GUINNESS ATKINSON FUNDS

Ethanol Report
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Ethanol: Fuel for thought.

The sun, rich mid-America farmland, water and a little patience. These simple, wholesome ingredients combine to form what has been dubbed an energy savior: ethanol. Ethanol seems almost a miraculous solution to our energy problems. But is it? Can ethanol replace gasoline as the transportation fuel of choice in the U.S.? Or is it more of a contributory element in reducing dependence on oil? And what impact does growing corn for fuel have on the global food supply? The only thing growing faster than ethanol production are the predictions for future ethanol production and usage. In this report we provide background information on ethanol--what it is, its history, supply and demand and its economics--and examine the prospects for ethanol going forward.

Why is everyone talking about ethanol?

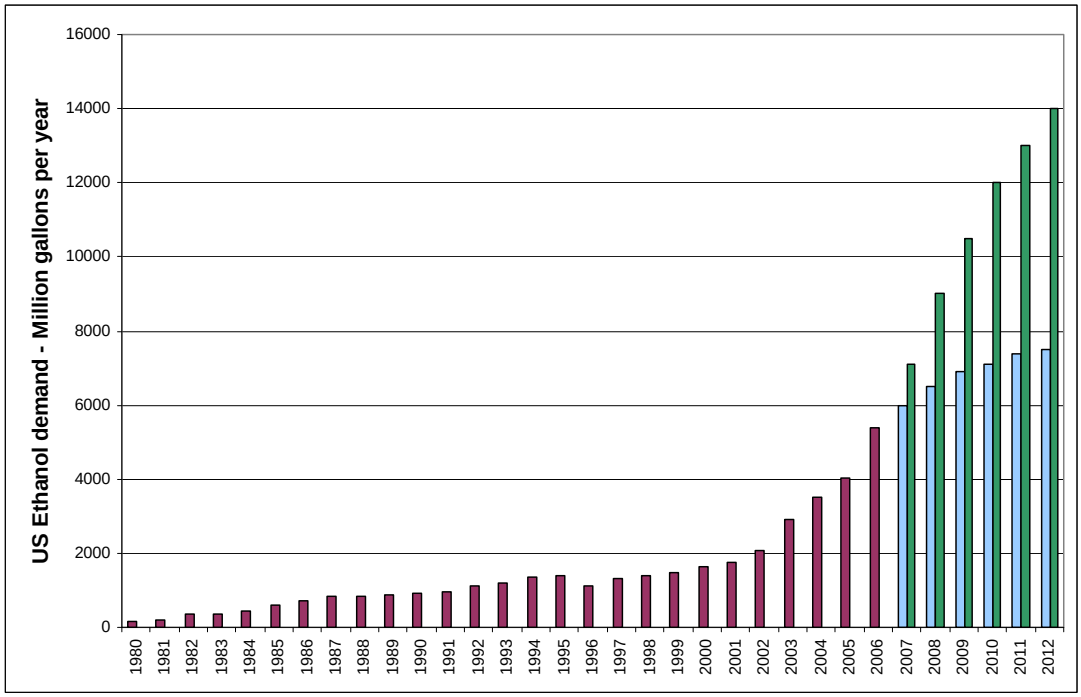
Ethanol is pure ethyl alcohol. It is produced by fermenting and distilling any of a number of biological feedstocks that contain significant amounts of sugar or starch of which corn is the main feedstock in the U.S. The main use of Ethanol in the U.S. is as a gasoline additive although it can be used in a more pure form as an alternative transport fuel in vehicles with specially modified engines. Ethanol has been used as fuel for vehicles since the beginning of the 20th century and was the fuel Henry Ford intended to use in the original Ford Model T[1]. However, petroleum based transport fuels soon became favoured as they were cheaper to produce.

There was a slight increase in demand for ethanol in the oil crisis of the 1970's but it wasn't until 1995 with the introduction of the Reformulated Gasoline (RFG) program[2] and the subsequent tightening of its rules in 2000 that a significant potential source of demand for Ethanol was established. The RFG program mandated the use of an oxygenate in gasoline in specific urban areas that were particularly affected by smog. The effect of adding the oxygenate was to create a cleaner burning fuel which would release less carbon monoxide as exhaust and therefore reduce the amount of smog in these areas.

The two oxygenates that were used were Methyl tert-Butyl Ether (MTBE) and Ethanol. Both of these also act as an octane enhancer which has become important as engine technology has evolved and required higher octane fuels. Typically refiners preferred using MTBE as it was less expensive although Ethanol was used in some parts of the Midwest. In 2004 the state of California banned the use of MTBE after it was found to be entering the water supply and studies showed that it was a probable carcinogen. This provoked a further 17 states to move towards MTBE-free gasoline. As a result of the need for an alternate oxygenate, demand for ethanol doubled between 2000 and 2004 as can be seen from Figure 1.

[1] http://www.ford.com/en/vehicles/specialtyVehicles/environmental/ethanol.htm
[2] For more information see: http://www.epa.gov/oms/rfg.htm

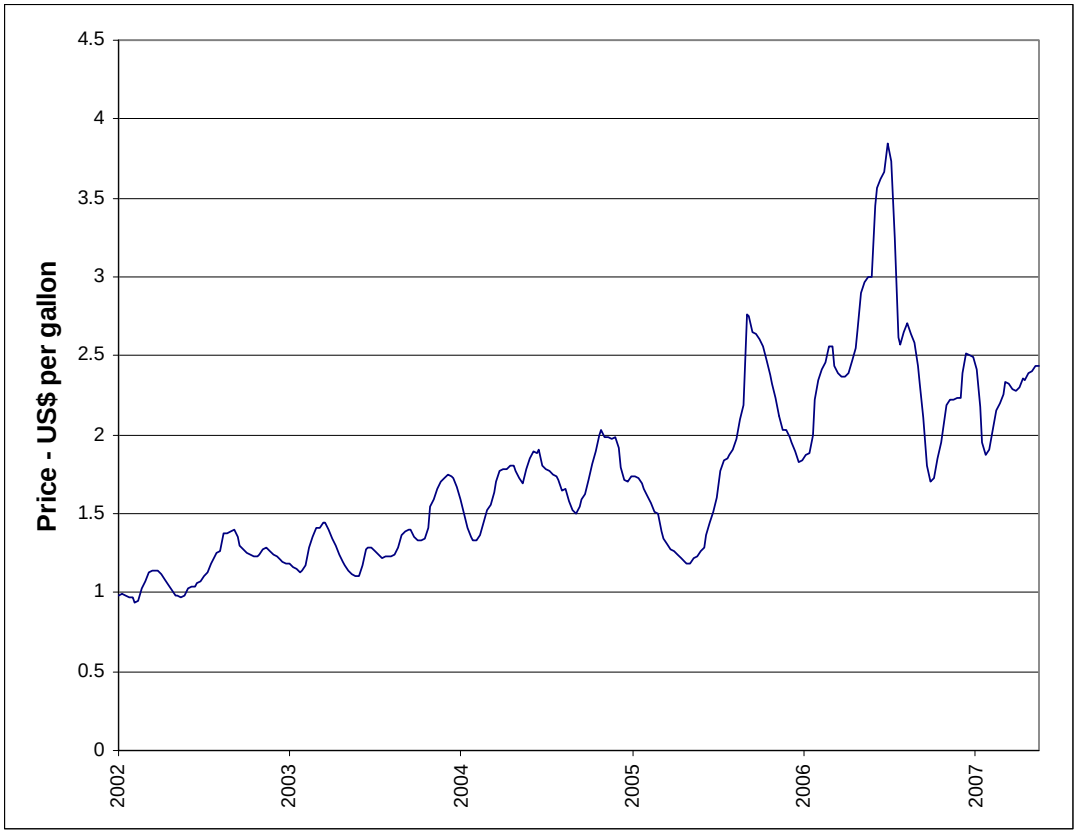
Figure 1: Annual US Ethanol demand since 1980[3]



In 2005 the Energy Policy Act removed the oxygenate requirement which effectively removed the state protection of refiners against litigation. When this came into effect in May 2006 refiners essentially stopped using MTBE and scrambled to find enough ethanol to replace it so that they could fulfil octane requirements and the applicable standards set by the Air Resources Board. George W. Bush's State of the Union Address[4] in January 2006 stated that the U.S. was "addicted to oil" and ethanol was to be part of the solution. Oil prices hit a record high in July 2006 and consequently gasoline prices reached over $3 per gallon. The role that ethanol is to play in the U.S. energy economy unsurprising received much press publicity and significant attention in the investment community. The anticipation of the increased demand for ethanol caused the spot price to soar to new highs of $4 per gallon in May 2006. See Figure 2. Bush in his January 2007 State of the Union Address[5] stated a new target of 35 billion gallons of alternative fuels[6] by 2017 and made clear that cellulosic ethanol would need to be developed further to meet this target.

[3] Source: Renewable Fuels Association. The projected demand between 2006 and 2012 in light blue is the demand which is mandated by the Renewable Fuel Standard (2005) of 7.5 billion gallons by 2012, whereas the projections in green are our own.
[4] For a transcript see http://www.whitehouse.gov/news/releases/2006/01/20060131-10.html
[5] For a Transcript see http://www.whitehouse.gov/stateoftheunion/2007/index.html
[6] Alternative fuels would include natural gas as well as ethanol and biodiesel.

Figure 2: Average spot price of Ethanol in the U.S.[7]



Could supply meet this new demand for ethanol?

Given the high level of mandated use of ethanol by 2012 and the 35 billion gallon alternative fuel target by 2017, is the U.S. able to supply enough ethanol to keep up with demand? The relationship between demand and supply for ethanol is a complicated one. In 2006 demand outstripped supply however, in 2007 rapid expansion in the industry has increased supply and the situation is now more balanced. If the 35 billion gallon alternative fuel target is mandated into law as many are anticipating to happen later this year then we could see demand outstripping supply again. However, further significant production volume is due to come online over the next few years.

Demand drivers.

The demand for ethanol over the next two years looks set to be strong and could persist for longer. The key demand drivers have been and keep in mind going forward are:

1. The phase out of MTBE and the introduction of the new Federal and State Renewable Fuel Standards has led refiners and blenders to seek an alternative oxygenate and octane enhancer to meet these criteria with ethanol being the only viable option. The Renewable Fuel Standard (2005) mandated the use of 7.5 billion gallons of renewable fuels by 2012.
2. Ethanol has also gained government and public support as it contributes to reduce the U.S. reliance on imported oil from politically unstable regions by adding to the gasoline supply. Bush stated in his state of the union address in January 2006 that he wanted to replace 75% of oil imported from the Middle East and in his January 2007 state of the union address stated a new target of 35 billion gallons of alternative fuels. The U.S. is

[7] Source: Bloomberg

also short of refining capacity, and therefore domestically produced gasoline, and has been for a number of years. Currently the U.S. imports over 1 million barrels per day of gasoline (mainly from Europe) and consumes around 9.5 million barrels of gasoline per day[8]. Ethanol can therefore play a part in both reducing crude oil imports from the Middle East and taking pressure off domestic refining capacity.

3. If the difference in price between ethanol and gasoline is low then there is an incentive for blenders to voluntarily add ethanol to gasoline for economic reasons. Blenders benefit from a 51c per gallon volumetric tax credit which means that for every gallon of ethanol they blend with gasoline they receive 51c.

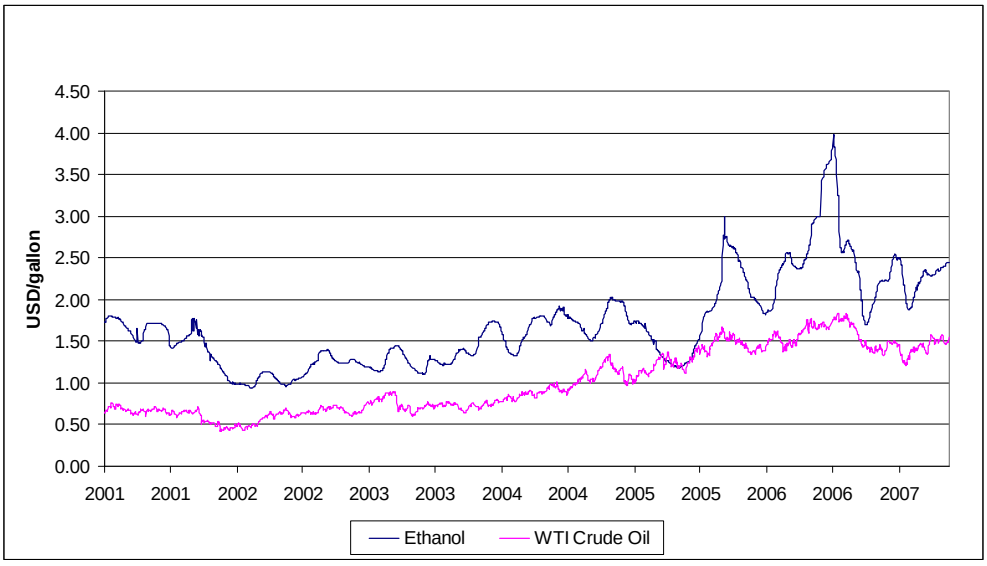
   Eg. If the price of Gasoline was $2.00 per gallon and the price of ethanol was $2.40 per gallon the effective cost to the blender of the ethanol is $2.40 – 0.51 = $1.89. Therefore, by adding ethanol to gasoline the resulting blend actually costs less than pure gasoline.

4. As ethanol is a renewable fuel it has gained support as it helps to reduce greenhouse emissions. However, ethanol production is not entirely carbon neutral due to the use of fertilizers in corn production and natural gas in the fermentation process[9].

Supply: surplus or shortage?

1. The price of ethanol has historically shown a good correlation with the price of oil (See Figure 3) and little correlation with the price of corn. With the price of gasoline strongly dependent on the crude oil price, the high oil price environment of the last few years has led to higher ethanol prices. Given that until recently the corn price has been relatively stable (see Figure 4), investors have seen that there are attractive margins to be had in the industry and consequently there has been significant investment in production capacity.

Figure 3: Ethanol and Crude Oil prices[10]



[8] Souce: US Department of Energy.
[9] Alexander Farrell at the University of California Berkley wrote in Science Magazine that use of corn based ethanol reduced green house gas emissions by only 13%.
[10] Source: Bloomberg.

Generic ethanol business model

As an example of the historical margins in the industry, using the long term average prices for corn and ethanol we get a 37% operating margin for an ethanol plant. See below:

	U.S.$ per gal
Ethanol Price	2.10
Distillers Grains[11]	+0.25
Corn Cost[12]	-0.82
Natural Gas	-0.25
Transport	-0.25
Other	-0.25
Op Profit	**0.78**
Op Margin	**37%**

The significant investment that is occurring means that we may well meet the Renewable Fuel Standard's target of 7.4 billion gallons per year long before the mandated date of 2012. Indeed our research shows we could meet this target by 2008. Therefore supply should meet demand in the next couple of years if no change is made to legislation. See below for a breakdown of current and planned production capacity[13].

	Millon gal per year
Total Current Capacity	6,137.40
Planned/under construction.	6,379.90
Current and planned capacity	**12,517.30**

2. The economics of Ethanol production are extremely sensitive to commodity prices. As the ethanol price has historically been linked to the gasoline price there is little that can be done to pass on to the consumer any rise in cost of the inputs costs such as corn and to a lesser extent natural gas. Instead margins will be squeezed and if input prices are high then investment in the industry will look less attractive and could severely impact investment in further production capacity. Recently corn prices have been the highest they have been since 1996 (see Figure 4) and we are starting to see this have significant impact on margins (see Figure 5). If this is a brief spike in the corn price then the long-term prospects for ethanol producers are still very good. However, if it becomes apparent that these higher prices are here to stay then clearly margins will be less attractive.

[11] Distillers grains are a bi-product of the ethanol production process which can be sold as cattle feed.
[12] Assumes corn cost of $2.30 per bushel. We assume that we can produce 2.8 gallons of ethanol per bushel of corn. $2.30 \div 2.8 = 0.82$.
[13] Source: Renewable Fuels association website: www.ethanolrfa.org

Figure 4: CBOT corn price[14]

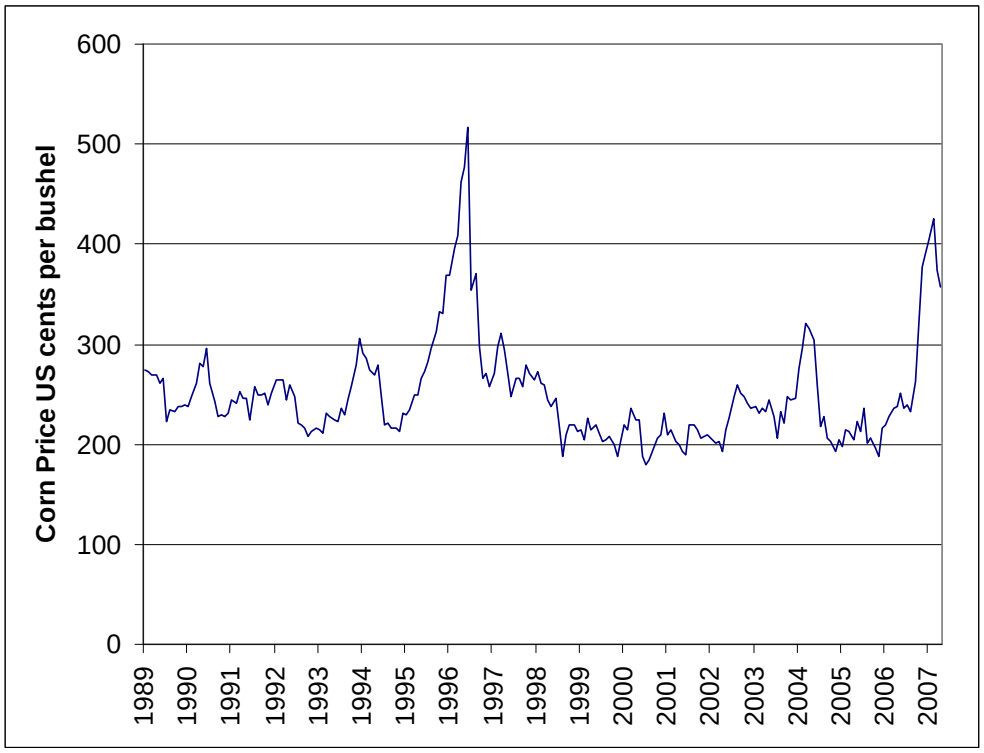
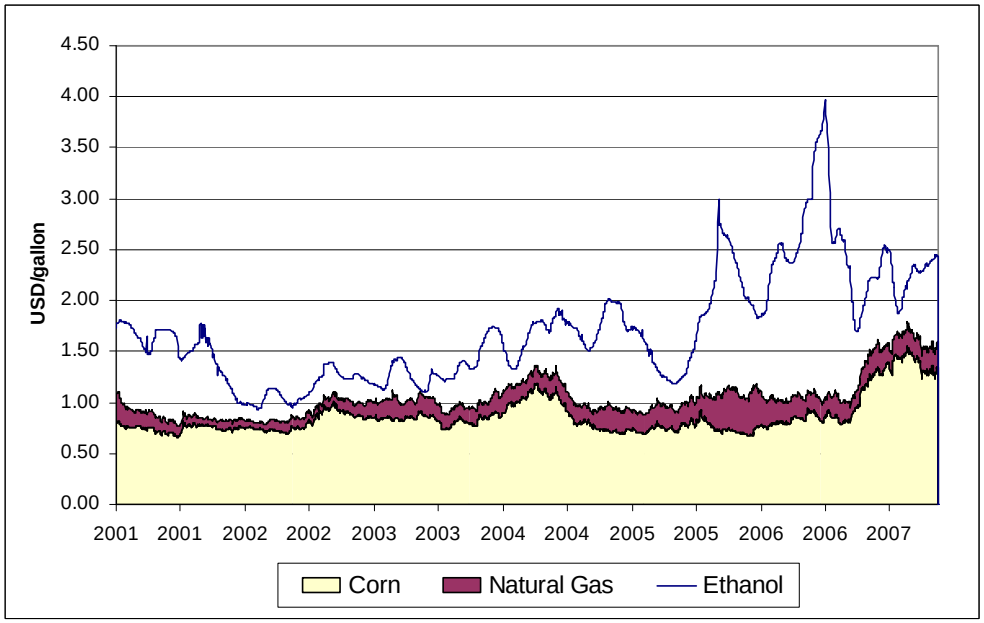


Figure 5: Price of Ethanol vs input cost per gallon of corn and natural gas[15].



[14] Source: Bloomberg.
[15] Source: Bloomberg.

3. The large number of plants being constructed or in the planning stages has posed a number of more short-term issues. Some sources are indicating that there is a shortage of suitable US engineering and construction capacity which is slowing down the roll out of planned production facilities. This combined with higher construction costs due to rising steel prices could also lead to increased prices for plant construction.

Our conclusion is that the drivers behind demand for ethanol over the next two years are favourable and recent good margins are attracting investment. As a caveat, we note less favourable margins due to high corn prices and increasing costs of building plant could curb availability of capital for building new plant.

Could ethanol replace gasoline as a transport fuel?

In the longer term what impact could ethanol have in reducing gasoline demand and thereby reducing the U.S.'s dependence on oil and reducing carbon dioxide emissions?

Demand for gasoline in the U.S. has been increasing steadily over the last 15 years growing at around 1.5% per year. See Figure 6. In 2006 U.S. demand for gasoline was 140 billion gallons. Compare this with ethanol production last year of around 6 billion gallons and it is clear that ethanol production would have to increase dramatically to reach these levels.

With current technologies (i.e. ethanol produced from corn rather than cellulosic ethanol) the demand for corn would be too high to replace all U.S. gasoline demand. In 2005 the U.S. produced around 11 billion bushels of corn of which around 13% or 1.4 billion went towards ethanol production[16]. Large scale ethanol producers are able to yield around 2.8 gallons of ethanol per bushel of corn. Therefore if we required 140 billion gallons of ethanol to replace gasoline we would require 50 billion bushels of corn. This is 4.5x greater than the entire U.S. corn crop today.

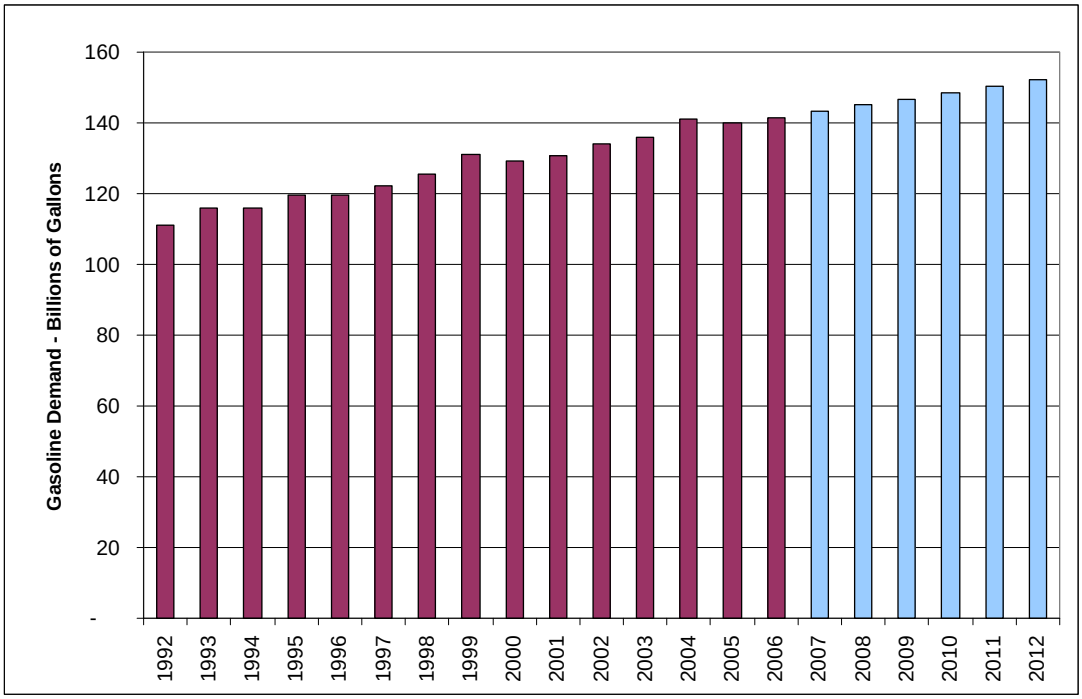
If we are generous one acre of land will yield on average around 150 bushels of corn. Therefore to produce 50 billion bushels of corn would require approximately 330 million acres of farmland. Compare this with the fact that entire U.S. there was only 303 million acres of harvested cropland in 2002 (the year of the last Census of Agriculture)[17]. Based on these numbers it clearly would not be possible for U.S. produced corn based ethanol to replace gasoline.

Cellulosic ethanol (ethanol produced from biomass waste) will have a part to play in meeting growing future demand but currently the technology has not advanced enough to make it economical[18]. The U.S. government has put incentives in place to encourage research into cellulosic ethanol. For example the Renewable Fuels Standard treats 1 gallon of cellulosic ethanol production as 2.5 gallons of renewable fuel. Furthermore on the 2nd of August 2006 the Department of Energy announced that it would invest $250 million in two "Bioenergy Research Centers"[19] which would devote much of their resources towards research into cellulosic ethanol. We wouldn't expect to see meaningful quantities of cellulosic ethanol being

[16] Source: US Department of Agriculture.
[17] Source: US Department of Agriculture.
[18] Specifically it is the fact that the enzymes needed in the process are too expensive. They are used to break down the cellulosic biomass into sugars which can then be fermented to make ethanol.
[19] For details see: http://www.energy.gov/news/3883.htm

produced for another five years. Cellulosic ethanol will also require the build out of new infrastructure. Much larger amounts of storage space will be required compared to corn: the biomass material will need to be dry before it can be used. Transportation costs will be higher than corn unless the plant has its own source of feedstock close by.

Figure 6: Annual US Gasoline demand since 1992[20]



Could the U.S. import sufficient Ethanol? Currently the only other significant producer of ethanol is Brazil which currently produces approximately the same volume as the U.S., although U.S. production is growing at a faster rate. Brazil and the U.S. account for 92% of global ethanol production[21]. Brazil uses sugar cane as its feedstock and uses approximately 50% of its sugar crop for ethanol production. However, Brazil has strong domestic demand for its own ethanol (only 10-20% is exported) as 50% of total car sales in Brazil are flex-fuel cars that can run on either ethanol or gasoline or a blend of the two. The U.S. has placed a tariff on ethanol imports of 54c per gallon which is not up for review until December 31, 2008 and is likely to be extended. Although Brazilian ethanol is cheaper to produce this tariff generally makes imports uneconomical unless the price of U.S. produced ethanol is high[22]. Therefore, imports are unlikely to be a significant source of ethanol supply.

Also there are some inherent, logistical and infrastructure issues that need to be considered. First, ethanol has approximately a 35% lower energy density than gasoline which means you travel fewer miles per gallon with ethanol than you would with gasoline. This does not have a marked effect at 10% blends but would do at higher blends. Second, ethanol cannot be transported along traditional oil pipelines as it is corrosive. Ethanol has to be transported by rail if the distances are long and is then splash blended with gasoline in the delivery truck. Given that rail use is close to capacity an alternative would need to be sought such as corrosion resistant pipelines which would be expensive. Third, but most importantly, most modern cars can run on a gasoline-ethanol blend of 90% gasoline and 10% ethanol (E10) without any

[20] Source: US Department of Energy. Projections are our own estimates assuming an annual growth rate of 1.2%.
[21] Souce: BP Statistical Review
[22] US imports of Brazilian ethanol were seen when the spot price of ethanol spiked in May 2006.

modification to the engine. However, a 20% ethanol blend would require modifications. At a 20% blend the modification is fairly simple and would cost only around $150 if done while manufacturing the car before it left the factory. However, this would take time to come into effect. Higher ethanol blends such as 85% ethanol would require the public to buy flex-fuel cars (such as those in Brazil) as well as filling stations providing access to the fuel.

Therefore, we see a relatively quick transition to an 8-10% blend as an achievable target with current corn based production techniques. 10% would equate to additional corn demand of 3.2 billion bushels compared to the last crop of 11 billion bushels. Although this will certainly put pressure on the corn price which will slow the rate of construction of new plants, changes in crop rotations, reducing exports of corn, improving yields and potentially gradually making use of dormant land will increase the corn supply and possibly temper corn prices in the long run. At higher blends we start to run into technical issues as discussed above and supply of feedstock for ethanol production will be tight. If auto manufacturers were to mass produce vehicles that can run at higher blends we could see a second phase of demand growth for ethanol. Ultimately cellulosic ethanol will probably have to play a part in providing capacity for this second phase but if the demand growth is relatively slow (1-2% per year) it is possible that improving corn yields could keep up with demand. Should cellulosic ethanol really take off and become economical without subsidy we may well see a third phase of increased demand but there are high technical barriers to this becoming a reality.

We can get some idea of the Bush administration's real target for ethanol replacement of gasoline by doing some further analysis. In Bush's State of the Union Address in January 2006 he stated one of America's great goals was, "to replace more than 75 percent of our oil imports from the Middle East by 2025."[23] In 2005 the U.S. imported 2.345 million barrels of oil per day from the Middle East.[24] Therefore, the number of barrels that the U.S. wants to replace is 75% x 2.345 million = 1.759 million barrels per day. In the same year the U.S. consumed 9.495 million barrels per day of light distillates which is mainly gasoline[25]. If we make the assumption that the oil imported from the Middle East is all refined into gasoline then we can work out what proportion of the total daily gasoline consumption this would make up: 1.759 ÷ 9.495 = 18.5%. Therefore perhaps we could see this as the Bush administration's rough target for gasoline replacement by ethanol. In reality the figure is probably somewhat lower as more oil could be imported from Canada as the Alberta oil sands production facilities come on line and there may be a drive to make use of improvements in vehicle fuel efficiency technology. However, we conclude that ethanol could account for around 10% of U.S. gasoline demand with current technology.

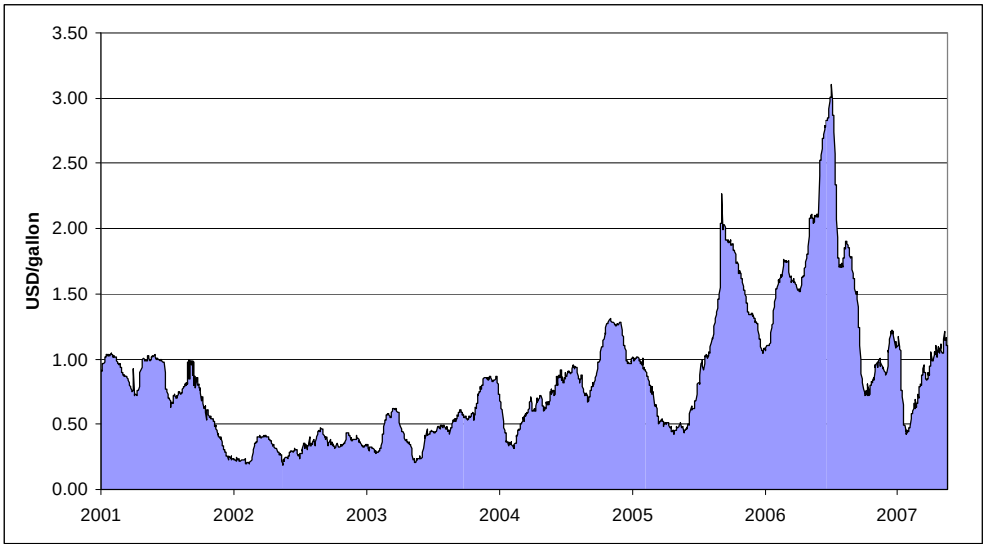
We have seen how demand for ethanol is set to grow over the next five years or so and discussed what is driving this demand. We have got a sense of how much ethanol the U.S. could produce and over what time period and what will eventually constrain this growth. So is the ethanol industry worth investing in and what are the risks to consider?

[23] For a transcript see http://www.whitehouse.gov/news/releases/2006/01/20060131-10.html
[24] Source: BP Statistical Review.
[25] Source: BP Statistical Review.

What are the key factors we need to consider when considering an investment in an ethanol company?

1. First, investments in ethanol producers are risky due to their dependence on commodity prices. We have seen in Figure 2 and Figure 4 how volatile both the price of ethanol and corn have been in the last six months. It is the difference in the price of ethanol per gallon and the cost of the amount of corn to produce a gallon of ethanol (the "crush spread") that is the most important factor in determining whether ethanol companies can be profitable. Figure 7 shows an approximation of industry crush spreads since 2001. If corn prices rise and ethanol prices fall as has happened recently margins can be significantly squeezed and if the opposite happens margins can be extremely attractive. Therefore, in order to determine if one is willing to ride the short-term peaks and troughs in margins one must attempt to take a view on what long-term average commodity prices will be. In the long run do you believe oil prices will continue to rise or will they fall back to a long-term average? Similarly with corn, is the recent ramp up in price of corn a structural long-term shift due to increased demand from ethanol production or is it just a short-term spike caused by speculative positions?

Figure 7: Industry Crush Spreads[26]



2. The second and third quarters of 2006 saw high margins for ethanol producers. The very high margins seen in the third quarter of 2006 are not sustainable in the long run as the barriers to entry for an investor to setup an ethanol plant are relatively low. The plants only take 18-24 months to build, they do not require excessive permitting, they are relatively cheap to construct, etc. High margins attract investment which eventually will result in supply meeting demand and therefore margin contraction. Therefore economic theory would expect to see a rise in corn prices caused by new demand from ethanol producers and a fall in ethanol prices due to overcapacity and thereby bring margins down to a more sustainable level.
3. When margins contract a cheap source of feedstock will be a key competitive advantage. It is important to look for companies who can minimize all their costs. Having a good local cheap source of corn is key to keep corn and transportation costs down. The price of natural gas is also important as is the price they can sell their distillers grains for.

[26] Source: Bloomberg

4. Does the company have a commodity hedging strategy such as selling its ethanol forward and buying its corn forward to lock in margins or does it sell and buy both on a spot market basis and take whatever margin that results. Does the company have a policy of locking in anything above a particular margin if available?
5. The industry is currently dependent on subsidies which may change in the future. What is the risk of legislation changing to the detriment of the ethanol industry?

Our view.
In the short-term our view on the ethanol industry is bearish. We are concerned about the rise in corn prices and the outlook for corn prices going forward. Quarterly results of ethanol companies have shown their margins being squeezed and we expect this to continue. We predicted this at the beginning of December and sold all core ethanol positions. Long-term demand looks set to be strong driven by the current Renewable Fuel Standards and industry fundamentals. A mandated "Alternative Fuel Standard" later in 2007 or 2008 would certainly be a further catalyst for the ethanol price and stocks in the sector.

The crucial question at this stage is what will the corn price do over the next year and beyond and therefore what will happen to the crush spread? Although this is very difficult to predict we are concerned corn prices will remain high.

Corn demand from ethanol is rising fast. In 2005 ethanol used 1.4 billion bushels of corn. The U.S. Department of Agriculture's chief economist Keith Collins in a recent announcement to the Senate committee of Agriculture, Nutrition and Forestry revised his estimate of the amount of corn used to make ethanol in 2006 from 2.15 billion bushels to 2.3 billion bushels. For 2007 some analysts are estimating an increase of 1 billion bushels to 3.3 billion bushels. This increase of around 1 billion bushels per year is very significant relative to the total crop of 2005 of 11 billion bushels and this level of increased demand looks set to continue. It also appears that the amount of corn being grown is not keeping up with demand. For the current crop year the USDA forecasts the total use of U.S. corn will be equivalent to the production on 85.6 million acres. Announced plantings for 2007 were a record 90.5 million bushels which roughly corresponds to this target when you consider that usually 8-10% less are actually harvested. Collins says, "Beyond 2007, to achieve steady increases in ethanol production from corn will require ever more acreage or higher corn yields per acre, or both." Although corn yields are increasing year on year (around 1-2%) the growth is nowhere near sufficient to meet ethanol demand alone. Therefore in order to meet demand it appears the U.S. must grow more corn and either find more land on which to grow it, by releasing land from the Conservation Reserve Program, or grow corn instead of another crop and thereby perhaps put pricing pressure on other crops. Either way a plan to meet this rising demand will take some time to come in to effect and we expect corn prices to remain at these higher prices for sometime.

Catalysts which may improve our outlook for the ethanol industry are an increase in the Renewable Fuels Standard, fundamental improvements in the corn price, or a reduction in ethanol stock prices. Until then we will continue to be bearish on U.S. ethanol stocks[27].

[27] Companies relevant to this report and in our investment universe are:
Archer Daniels Midland, Verasun, Aventine, MGPI Ingredients, Green Plains Renewable Energy
GTL Resources, Renova, Pacific Ethanol, Xethanol, U.S. Bioenergy

The Guinness Atkinson Alternative Energy Fund invests in foreign securities which will involve greater volatility, political, economic and currency risks and differences in accounting methods. The Fund is non-diversified meaning that it concentrates its assets in fewer holdings that diversified funds. Therefore, the Fund is more exposed to individual stock volatility than diversified funds. The Fund also invests in smaller companies, which will involve additional risks such as limited liquidity and greater volatility.

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