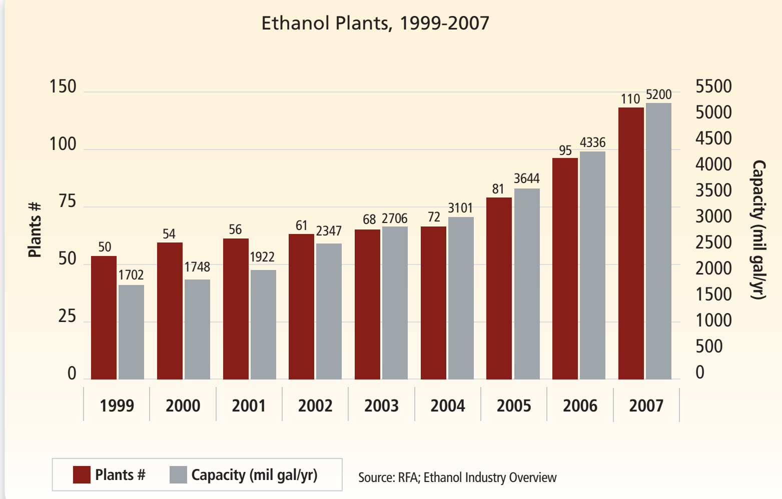
[8] The National Highway Traffic Safety Administration offers a 1 mpg CAFE credit to manufactures of E-85 capable vehicles until 2008.

An Ethanol Supply Boom — The Refinery Build-out

The current boom in ethanol demand has attracted significant investment in new plants. Figure 8 shows the ramp-up in number of facilities and their capacity. According to the Renewable Fuels Association (RFA[9]), there are now 114 operating ethanol plants, with 80 under construction and seven new expansion projects underway.

The current operating plants have 5.6-billion gallons/year of capacity and new facilities could produce another 6.4-billion gallons/year. Together, this could amount to 12 billion gallons per year by 2009. In other words, ethanol production has the potential to double in the foreseeable future, assuming all the plants under construction are completed.

Figure 8



Growing plant investment has been driven by strong profitability. One study estimated recent profitability of 49 cents per gallon for a hypothetical plant without any operating debt.[10] Not all plants are financed without debt, so this measure of profitability is not applicable to all facilities.

Ethanol plants that are enjoying this level of profitability benefit from the price support created by action of the 51-cent tax credit and the 54-cent impost on ethanol imports from abroad. The tax credit creates an effective saving for fuel blenders— savings that fuel blenders appear to be passing on to U.S. ethanol producers. Additionally, the levy on imports creates a price umbrella under which domestic producers are protected from foreign competition–at least to the extent that the perceived price of competitive imports is 54 cents higher than foreign producer prices.

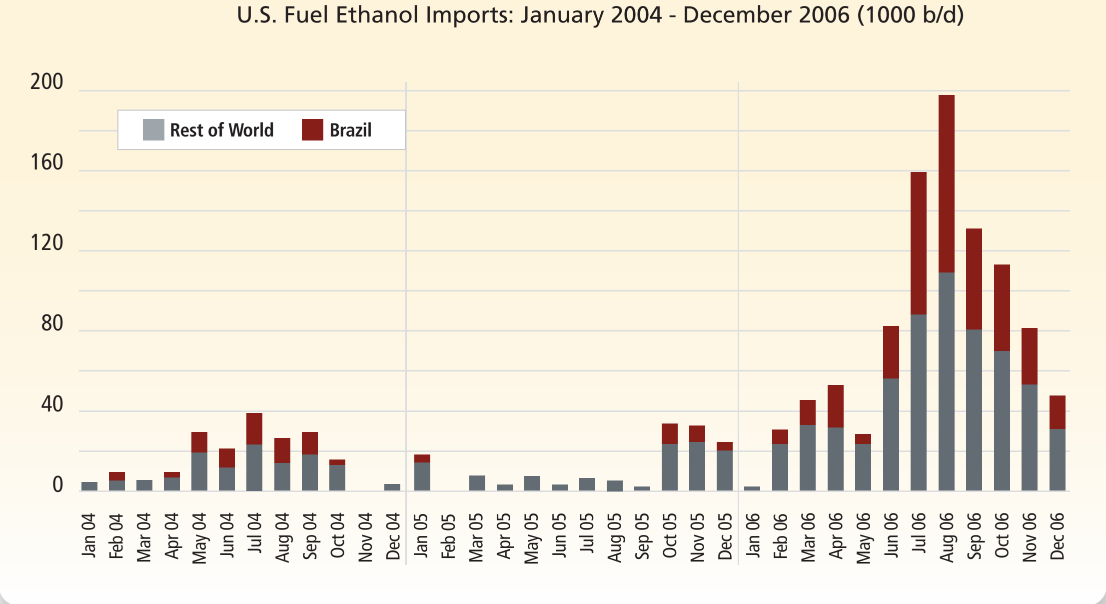
[9] RFA, Ethanol Biorefinery Locations, March 2007. See: http://www.ethanolrfa.org/industry/locations/

[10] See Ethanol Plant Profits Improve, a study by DTN Ethanol Center at http://www.dtnethanolcenter.com/index.cfm?show=10&mid=55&pid=23

Ethanol Imports — Growing Incremental Supply

Figure 9 shows monthly ethanol imports from 2004 through 2006. Imports were not a major consideration until the MTBE phase-out gained momentum in early 2006. These imports began to grow in a market with tight ethanol supplies and rising prices.

Figure 9



Source: RFA

But imports began to decline quickly as 2006 ended, likely as a result of lower prices and increasing U.S. production. For 2007, higher domestic production from additional plant capacity should be sufficient to meet domestic needs without significant reliance on imports. Combined with low prices and the 54-cent per gallon import levy, the quantity of imports will probably be at a background level.

While Figure 9 shows that Brazil can be a “swing producer” during months of low supply or high demand, it is more likely that even this important ethanol producer will, at most, be placed in a summer “fill” role under the set of economics currently in place.

Investment — Ethanol Plant vs. Oil Refining

Rapid growth in ethanol demand has led to increased investment aimed at expanding ethanol plant capacity. Seemingly high rates of return on investment have attracted an impressive flow of capital into the sector. Between 2003 and 2007 (to date), both the number of ethanol production facilities and their capacity have doubled, reaching the equivalent of 340,000 b/d of physical volume.

As ethanol capacity grew, petroleum refining capacity failed to keep up with the demand for refined products. While the nation's appetite for foreign refined petroleum grew from 2.6 to 3.6 mbd between 2003 and 2006, domestic refinery capacity increased from 16.8 mbd to 17.4 mbd during the same period. This means that the nation's need for refined products grew 1.0 mbd, but refining capacity only grew by 0.6 mbd. The refining deficit grew, leaving the nation more dependent on imported gasoline. At the same time, ethanol production doubled. The net result is that the nation became more dependent on foreign refining, even while ethanol production grew. Much more ethanol capacity (another 400,000 b/d) is under construction now, something that cannot be said for petroleum refining.

Oil refining needs capital to meet the demand for oil products, and it may be in a deficit position relative to investor support for new ethanol facilities. Additionally, as these new plants come on line, they appear to be driving ethanol prices down—and corn prices up—creating an adverse set of economics for this new industry. It may well be a matter of new ethanol facilities or increased oil refining capability, but not both: Projects benefiting from tax credits have the advantage in competition for investment funding.

Capital is available for ethanol plants, and the sharp increase in capacity will discourage petroleum refinery growth. This will be particularly true under the president's 35 billion gallon proposal. Table 2 below shows the current and EIA 2017 reference case gasoline demand scenario contrasted with what it would be with the president's plan.

Under the president's plan, by 2017 consumption of gasoline refined from petroleum is reduced by 1.3 mbd relative to the reference case for that year. This is due to use of 0.74 mbd more ethanol, and by a 0.55 mbd reduction in consumption due to mandated improvements in the vehicle fleet efficiency.

Relative to actual consumption of gasoline made from petroleum during 2006, the president's proposal by 2017 would reduce consumption by about 600,000 from what it had been last year.

Table 2: Gasoline Outlook 2017 (mbd)

	2006 Actual	2017 Reference	2017 President
EIA Base	9.24	10.48	10.48
Ethanol	0.28	0.78	1.52
CAFE Change	—	—	0.55
Net Conv. Gas Supply	9.02	9.70	8.41

Source: EPRINC estimates.

Notes: Blended ethanol adjusted for Btu content. CAFE improvement at 4% (as proposed) annually 2010 to 2017.

These numbers suggest that—were refiners to take the president's plan as guidance for demand for oil products—the implied message from his proposal would be to stop investing in incremental oil refining capacity because demand for oil based motor fuel is going to decline as a result of renewables taking market share.

In addition to the risks from under-investment in refining capacity, ethanol—in whatever quantity used—superimposes commodity risk on top of underlying gasoline supply risk. At present levels of less than 5%, the risk is relatively small. But as ethanol consumption heads toward 10% of gasoline consumption, commodity risk will become more significant, especially as ethanol investment crowds out oil refining capacity additions. And when ethanol use approaches 20% of gasoline consumption, commodity risk becomes a dominant feature of the gasoline security and price risk profile.

Price Volatility and Commodity Risk

An important goal of measures aimed at increasing U.S. energy security is price stability. Avoiding or mitigating the impact of price shocks on the economy and consumers has proven challenging: Reliance on large amounts of ethanol adds to the risks that roil fuel markets.

The gasoline price increases during the first part of this year are a good example of volatility best avoided. Pump prices for regular gasoline bottomed at $2.17 per gallon at the end of January; by the end of March, they were $2.64. That represents a $0.47 increase—the equivalent of 22%—in two months.

Why did this occur? Much of the price hike is related to outages at U.S. refineries, planned and unplanned. Essentially, the nation is in a deficit position in refining, and refineries are run at higher utilization rates than they might otherwise operate, leading to longer planned outages as well as shut-downs resulting from prolonged operation at maximum capacity. Taken together with refinery capacity being lower than domestic needs, and the necessity to import foreign refined oil products, the U.S. is exposed to supply constrictions not easily or quickly made-up.

Blender Tax Credit — Goals Achieved?

Even though the RFS targeted 7.5 billion gallons per year of ethanol production by 2012, capacity now on line or under construction already exceeds a supply goal that is 5 years in the future. With 6 billion gallons of capacity on line at the start of 2007, another 80 ethanol plants are being built, with an estimated capacity of 6.4 billion gallons per year. When these facilities come on line in the near future, capacity will amount to 12 billion gallons. By 2009, corn ethanol capacity in the aggregate will be the equivalent of about 780,000 barrels per day or roughly 8% of all gasoline and fuel blends consumed. This is 60% more than EPAct 05 calls for. Unless the ethanol distribution infrastructure can provide nationwide supply on a universal basis, the amount of corn ethanol that will be available could exceed the motor vehicle fleet's capability to consume all the potential supply.

Investors put capital into ethanol refineries based on the EPAct 05 RFS mandate. These investments were presumably driven by ethanol's rapid growth in the motor fuels market, and by the expectation that high ethanol prices and the 51-cent per gallon tax credit would assure profitability for the plants. Economics based on this strategy resulted in capital investments into ethanol capacity that may exceed likely demand during the next few years. Ethanol prices—as reflected in the 12-month futures strip (see Figure 6)—reflect futures market anticipation of enough production to drive prices down from current trends as supplies from new plants reach markets.

As the president's proposed 35 billion gallon mandate is considered, it is time to review what role the tax credit is playing in developing the ethanol industry. It appears as if a surfeit of corn-ethanol plants has been created; corn-ethanol is no longer an infant industry needing subsidy.

Cellulosic ethanol should be the next supply increment. This technology is not commercial, and substantial technical development is necessary. On Feb. 28, 2007, DOE Secretary Bodman announced grants totaling $385 million to six firms trying to develop facilities that would produce ethanol on a commercial basis from non-food sources. If ethanol production calls for government assistance, it should be targeted for fuel from non-food feedstock, as corn-based ethanol production has developed capacity that could be greater than the feedstock available without significant disruption of agricultural commodity markets.

[1] New Technologies in Ethanol Production, AER-842, Office of Energy Policy and New Uses, USDA.

[11] As reported by Dow Jones, March 5, 2007.

Appendix:

Net Energy — Ethanol Production Is Energy Intensive

Producing ethanol from corn is energy intensive. The fuel is used in machinery required for crop growing, as well as nitrogen fertilizer is produced from natural gas. Lastly, the corn-to-ethanol process still requires significant amounts of natural gas and electricity, despite improvements in the energy efficiency within these processes.

With regard to energy use in growing corn and in the corn-to-ethanol conversion, the United States Department of Agriculture (USDA) has observed[11] energy efficiency improvements with the ethanol refining process. The energy required to produce a gallon of ethanol has fallen from 70,000 Btu's during the 1970s to around 40,000 and 40,000 to 50,000 Btu's for dry and wet mills, respectively. In addition to generalized improvements in plant efficiency, dry milling is 77% efficient and wet milling is 57% efficient (a current weighted average of 67% for the two methods), reflecting a trend toward the more energy efficient dry plants, which now comprise 80% of total ethanol capacity.

It is noteworthy that these energy use estimates are adjusted so that energy consumption is proportionally allocated to ethanol and the marketable coproducts resulting from the ethanol manufacturing process.

How much imported petroleum is really saved by the use of an incremental gallon of ethanol? Proponents suggest that 67% of ethanol is a net energy addition. The other 33% is domestic natural gas and coal, which, embodied in the ethanol, becomes motor fuel. In terms of Btu's, the net energy addition is 51,000 Btu's — this amounts to about 45% of a gallon of gasoline. The import saving from the whole gallon of ethanol—including the input of domestic natural gas and coal—amounts to 67% of a gallon of gasoline. To establish some simple metrics, it can be said that:

» One gallon of ethanol displaces 0.67 gallons of imported gasoline.

» Of the 0.67 gallons, 0.22 gallons of reduced gasoline imports is attributable to the role of domestic energy in ethanol manufacturing.

» A gallon of ethanol used as motor fuel really does not produce a Btu-for-Btu saving of oil imports, nor does it offer a one-for-one energy security benefit.

[1] New Technologies in Ethanol Production, AER-842, Office of Energy Policy and New Uses, USDA.

[11] As reported by Dow Jones, March 5, 2007.