

## ETHANOL PROFIT MARGINS -- MARCH 2009

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Iowa, along with several other Midwestern states, is at the tail end of the corn ethanol boom that has generally benefitted the state and many rural communities. However, volatility in corn and ethanol markets, caused by a variety of economic and political factors, has slowed expansion and profitability of the industry.

From a public policy perspective this leaves several questions unanswered. Will ethanol plants go bust? How do high corn or low ethanol prices affect expenses and revenues? What are the expected net profits or losses? Do local incentives matter to the plant's bottom line? The purpose of this analysis is to assist policy makers in understanding the future economic viability of ethanol plants under current price scenarios.

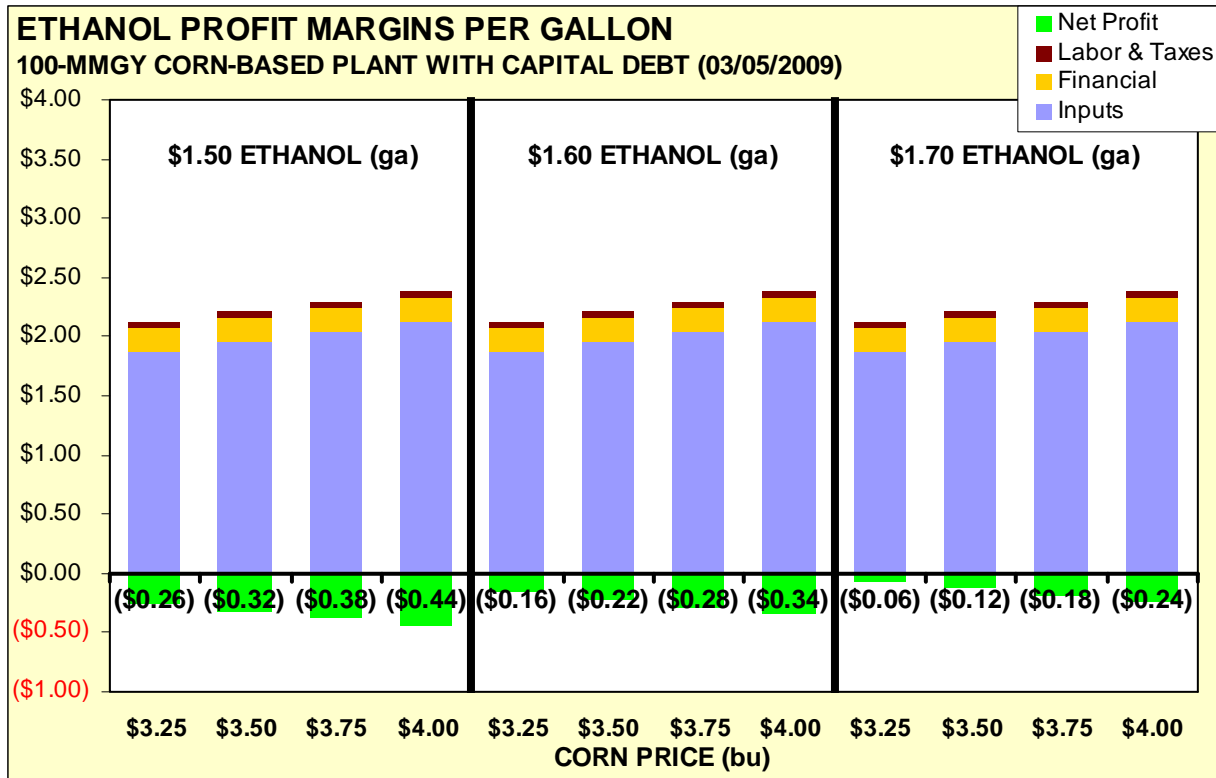
### CURRENT PRICES

In early March 2009 bid prices for ethanol at Iowa plants ranged between \$1.45 to \$1.56 per gallon; and ethanol futures ranged from \$1.49 to \$1.56 for delivery between September 2009 through March 2010.

In this same period, bids for corn given at Iowa plants ranged from \$3.25 to \$3.50 per bushel; and 2009 corn futures were \$3.50 for May, \$3.70 for September, \$3.80 for December, and \$3.90 for March 2010.

### PROFIT MARGINS – PLANTS WITH CAPITAL DEBT COSTS

This scenario is for a 100 million gallon per year (MMGY) corn-based ethanol plant built in 2005 and financing 60 percent of its capital costs at 8 percent interest per annum for 10 years. Debt and depreciation costs \$0.20 per gallon of ethanol produced, and labor and taxes generally cost \$0.06 per gallon.



At roughly the **current bid price for ethanol of \$1.50 per gallon**, ethanol plants with capital debt are expected to lose money at current and near-time corn prices.

- At \$3.25 per bushel corn prices (current low bids), plants stand to lose \$0.26 per gallon of ethanol produced, equaling \$26.31 million dollars lost annually. For investors this is a 41% loss in the annual equity rate of return.
- At \$3.75 per bushel corn prices (close to December 2009 bids), plants lose \$0.38 per gallon of ethanol produced or a \$38.28 million dollar annual loss. Investors would experience an equity loss of 60% in the current year.
- At these prices the break even corn price would need to be \$2.15 per bushel.

At about the **near-term ethanol futures price of \$1.60 per gallon**, ethanol plants with capital debt are also expected to operate at a net loss. However, the losses are smaller than under the \$1.50 ethanol scenario.

- At \$3.25 per bushel corn prices, plants lose \$0.16 per gallon of ethanol produced, equaling a \$16.31 million dollar loss annually. The annual equity rate of return for investors is a loss of 25%.
- At \$3.75 per bushel corn prices, plants lose \$0.28 per gallon of ethanol produced or a \$28.28 million dollar annual loss. Investors would experience an equity loss of 44% in the current year.
- In order for plants to break even, corn would need to fall to \$2.50 per bushel.



Although near-term ethanol prices are not expected to reach this mark, if the **high price for ethanol were \$1.70 per gallon** plants with capital debt are still expected to operate at a net loss, or at best will roughly break-even.

- At \$3.25 per bushel corn prices plants lose \$0.06 per gallon of ethanol produced, equaling a \$6.31 million dollar annual net loss. For investors this is a 10% loss in the annual equity rate of return.
- At \$3.75 per bushel corn prices plants lose \$0.18 per gallon of ethanol produced or an \$18.28 million dollar annual loss. Investors would lose 29% in equity returns annually.

## **PROFIT MARGINS – PLANTS WITH NO CAPITAL DEBTS**

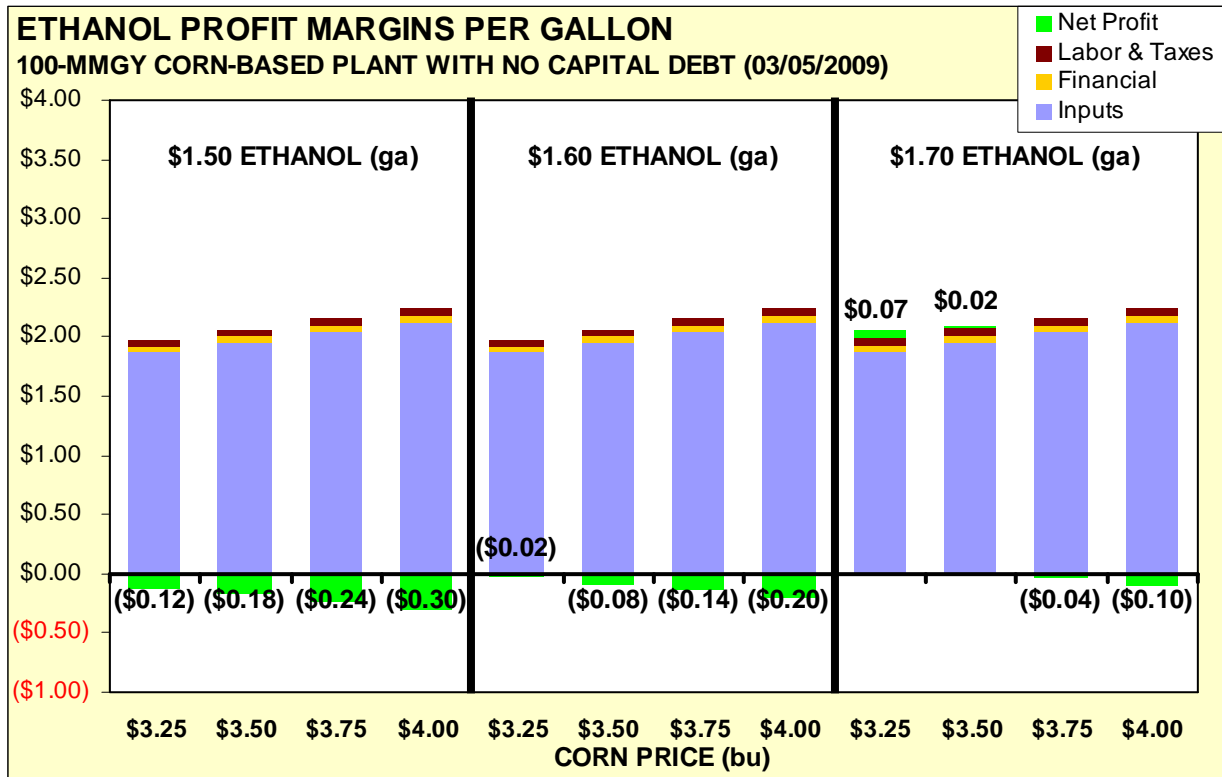
This scenario is for a 100 million gallon per year (MMGY) corn-based ethanol plant built in 2005 that is all investor-owned with no capital debt costs. Labor and taxes generally cost \$0.06 per gallon of ethanol produced, and depreciation costs \$0.06 per gallon.

At the **current bid price for ethanol of \$1.50 per gallon**, debt-free ethanol plants are expected to lose money at current and near-time corn prices.

- At \$3.25 per bushel corn prices (current low bids), plants are expected to lose \$0.12 per gallon of ethanol produced, totaling \$12.03 million dollars annually. For investors this is an 8% loss in the annual equity rate of return.
- At \$3.75 per bushel corn prices (close to December 2009 bids), plants lose \$0.24 per gallon of ethanol produced, equaling a \$24.00 million dollar annual loss. Investors would experience an equity loss of 15% in the current year.
- In order for plants to break even, corn would need to fall to \$2.75 per bushel.

At the **near-term ethanol futures price of \$1.60 per gallon**, debt-free ethanol plants are expected to break even at current prices but experience small net losses at near-term prices.

- At \$3.25 per bushel corn prices, generate a very small net loss of \$0.02 per gallon of ethanol produced, amounting to \$2.03 million dollars in losses annually. The annual equity rate of return for investors is a negligible loss of 1%.
- At \$3.75 per bushel corn prices, plants lose \$0.14 per gallon of ethanol produced or a \$14.00 million dollar annual loss. In the current year investors would experience an equity loss of 9%.
- At these prices the break even corn price would need to be \$3.15 per bushel.



Although near-term ethanol prices are not expected to reach this mark, if the **high price for ethanol were \$1.70 per gallon** plants with no capital debt generate moderate profits at current corn prices and small losses at near-term prices.

- At \$3.25 per bushel corn prices plants generate a moderate profit of \$0.07 per gallon of ethanol produced or \$6.67 million dollars in annual profits. For investors this represents a 4% gain in the annual equity rate of return.
- At \$3.75 per bushel corn prices plants generate a small net loss of \$0.04 per gallon of ethanol produced or \$4.00 million dollars in annual losses. Investors would lose 3% in equity returns annually.



## SUMMARY

For ethanol plants with **capital debt costs** the **ethanol break even price ranges from \$1.75 to \$1.95 per gallon**. This is higher than the near-term ethanol price of \$1.50 to \$1.60 per gallon. Thus, under all corn price scenarios ethanol plants with capital costs are expected to generate net losses in the near-term.

- At \$3.25 corn the ethanol break even price with debt is \$1.76 per gallon.
- At \$3.50 corn the ethanol break even price with debt is \$1.82 per gallon.
- At \$3.75 corn the ethanol break even price with debt is \$1.88 per gallon.
- At \$4.00 corn the ethanol break even price with debt is \$1.94 per gallon.

For **debt-free** ethanol plants with no capital costs **the ethanol break even price ranges from \$1.60 to \$1.80 per gallon**. Under near-term ethanol prices, debt-free plants are expected generate small net profits when corn prices are about \$3.25 per bushel. However, debt-free plants begin to generate larger net losses as corn rises above \$3.50 per bushel.

- At \$3.25 corn the ethanol break even price is \$1.62 per gallon.
- At \$3.50 corn the ethanol break even price is \$1.68 per gallon.
- At \$3.75 corn the ethanol break even price is \$1.74 per gallon.
- At \$4.00 corn the ethanol break even price is \$1.80 per gallon.

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## TECHNICAL NOTES

To understand ethanol plant economics requires a model of how plants operate in terms of revenues and costs. This analysis models a 100-MMGY ethanol plant that was constructed in 2005 and represents the viability of most ethanol plants in Iowa and Nebraska.

In terms of production capacity, the 100-MMGY plant is assumed to operate at 100 percent capacity with an ethanol yield of 2.9 per bushel, a dry distiller's grains yield of 19.0 lbs. per bushel of corn, and a carbon dioxide yield of 17.5 lbs. per bushel of corn. Energy and water inputs 7 gallons of water per bushel of corn, 1.1 kilowatt hours of electricity per gallon of ethanol, and 35,000 BTUs of natural gas per gallon of ethanol. Production information is taken from Tiffany and Eidman (2003) at the University of Minnesota, and Swenson and Eathington (2006) at Iowa State University.

Investment costs are the total capital needed to construct and equip an ethanol plant. Capital costs of a 100-MMGY plant built in 2005 are estimated at \$160 million in nominal dollars. Investment information is taken from Gallagher, Brubaker, and Shapouri (2005) at Iowa State University. For financial matters it is assumed that plants are financed through 60 percent debt (paid over 10 years at 8 percent interest per annum) and 40 percent equity (with an expected return of 15 percent per annum). Straight-line depreciation is assumed over 20 years with a salvage value equaling 25 percent of total investment costs.

Labor requirements assume that a 100-MGY plant will need to employ 45 workers at an average annual wage per job of \$47,750. Benefits are estimated at 13 percent of the wage base. Other labor and management costs are assumed to be 10 percent of total wage costs. Labor information is taken from the Nebraska Department of Labor's employment and wages database.

In terms of inputs, corn costs are taken from the Chicago Board of Trade and Ethanol Plant Reports from USDA Market News. Water costs are taken from the Iowa Department of Natural Resources. Electricity and natural gas costs for Iowa are taken from the U.S. Department of Energy. Costs of secondary inputs are taken from primary data collected by Tiffany and Eidman (2003) and Swenson and Eathington (2006). Secondary inputs include enzymes, denaturants, yeasts, chemicals for processing and cooling, various antibiotics, waste management, maintenance, transportation costs, and miscellaneous administrative costs. Transportation costs are estimated by assuming the plant ships out ethanol on rail to rack markets 200 miles away, and trucks in corn from 15 miles away.

In terms of revenues, ethanol prices are taken from the Chicago Board of Trade and Ethanol Plant Reports from USDA Market News. Dry distiller grain prices are assumed to be 90 percent of corn prices on a dry-matter basis. Prices for carbon dioxide are taken from Tiffany and Eidman (2003).

Taxes are estimated from data provided by the Iowa Department of Revenue. Property taxes are estimated at 1.75 percent of assessed valuation (estimated at 90 percent of total investment). Sales taxes are assumed to be levied on 50 percent of the input costs for enzymes, yeasts, and chemicals. Corporate income taxes are applied to any gross profit, with a rate of 6 percent on the first \$25,000 raising to 12 percent on profits over \$250,000. Insurance trust taxes are estimated at 10 percent of total wages paid; and includes Social Security, Medicare, unemployment, and workers compensation. No federal or state ethanol production tax credits are including in this analysis. Local incentives, such as tax increment financing, are not considered in this analysis.

Gallagher, P., H. Brubaker, and H. Shapouri. 2005. "Plant-Size: Capital Costs Relationships in the Dry Mill Ethanol Industry." *Biomass and Bioenergy* 28: 565-571.

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U.S. Department of Energy. 2006. *State Energy Consumption, Price, and Expenditure Estimates* [datafile]. Washington, DC: Energy Information Administration, U.S. Department of Energy [producer].

