# Another Plant?!...The Rapid Expansion in the Ethanol Industry and its Effect all the Way Down to the Farm Gate.

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**Abstract**

The ethanol industry has expanded rapidly in recent times. Utilizing budgeted ethanol plant and farm models we determine the effect of this expansion on future corn acreage and farm incomes. Several scenarios are presented to determine the profitability of the ethanol industry at various input and output prices.

**Introduction/Statement of the Problem**

In recent times it is a rarity to glance through any mid-west agricultural publication without reading about an additional ethanol plant coming online, breaking ground, or raising capital. As of January 2006, national annual ethanol production capacity was approximately 4.6 billion gallons, up one billion from 2005 (ACE). In addition, there are currently 34 ethanol plants currently under construction, equating to an estimated 6.7 billion gallons of ethanol production capacity by January 2007, compared to a capacity of 1.77 billion gallons in 2002 (ACE).[1] Long-term ethanol production estimates are widespread and contingent on many outside economic factors but have been predicted to exceed 12 billion gallons by 2008, far exceeding the Renewable Fuels Standard of 6.1 billion gallons (RFA).

With estimated capitol costs for plant construction ranging in magnitude from $1.00-1.50, investment in plant construction alone will range from $2.02-3.03 billion in 2006. Given the size of investment in ethanol plants, there is a potential for current and future investment in ethanol to be the “silicon-valley boom” for agriculture. The question is, will this “ethanol boom” look similar in 2010-12 to what silicon-valley did in the late 1990’s?

What caused ethanol production to outpace the benchmarks established by the renewable fuel standard? The answer may be relatively elementary, we are in a  golden time for ethanol!

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[1] These figures only account for plants currently under construction, not those who have not broken ground, are currently in the process of an equity drive, and/or do not use corn for their conversion technology.

High energy prices coupled with low corn prices along with recent technological increases that allow plants to more efficiently convert a bushel of corn into several gallons of ethanol. Outside these advantages comes a domestic ethanol tax break of $0.51 along with a tariff equal to the above break for imported ethanol. Hence, ethanol is looking profitable at this point in time, but will there be enough domestic corn production to supply our newfound massive friend?

In the remainder of this paper we will examine current and future corn supply and demand given projected increases in ethanol production. These estimates will be used to determine whether corn acreage will need to increase to meet future corn processing and export demand. Since a majority of the estimated increased ethanol production will occur in Iowa, a more in-depth state-wide outlook for Iowa will be estimated as well.

Another central question to increased ethanol production is if the industry itself is fact sustainable. We will model the breakeven margin for a representative ethanol plant given several energy and commodity price scenarios. These scenarios will provide a framework to establish what factors affect the profitability of the industry.

At the heart of the ethanol/increased corn acreage issue is whether farmers have an incentive to shift their crop rotations to a higher percentage of corn. Given current commodity and input costs, we will determine what corn price is required to make corn production more profitable relative to soybeans. We will also address the possibility of Asian Rust for soybeans to determine how its presence affects the profitability of corn relative to soybeans.

In conclusion we will bring up some future wild cards that have the potential to significantly alter the demand for ethanol and/or corn. A few of the intended scenarios are: changes in biomass conversion technology, changes in corn degerming technology, fuel cell breakthroughs, and energy policy changes.

**Corn Supply and Demand**

Figure 1 depicts US corn production, domestic use, and availability for exports projected to 2012. This figure shows historic numbers up to 2005 and projected bushels from 2006-2012. Corn demand for processing is trended both by recent increases in ethanol production and by ethanol production increases required to stay in step with the Renewable Fuels Standard. As depicted, the trend for increased processing demand estimates far exceed what will be required given RFS of 7.5billion gallons in 2012. Feed use is adjusted for DGS for 2006-2012, this is adjusted considering that DGS will gradually account for 15%, 18%, and 10% of the total feed ration for beef cattle, dairy, and hogs, respectively. Given the above adjustments with trended yield patterns from 1970-2005 and 2005 corn acreage, the red production line depicts increased corn production. If corn production grows at the rate of trended yield predictions and acreage remains at the 2005 level, corn available for export falls to 0.1 billion bushels by 2012.

Two alternative scenarios are depicted in this figure: production needed to maintain current exports of 1.94 billion bushels and production needed with current exports and China demanding 300 million bushels in 2006 with a 5% increase in subsequent years. In each case, production must significantly increase above the level of 2005 acres and a trended yield.

Figure 2 depicts extra US corn acres needed to maintain exports & projected ethanol production relative to 2005 acreage. This figure also depicts the additional corn acreage required given in the event that China becomes a major importer of US corn. The key assumptions behind this estimate are a trended corn yield from 1970-05, DGS reduces corn feeding, and no major droughts. Another key assumption that needs explanation is that additional corn acreage will produce 80% of current corn acreage. Studies have been conducted to determine the yield between first and second year corn, they have concluded that $2^{nd}$ year corn yields, on average, 10-15% less than corn that was planted following soybeans; this will be discussed in more detail later in this paper. Another reason that decreased yields for new corn acreage may be observed is that corn may be introduced on marginal land that lacks the production potential of current corn acres.

Under the scenario that China imports 300 million bushels of US corn in 2006 with 5% subsequent annual increases, approximately 13.8 million additional corn acres will be required relative to 2005. If China does not demand any US corn in 2006, current corn acres are adequate to supply 2006 increases in ethanol production.

## Implications for Iowa

Since Iowa has historically been the number one state with respect to corn production, currently produces 33% of the nation's ethanol, and represents 50% of the predicted increases in national ethanol production, it is considered separately. Table 1 depicts current and planned ethanol production.

Iowa's current ethanol plants demand 930 million bushels of corn and plants in the construction and planning stages will demand an additional 1.15 billion bushels for a potential ethanol demand for corn of 2.08 billion bushels. Given the 2005 corn crop this indicates that Iowa will become a net corn importer with -621 million bushels available for export when all of the planned plants have reached their production capacity. Compared to 2002, this is a 1.47 billion bushel swing in corn available for export unless more acres are devoted to corn.

The capacity rating +20% calculations are included because it has become very commonplace in the industry for plants to produce over the capacity that they were constructed for. The authors would also like to indicate that at the time this paper was authored, another ethanol plant was announced almost weekly. Hence, additional plant announcements may occur between when this paper was written (May 2006) and when it is read.

To give the reader a visual of the number of actual and planned ethanol plants, Figure 3 is provided. Figure 3 illustrates the location of each ethanol plant and a circle showing the required acreage of corn in each area to supply its demand for corn. East-central Iowa has numerous concentric circles. In this region of the state Archer Daniels Midland alone demands 383 million bushels of corn annually for their ethanol plants.

**Ethanol Profitability Scenarios**

In order to model ethanol plant profitability a representative ethanol plant was created. This plant has an annual capacity of 60 million gallons per year and is dry-mill technology. The plant is owned by shareholders with profits to the plant returned as dividends and retained earnings. Corn is assumed to be bought on the open market, no delivery requirements by shareholders, and all input prices are set at current market levels. The general technical coefficients are listed below:

Inputs

- 1 Bushel of Corn
- 2 Gallons of Water
- 0.495 kWH of Electricity
- 0.035 mmBTU of Natural Gas
- $0.62 in Fixed Costs

Outputs

- 2.7 Gallons of Ethanol
- 17 lbs. Dried Distillers Grain with Solubles (DDGS)

In order to model the historical profits of a representative ethanol plant, past monthly prices for corn, ethanol, DDGS, natural gas, and electricity were obtained from 1996-2006. The technical coefficients listed above were applied to the historic price series to model estimated gross and net plant margins. Figure 4 depicts monthly historical net and gross margins for a representative ethanol plant for 1996-2006. Gross margins represent ethanol and DDGS revenue less corn prices. Net margins represent gross margins less energy, chemical, and fixed costs. Given today's ethanol production technology, gross margins would have been positive over the time-period. Except for a short period in 1996 and two months in 2002 and 2003, net margins would have been positive.

Table 2 is an income statement for the representative ethanol plant given average corn, ethanol, DDGS, and natural gas prices from 1996-2006. This representative ethanol plant would have enjoyed an average net-margin of $43,892,580 annually or roughly $0.73 a gallon. Under this average price scenario, income from DDGS accounts for only 11.5% of total income. In fact, if we assume that the price for DDGS is $0, the plant still boasts a net-margin of $28,667 or roughly $0.48. Corn and natural gas are the largest expense outlays for the plant, accounting for 45% and 22% of total costs, respectively.

Using average prices for the past 12 months, the respective plant would earn a net margin of $55,160,743 or roughly $0.91 per gallon. Table 3 lists six different net margin breakeven scenarios for the representative ethanol plant. The prices that are bolded are breakeven prices for the ethanol plant given the other prices. The six scenarios are described below:

Scenario one fixes the ethanol price at $2.11, this is the average price of ethanol from May 2005 through April 2006. Given ethanol at this price level, the breakeven corn price is $4.29. In other words, with ethanol at $2.11 the plant could afford to bid up to $4.29 a bushel for corn and still have a positive net-margin. This is corn price is significantly higher than corn price estimates for the 2006-2007 marketing year (Wisner).

Scenario two fixes the ethanol at $1.91, which corresponds to the January 1, 1996 to April 1, 2005 average price. At this price level the breakeven corn price is $3.75, which remains significantly higher than forecasted price estimates (Wisner).

Scenario three fixes ethanol at $3.00, although this seems alarmingly high, daily ethanol rack prices for ethanol have been hovering about $3.00 in the mid-west in late April and early May this year. The breakeven corn price in this case is an unimaginable $6.69 per bushel. If this corn price were to be realized, it would stem from a significant corn shortage.

Scenario four fixes ethanol at $1.50, the average national ethanol price was at or below this level in 89 months since January of 1996 which accounts for an historical probability of 72%. The breakeven corn price in this scenario is $2.64; this price was realized in 16 months since January of 1996 with an historical probability of 13% for the time period.

Scenario five fixes corn at $3.00 per bushel, this scenario accounts for an increase in corn prices above current levels. Corn price forecast that corn will reach this level in the 2006-07 marketing year with a probability of 16% (Wisner). The breakeven ethanol price in this scenario is $1.63; ethanol has been at or below this level in 98 months since 1996 with an historical probability of 80% for the time period.

Scenario six fixes corn at $1.74, which is the average corn price from 1996-2006. The breakeven ethanol price is $1.17, which has occurred in 47 months with a historical probability of 38% for the time period. However, this corn price is significantly lower than average forecasted corn prices for the 2006-07 marketing year (Wisner).

The conclusion of these scenarios is that given current (May 2006) and 12 month average ethanol prices, the breakeven corn price is significantly higher than forecasted season average corn prices for the next few years. However, if oil prices were to fall significantly, hence lower ethanol prices, breakeven corn prices might be met, signaling negative profits for ethanol plants. Forecasting future oil prices is outside the scope of this paper. If corn prices meet the $3 and above level with a $1.63 ethanol price or lower, negative net-margins for ethanol plants could also be realized.

**Farm Level Implications**

The previously mentioned predictions favor increased ethanol expansion and increased US and Iowa corn acreage until 2012. However, we have not discussed whether an individual farmer has an incentive to devote more acreage to corn, especially given currently high energy prices. In order to calculate the profitability of rotation alternatives relative to a 50:50 corn and soybean rotation, a farm representative to an Iowa cash operation was constructed. Listed below are the farm's characteristics:

- 1500 Acre Operation
- Northern Iowa soil quality/characteristics
- 640 acres owned, 860 acres cash rented
- Baseline production assumed to be 50:50 corn: soybeans.
- 2/3 corn 1/3 soybeans and 100% corn considered as rotation alternatives.
- On farm storage is adequate to handle the commodities in each rotation.
- Adequate equipment to handle all three rotations without additional capital investment.
- All machinery is owned and power implements are 3-5 years old.
- Rotation shifts do not have a significant impact on machinery ownership costs.

Average Iowa corn and soybean yields were also assumed. In addition, a 10-13% yield penalty was assessed on corn planted following corn (2$^{nd}$ year corn) relative to corn following soybeans (1$^{st}$ year corn). Figure 5 depicts 1$^{st}$ and 2$^{nd}$ year corn data on Iowa State University test plots. The solid line represents the 45 degree line, as indicated; a vast majority of the points are below this line, indicating a decrease in 2$^{nd}$ year corn yield. However, no additional yield penalties were assumed for 3$^{rd}$ year corn and beyond.

As the farm changes between the three rotation choices the required amount of labor, herbicide, nitrogen, insecticide, fuel, and drying costs change to reflect increased costs for planting more or less of 2$^{nd}$ year corn.

Other assumptions for the modeled farm were that N, P, and K quantities were assumed to be equal to the nutrient removal rate of the soil type. Input prices reflect current market prices and the primary farm operator supplies 2,500 hours of labor with additional needed labor hired at a wage rate of $10. Counter cyclical, direct, and LD payments were calculated off of base acres, current market prices, and season averages. Crop insurance premiums are $5.50 per acre for soybeans and $7 for corn, expected indemnities are assumed to offset expected yield losses (ISU). For simplicity corn and soybeans are initially set at their forecasted 2006-07 season average prices of $2.30 and $5.15, respectively (Wisner).

Tables 4-6 are individual crop budgets for the three different crop systems. Given current prices, corn following soybeans is currently the most profitable enterprise with an estimated return over variable costs of $221.80 per acre. However, returns for corn following corn are significantly lower. The decrease in returns is due to increased nitrogen, fuel, insecticide, and labor requirements along with a yield penalty of 10%.

Table 7 is the farm's consolidated income statement and is based off of a 50:50 corn and soybean rotation. Net income from operations is estimated as $45,377 given current prices and corn and soybean yields of 180 and 45, respectively.

Tables 8-9 contain sensitivity analysis of net farm incomes under each of the three rotations. The corn prices are those that equate the net farm income between two selected rotations given different yield scenarios. In other words they show the minimum corn price at which the producer would shift from one rotation to the next.

For example, in Table 8a with soybean and corn yields of 45 and 180, respectively; a corn price of $2.86 would make net farm income equal for both the 50:50 and 2/3:1/3 rotations. A corn price above $2.86, given the assumed yields and soybean price would result in a shift from a 50:50 rotation to a 2/3:1/3 rotation. In Table 8b the corresponding cell with the same yields is $2.91; this is the breakeven corn price to equate the 2/3:1/3 and 100% corn rotations. Intuitively, this indicates that given $5.15 soybeans, once the price of corn is $2.86 it is just as profitable to plant 2/3 corn as 50% corn and once the price of corn reaches $2.91 it is just as profitable to plant 100% corn. When the price of corn is greater than $2.91, it is more profitable to plant 100% corn and no soybeans.

Tables 8a and 8b indicate the breakeven corn prices if Asian Rust is present in the soybeans. Asian Rust is assumed to add $25 per acre in increased fungicide, spraying, and labor costs along with a 10% yield dock. Looking at the same yields as above, the corn price that equates 50:50 and 2/3:1/3 is $2.50 and the price that equates 2/3:1/3 and 100% corn is $2.57. The breakeven prices are significantly lower when Asian Rust is present.

Overall, given Iowa average corn and soybean yields, the breakeven prices favor a 50:50 corn and soybean rotation. However, average corn prices could break the $3 barrier in the 2006 marketing year with an historical probability of 18% (Wisner). A main assumption with these breakeven prices is that soybeans remain at $5.15, if they were to rise to last year's season average price of $5.74, higher corn breakeven prices would be observed.

**Conclusions/Future Wildcards**

Countless outside variables can greatly alter the estimates presented in this paper. On the farm side, note that the estimated net income for the representative farm was approximately $45,000, and government payments were approximately $48,000. A significant change in government payments such as the elimination of counter-cyclical or LD payments could significantly alter cropping patterns nationally.

If energy prices remain high, ethanol prices are likely to stay at their current elevated price levels. If this is the case, ethanol production will remain profitable, sparking increased ethanol production across the United States, levels that will more than likely exceed the Renewable Fuels Standard. With production that exceeds the RFS, ethanol serves as an extender to the US's supply of gasoline and competes with gasoline at the pump, not merely as a mandated additive. If oil and ethanol prices fall so that ethanol production beyond the RFS is not profitable, ethanol serves as an additive and its place in the petroleum market will be altered.

Ethanol producers currently enjoy a $0.51 tax break on every gallon they produce. This makes ethanol appealing to fuel blenders. However, if policy changed such that this tax break was removed, ethanol will seem less appealing to the petroleum market. Along those lines is the current $0.51 per gallon tariff on imported ethanol. Select policy makers have already called for the removal of this tariff. If this was the case, our import market for ethanol would seem very appealing to countries such as Brazil and Argentina with established ethanol production capacities.

There is currently a calling for increased research in cellulose ethanol conversion technology and private and government entities have already put forth significant capital to its development. If there is a future breakthrough in this research and ethanol can be produced more efficiently with less expensive inputs such as switch-grass and/or corn stalks, the future of corn based ethanol could be jeopardized.

Another realm of research that government and private entities are pursuing is fuel-cell technology that would greatly improve the efficiency of vehicles. If fuel-cell cars become readily available to American consumers, the US demand for oil and ethanol could be reduced, adversely affecting oil and ethanol prices.

Overall, given the predicted increases in corn based ethanol production to 2012 and trended corn yield increases, US corn acreage must increase in order to keep current export numbers. China is a major wildcard in this mix, if China decides to import a significant amount of US corn; acreage may need to increase as much as 13.8 million acres.

Current corn based ethanol production is profitable given current technologies and average historic input and output prices. With current ethanol and corn prices, ethanol plants appear to be exceptionally profitable. However, with a leveling of ethanol prices along with corn around the $3 level, ethanol plants could face negative margins in the future.

On the farm level, given current prices, corn following soybeans is the most profitable cropping enterprise. However, due to increased inputs, corn following corn is not as profitable as 1$^{st}$ year corn or soybeans. Hence, a typical Iowa producer does not have the incentive to switch to a higher percentage corn rotation. The ethanol and/or export market will need to drive up the price of corn higher than predicted 2006-2007 levels in order to give farmers an economic incentive to increase corn production

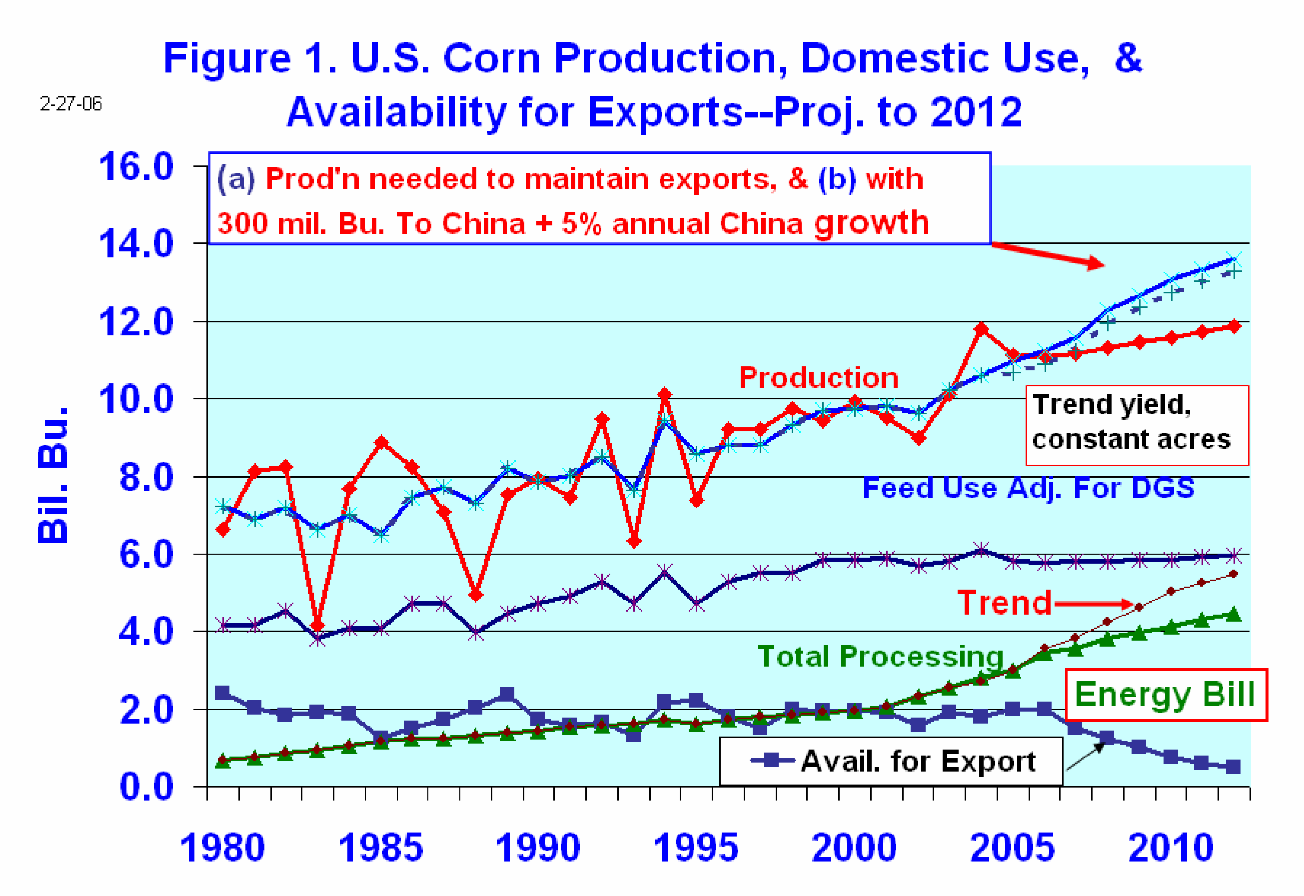
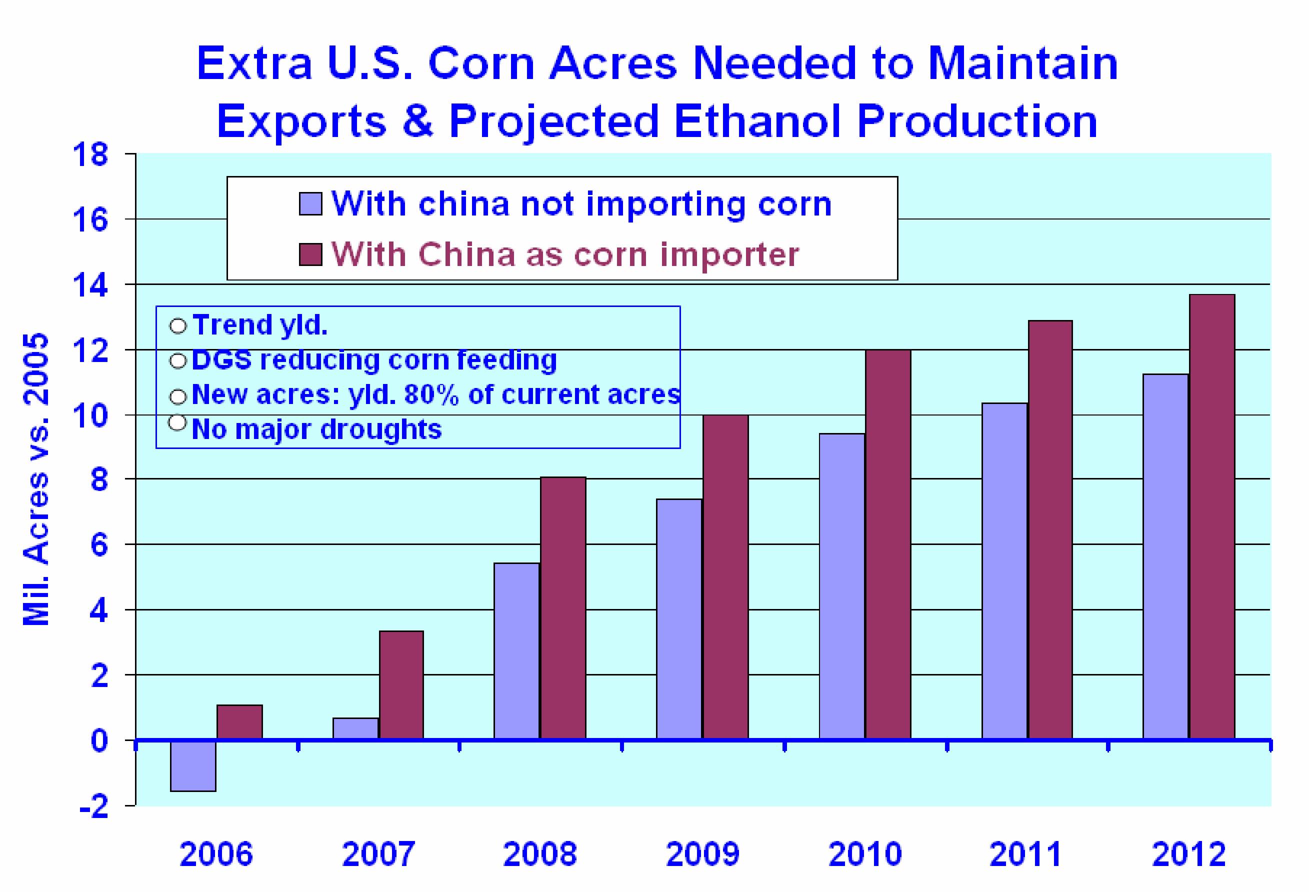


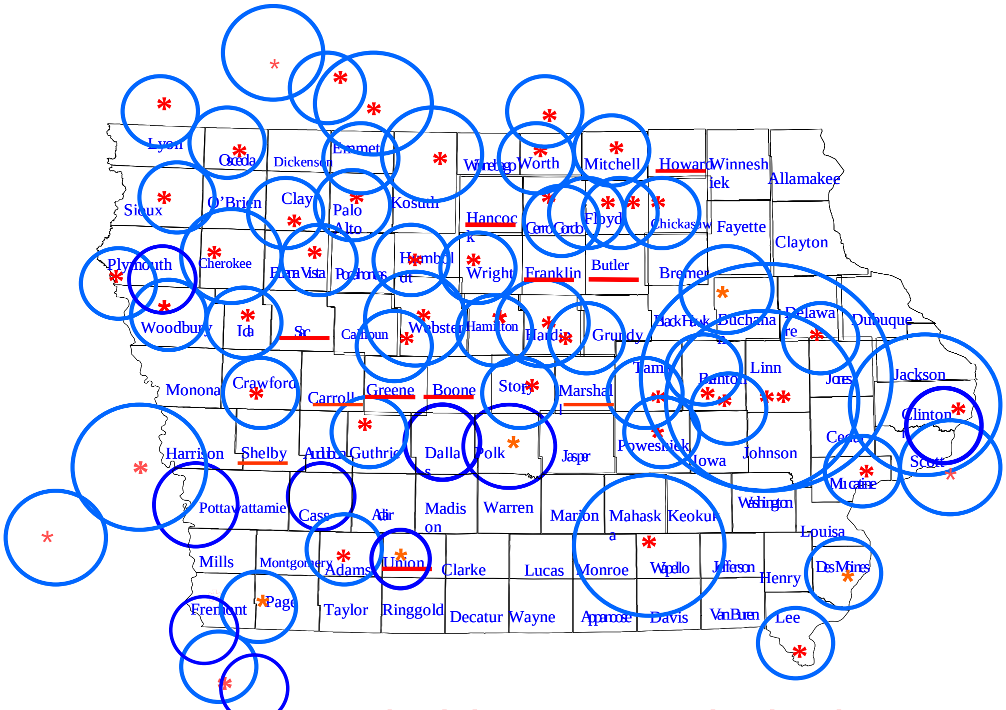
Figure 1. U.S. Corn Production, Domestic Use, &
Availability for Exports--Proj. to 2012
2-27-06
(a) Prod'n needed to maintain exports, & (b) with
300 mil. Bu. To China + 5% annual China growth
Production
Trend yield, constant acres
Feed Use Adj. For DGS
Trend
Total Processing
Energy Bill
Avail. for Export
Bil. Bu.
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1980
1985
1990
1995
2000
2005
2010

## Figure 2:



Extra U.S. Corn Acres Needed to Maintain Exports & Projected Ethanol Production
With china not importing corn
With China as corn importer
Trend yld.
DGS reducing corn feeding
New acres: yld. 80% of current acres
No major droughts
Mil. Acres vs. 2005
18
16
14
12
10
8
6
4
2
0
-2
2006
2007
2008
2009
2010
2011
2012

# Figure 3:




Iowa Corn Processing & Ethanol Plant Locations, Actual & Planned, 5/23/06

**Figure 4: Estimated Ethanol Plant Monthly Profitability, 1996-2006**

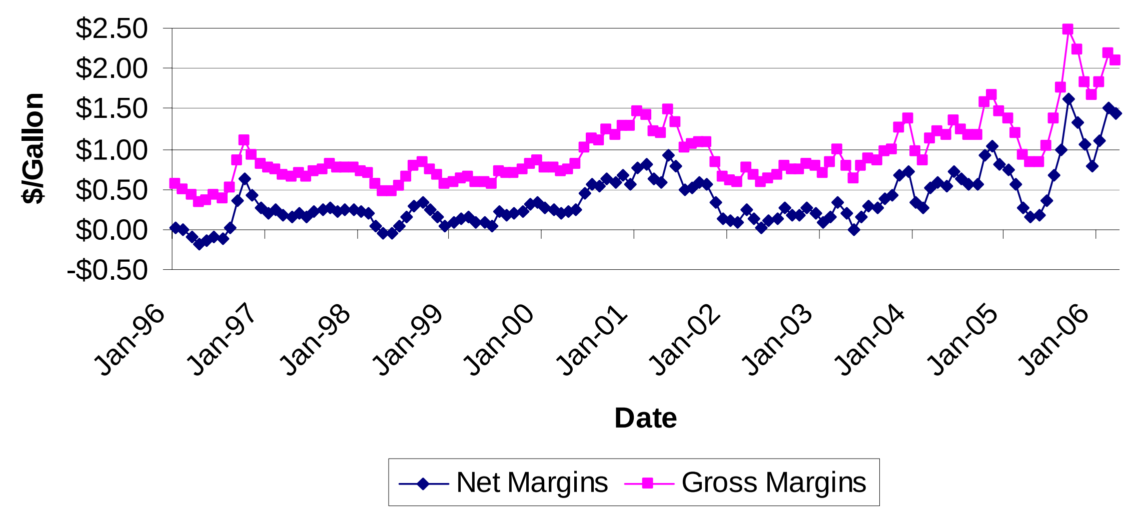


**Figure 5: 1st and 2nd Year Corn Yield, Iowa State University Extension Farm**

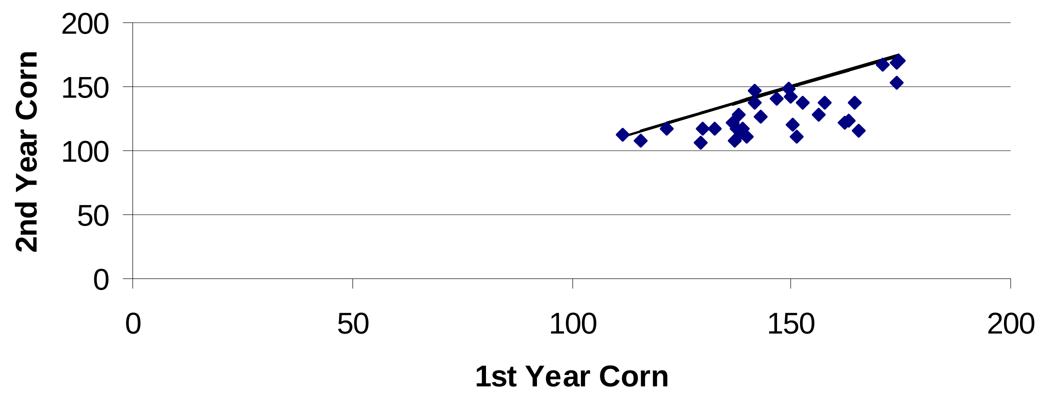



**Table 1: Iowa Corn Demand for Ethanol and Available for Export**

| **Ethanol Plants** | **Corn Demand (Mill Bu)** |
|---|---|
| Currently in Production | 930 |
| Planned or in construction | 1,154 |
| **Total** | **2,084** |
| **Total (Capacity +20%)** | **2,501** |
| | |
| **Production** | **Corn Demand (Mill Bu)** |
| 2005 Corn Crop | 2,163 |
| 2005 Corn Feeding | 700 |
| Corn Available for Exports and Processing | 1,463 |
| | |
| **Corn Available for Export** | **Mill Bu (Relative to 2005)** |
| 2002 | 858 |
| With Current Plants | 533 |
| | |
| **With Current and Planned Plants** | **-621** |
| **With Current and Planned Plants +20%** | **-1,038** |

**Table 2: Estimated Ethanol Plant Profitability Given Average Prices (1996-2006)**

**Technical Assumptions**

| Item | Gallons of Ethanol |
|---|---|
| Plant Capacity | 60,000,000 |
| Ethanol Yield (Gal/Bu) | 2.7 |
| mmBTU of Natural Gas | 16.36 |
| Kilowatt Hour | 1.10 |

| Item (Pounds) | Per Bushel of Corn |
|---|---|
| DDGS | 17 |
| CO2 | 17 |

**Price/Cost Assumptions**

| Item | Price |
|---|---|
| Corn ($/Bu) | $1.74 |
| Ethanol ($/Gal) | $1.91 |
| DDGS ($/Ton) | $79.00 |
| CO2 ($/Ton) | $0.00 |
| Electricity ($/kwh) | $0.05 |
| Natural Gas ($/mmBTU) | $8.86 |
| Capital Costs ($/Gal) | $1.00 |
| Marketing Costs ($/Gal) | $0.05 |

**Ethanol Plant Income Statement**

| Item | Subtotal | Total |
|---|---|---|
| **Revenue** | | |
| Ethanol | $114,600,000 | |
| DDGS | $14,922,222 | |
| CO2 | $0 | |
| **Total Revenues** | **$129,522,222** | **$129,522,222** |
| **Expenses** | | |
| Cash Operating Expenses | | |
| Corn | $38,666,667 | |
| Natural Gas | $18,911,232 | |
| Electricity | $3,143,328 | |
| Chemicals and Water | $8,160,000 | |
| Marketing | $3,000,000 | |
| Other Cash Expenses | $11,436,000 | |
| Interest Expense | $2,312,415 | |
| **Total Expenses** | **$85,629,642** | **($85,629,642)** |
| **Net Operating Margin** | | **$43,892,580** |
| Depreciation | $4,000,000.00 | ($4,000,000) |
| **Net Income Before Taxes** | **$39,892,580.24** | **$39,892,580** |
| Income Taxes | $13,962,403.08 | ($13,962,403) |
| **Net Income** | | **$25,930,177** |

| | |
|---|---|
| Profits for Shareholders/Lenders | $29,930,177 |
| Principal Payment Due | ($1,640,191) |
| Dividend Payable | ($7,779,053) |
| **Total Additions to Equity** | **$20,510,933** |

**Leverage Assumptions**

| | |
|---|---|
| Initial Debt/Asset | 60% |
| # of Shares | 1,000 |
| Price Per Share | $24,000 |
| Initial Equity | $24,000,000 |

| | |
|---|---|
| Dividend Rate | 30% |

**Table 3: Breakeven Ethanol Plant Net Margin Given Selected Scenarios**

| Number | Scenario | Ethanol ($/Gal) | Corn ($/Bu) | DDGS ($/Ton) | Natural Gas ($/MmBTU) |
|---|---|---|---|---|---|
| 1 | $2.11/Gallon Ethanol | 2.11 | **4.29** | 86.67 | 9.22 |
| 2 | $1.91/Gallon Ethanol | 1.91 | **3.75** | 86.67 | 9.22 |
| 3 | $3.00/Gallon Ethanol | 3.00 | **6.69** | 86.67 | 9.22 |
| 4 | $1.50/Gallon Ethanol | 1.50 | **2.64** | 86.67 | 9.22 |
| 5 | $3.00/Bushel Corn | **1.63** | 3.00 | 86.67 | 9.22 |
| 6 | $1.74/Bushel Corn | **1.17** | 1.74 | 86.67 | 9.22 |

# Table 4: Soybean Cash Income Per Acre (45 Bu/Ac)

## Cash Inflows

| | |
|---|---|
| Crop Income | $231.75 |
| Government Payments | $32.32 |
| **Total Cash Inflows** | **$264.07** |

**Variable Costs**

| | |
|---|---|
| Pre-harvest | |
| Fuel | $1.28 |
| Lubrication | $0.19 |
| Repairs | $1.20 |
| Seed | $39.20 |
| Nitrogen | $0.00 |
| Phosphate | $12.95 |
| Potash | $16.10 |
| Lime (yearly cost) | $6.00 |
| Herbicide | $21.84 |
| Insecticide | |
| Crop Insurance | $4.85 |
| Hired Labor | $0.83 |
| Interest on Pre-harvest Variable Costs | $4.25 |
| (8 Months@6%) | |
| Total Pre-harvest Variable Costs | $108.70 |
| | |
| Harvest | |
| Fuel | $2.75 |
| Lubrication | $0.41 |
| Repairs | $2.10 |
| | |
| Total Harvest Var Costs | $5.26 |
| | |
| **Total Variable Costs** | **$113.96** |
| | |
| **Return Over Variable Costs** | **$150.11** |

# Table 5: Corn Following Soybeans Income Per Acre (180 Bu/Ac)

## Cash Inflows

| | |
|---|---|
| Crop Income | $414.00 |
| Government Payments | $32.32 |
| **Total Cash Inflows** | **$446.32** |

**Variable Costs**

| | |
|---|---|
| Pre-harvest | |
| Fuel | $2.80 |
| Lubrication | $0.42 |
| Repairs | $1.30 |
| Seed | $39.00 |
| Nitrogen | $48.77 |
| Phosphate | $23.63 |
| Potash | $12.02 |
| Lime (yearly cost) | $6.00 |
| Herbicide | $34.72 |
| Insecticide | $0.00 |
| Crop Insurance | $7.00 |
| Hired Labor | $2.45 |
| Interest on Pre-harvest Variable Costs (8 Months@6%) | $7.25 |
| Total Pre-harvest Variable Costs | $185.35 |
| | |
| Harvest | |
| Fuel | $4.54 |
| Lubrication | $0.68 |
| Repairs | $2.85 |
| Drying Fuel | $31.10 |
| | |
| Total Harvest Var Costs | $39.17 |
| | |
| Total Variable Costs | $224.52 |
| | |
| **Return Over Variable Costs** | **$221.80** |

# Table 6: Corn Following Corn Income Per Acre (162 Bu/Ac)

## Cash Inflows

| | |
|---|---|
| Crop Income | $372.60 |
| Government Payments | $32.32 |
| **Total Cash Inflows** | **$404.92** |

### Variable Costs

| | |
|---|---|
| Pre-harvest | |
| Fuel | $7.22 |
| Lubrication | $1.08 |
| Repairs | $1.80 |
| Seed | $45.00 |
| Nitrogen | $68.57 |
| Phosphate | $22.95 |
| Potash | $11.06 |
| Lime (yearly cost) | $6.00 |
| Herbicide | $32.00 |
| Insecticide | $15.00 |
| Crop Insurance | $7.00 |
| Hired Labor | $4.54 |
| Interest on Pre-harvest Variable Costs (8 Months@6%) | $9.05 |
| Total Pre-harvest Variable Costs | $231.28 |
| | |
| Harvest | |
| Fuel | $4.54 |
| Lubrication | $0.68 |
| Repairs | $2.85 |
| Drying Fuel | $27.99 |
| | |
| Total Harvest Var Costs | $36.06 |
| | |
| Total Variable Costs | $267.34 |
| | |
| **Return Over Variable Costs** | **$137.58** |

**Table 7: Consolidated Farm Income Statement**

| Item | Subtotal | Total |
|---|---|---|
| **Farm Revenue** | | |
| Crops | $484,313 | |
| Government Payments | $48,482 | |
| Other Farm Income | $21,000 | |
| **Value of Farm Production** | **$553,794** | **$553,794** |
| | | |
| **Farm Expenses** | | |
| Operating Expenses | | |
| Seed | $58,650 | |
| Crop Inputs | $136,518 | |
| Fuel and Lubrication | $33,131 | |
| Repairs | $6,000 | |
| Crop Insurance | $8,888 | |
| Hired Labor | $2,459 | |
| Cash Rent | $129,000 | |
| Property Taxes | $16,000 | |
| Depreciation | $52,742 | |
| **Total Farm Operating Expenses** | **$443,388** | |
| | | |
| Interest Expenses | | |
| Operating Loan | $8,626 | |
| Machinery Loans | $23,552 | |
| Real Estate | $32,850 | |
| **Total Interest Expense** | **$65,028** | |
| | | |
| **Total Farm Expenses** | **$508,417** | **($508,417)** |
| | | |
| **Net Income From Operations** | **$45,377** | **$45,377** |
| **Gains/Losses on Sales of Capital Assets** | **$0** | **$0** |
| **Net Income Before Taxes** | **$45,377** | **$45,377** |
| | | |
| **Non farm Adjustments** | | |
| Wages | $20,000 | |
| Ethanol Investment Gains (Loss) | $0 | |
| Other Nonfarm Income | | |
| **Total Nonfarm Income** | **$20,000** | **$20,000** |
| | | |
| **Income Before Taxes and Extraordinary Items** | **$65,377** | **$65,377** |
| | | |
| **Income Taxes** | | |
| Cash Income Tax Expense | $13,075 | |
| **Total Income Tax Expense** | **$13,075** | **($13,075)** |
| | | |
| **Income Before Extraordinary Items** | **$52,302** | **$52,302** |
| | | |
| **Net Income** | **$52,302** | **$52,302** |

**Table 8a: Corn Price Where 50:50 = 2/3:1/3 ($5.15 Beans)**

| Corn Yield | Soybean Yield 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|
| 150 | 2.88 | 3.06 | 3.25 | 3.43 | 3.61 |
| 160 | 2.75 | 2.93 | 3.10 | 3.27 | 3.45 |
| 170 | 2.65 | 2.81 | 2.97 | 3.14 | 3.30 |
| 180 | 2.55 | 2.71 | **2.86** | 3.01 | 3.17 |
| 190 | 2.47 | 2.61 | 2.76 | 2.90 | 3.05 |
| 200 | 2.39 | 2.53 | 2.67 | 2.80 | 2.94 |

**Table 8b: Corn Price Where 2/3:1/3 = 100% Corn ($5.15 Beans)**

| Corn Yield | Soybean Yield 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|
| 150 | 2.90 | 3.08 | 3.27 | 3.46 | 3.65 |
| 160 | 2.78 | 2.96 | 3.14 | 3.31 | 3.49 |
| 170 | 2.68 | 2.85 | 3.01 | 3.18 | 3.35 |
| 180 | 2.59 | 2.75 | **2.91** | 3.06 | 3.22 |
| 190 | 2.51 | 2.66 | 2.81 | 2.96 | 3.11 |
| 200 | 2.44 | 2.58 | 2.72 | 2.87 | 3.01 |

**Table 9a: Corn Price Where 50:50 = 2/3:1/3 ($5.15 Beans)**

| Corn Yield | Soybean Yield ***with Asian Rust*** 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|
| 150 | 2.49 | 2.66 | 2.82 | 2.98 | 3.15 |
| 160 | 2.40 | 2.55 | 2.70 | 2.85 | 3.01 |
| 170 | 2.31 | 2.45 | 2.60 | 2.74 | 2.88 |
| 180 | 2.23 | 2.37 | **2.50** | 2.64 | 2.77 |
| 190 | 2.16 | 2.29 | 2.42 | 2.55 | 2.68 |
| 200 | 2.10 | 2.22 | 2.35 | 2.47 | 2.59 |

**Table 9b:Corn Price Where 2/3:1/3 = 100% Corn ($5.15 Beans)**

| Corn Yield | Soybean Yield ***with Asian Rust*** 35 | 40 | 45 | 50 | 55 |
|---|---|---|---|---|---|
| 150 | 2.54 | 2.70 | 2.87 | 3.04 | 3.20 |
| 160 | 2.45 | 2.60 | 2.76 | 2.91 | 3.07 |
| 170 | 2.37 | 2.51 | 2.66 | 2.81 | 2.95 |
| 180 | 2.30 | 2.43 | **2.57** | 2.71 | 2.85 |
| 190 | 2.23 | 2.36 | 2.49 | 2.63 | 2.76 |
| 200 | 2.17 | 2.30 | 2.42 | 2.55 | 2.67 |

**Works Cited**

American Coalition of Ethanol http://www.ethanol.org

Renewable Fuel Standard http://www.ethanolrfa.org

Wisner, R., “Wisner Balance Sheets” 15 May 2006 Available at: http://www.econ.iastate.edu/faculty/Wisner/index.html