Impact of Ethanol on the Hereford Industry

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Summary

If gasoline prices remain high, ethanol production should bring about the biggest change in U.S. agriculture since the introduction of soybeans.
U.S. Retail Gasoline Prices, All Grades, All Formulations, 1996-2007

Source: U.S. Energy Information Administration
World Ethanol Production, 2006

Source: Renewable Fuels Association
Corn Is the Key Crop
U.S. Average Corn Price, 1908-2006

Source: USDA/NASS
U.S. Average Corn Price, 1908-2006

1908-1942
35 years
Avg $0.78

1942-1972
30 years
Avg $1.26

1973-2006
34 years
Avg $2.37

Source: USDA/NASS
The 1940s step raised corn price 62%; the 70s step 88%. A 75% step will take corn to $4.15/bu.
### Million Acres Planted by Crop

<table>
<thead>
<tr>
<th>Crop</th>
<th>2006</th>
<th>2007*</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>78.327</td>
<td>92.888</td>
<td>+ 14.561</td>
</tr>
<tr>
<td>Soybeans</td>
<td>75.522</td>
<td>64.081</td>
<td>- 11.441</td>
</tr>
<tr>
<td>Wheat</td>
<td>57.344</td>
<td>60.505</td>
<td>+ 3.161</td>
</tr>
<tr>
<td>Cotton</td>
<td>15.274</td>
<td>11.058</td>
<td>- 4.216</td>
</tr>
<tr>
<td>Sorghum</td>
<td>6.522</td>
<td>7.765</td>
<td>+ 1.243</td>
</tr>
<tr>
<td>Oats</td>
<td>4.168</td>
<td>3.860</td>
<td>- 0.308</td>
</tr>
<tr>
<td>Barley</td>
<td>3.452</td>
<td>4.044</td>
<td>+ 0.592</td>
</tr>
<tr>
<td>18 crops</td>
<td>315.835</td>
<td>320.052</td>
<td>+ 4.217</td>
</tr>
</tbody>
</table>

*June 29 estimate
U.S. Corn Use, 2005-06

Source: PRX ProExporter Network
U.S. Feeding of Corn, 2005-06

Source: PRX ProExporter Network
Shortage of Corn for Feed

- As long as energy prices remain high, ethanol plants can outbid livestock for corn.
FORECAST CHANGE IN CORN USAGE 2005-15 (million bushels)

Source: February 2006 USDA Agricultural Baseline Projections
Feed Use of U.S. Corn

- In the last 10 years, feed use of corn has increased by 1.1825 billion bushels
- Will it not increase at all during the next 10 years?
The New Ag Market?

- Crude oil drives ethanol prices
- Ethanol drives corn prices
- Corn drives livestock prices
Introduction
Basics of Ethanol Production

- Ethanol is an alcohol made by fermenting grain and other carbohydrates.
- This is an old process which traditionally has been used to produce ethanol for use as a beverage.
- 97% of U.S. ethanol is made from corn.
- Rest: milo, wheat, brewery waste, whey, etc.
The economics of biofuels is confusing, in part, because we measure gasoline and diesel in gallons and corn and soybeans in bushels.

Measuring everything in pounds makes the economics easier to understand.
Economics of Ethanol

- Corn is worth 6¢ per pound
- Gasoline is worth 27¢ per pound
- DDGS is worth 5.5¢ cents per pound
- The cost of conversion is 3.5¢ per pound
- There is a federal government subsidy of 2.5¢ for each pound of corn converted to ethanol and DGS
How much gasoline can ethanol replace?
U.S. Gasoline Usage, 1986-06

Source: U.S. Energy Information Administration
Ethanol Production, 1980-06

Source: Renewable Fuels Association
Gasoline & Ethanol Production, 1986-06

Source: U.S. Energy Information Administration
U.S. Gasoline Usage

- 141 billion gallons gasoline used per year
- Mandating 10% ethanol in all gasoline would require that nearly half of the U.S. corn crop be processed into ethanol
- If all U.S. corn were made into ethanol, it would produce 31 billion gallons per year
- To replace all U.S. gasoline would require 78.6 billion bushels of corn annually
U.S. Corn Production, 1970-06
78.6 Billion Bushels of Corn

- Record U.S. corn yield is 160 bu/acre
- 78.6 billion bushels at 160 bu/acre would require 491 million harvested acres of corn
- Equals 156% of 2005 U.S. harvested acreage of corn, soybeans, wheat, sorghum, cotton, rice, sunflowers, barley, oats, rye, peanuts, tobacco, canola, sugar beets, sugarcane, potatoes, dry edible beans, proso millet and hay combined.
Corn Milling Options

- Wet Milling
- Dry Milling
Wet Milling Process

- Corn
  - Germ
  - Bran
  - Gluten
  - Steepwater solubles
  - Corn Gluten Meal
  - Corn Gluten Feed
  - Corn Oil
  - Germ Meal
  - Corn Germ Meal
- Starch Ethanol HFCS
Dry Milling Process

- **Stillage**
  - **Thin Stillage**
    - **Condensed Distillers Solubles**
      - **Wet Distillers Grain with Solubles**
        - **DDGS**
          - **A bushel of corn will produce ~2.75 gallons of ethanol, 17 lbs of CO₂ and 17 lbs of DDGS**

- **Corn**
  - **Ethanol**
    - **Wet Distillers Grain**
Wet & Dry Milled Corn for Ethanol

Forecast

Source: FAPRI
How Many Ethanol Plants?
Alaska has one ethanol plant in the planning stage.

Hawaii has two ethanol plants in the planning stage.
Ethanol Capacity Growth

Source: Renewable Fuel Association website [http://www.ethanolrfa.org/industry/statistics/#B]
Ethanol Plant Statistics, 8/1/07

- 124 plants operating in 26 states with capacity to produce 6.4844 billion gallons of ethanol per year (49 plants farmer owned)
- 76 new plants under construction and 7 expansions with capacity to produce 6.3989 billion gallons of ethanol per year
- ~100 plants being planned

Source: Renewable Fuels Association
Corn Milled for Ethanol

% corn for ethanol:
2000-01: 6%
2005-06: 14%
2006-07: 20%
2007-08: 26%

Forecast

Billion Bushels
Ethanol as Fuel

- Over 90% of U.S. ethanol is used as fuel
- Although ethanol and gasoline can be blended in any proportion, in the U.S. it is largely:
  - 10% ethanol & 90% gasoline
  - 85% ethanol & 15% gasoline (E85)
- Blends with high ethanol content require modifications in the automobile (flexible fuel vehicle)
  - Sensor to detect ethanol/gasoline ratio
  - Corrosion resistant fuel tank & lines
Energy Content of Ethanol
## Formulation of Alcohols

<table>
<thead>
<tr>
<th>Alcohol</th>
<th>Formula</th>
<th>BTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol</td>
<td>CH₃OH</td>
<td>62,800</td>
</tr>
<tr>
<td>Ethanol</td>
<td>C₂H₅OH</td>
<td>84,400</td>
</tr>
<tr>
<td>Propanol</td>
<td>C₃H₇OH</td>
<td>100,000</td>
</tr>
<tr>
<td>Butanol</td>
<td>C₄H₉OH</td>
<td>110,000</td>
</tr>
</tbody>
</table>

Gasoline is mostly C₈H₁₈

Gasoline has 125,000 BTU/gallon
Approximate Energy Content

Gasoline has 125,000 BTUs per gallon
10% ethanol has 120,940 BTUs per gallon
E85 averages 92,500 BTUs per gallon
100% ethanol has 84,400 BTUs per gallon

Less energy means fewer miles per gallon... But, ethanol has a higher octane rating than gasoline
Camdenton Gas Stations 12/7/06

- **East side of Highway 5**
  - 87 octane unleaded: $2.049/gallon
  - 89 octane super unleaded: $2.149/gallon

- **West side of Highway 5**
  - 87 octane unleaded: $2.049/gallon
  - 89 octane super unleaded: $2.049/gallon
Reasons Ethanol Production Is Increasing

- **Legislation**
  - Production Subsidies
  - Mandated use
  - Phase-out of MTBE as oxygenate

- **Ethanol production is profitable**
  - High cost of crude oil
  - Cheap corn
Subsidies for Ethanol Production

- 51 cent per gallon federal excise tax credit
  - Amounts to 5.1 cents/gallon for 10% blend
  - 43 cents/gallon for E-85

- Missouri has producer tax credits
  - 20 cents on first 12.5 million gallons

- Iowa and Illinois state excise tax exemptions
  - 1 to 1.5 cents per gallon with income tax credits for Iowa retailers selling more than 60 percent ethanol-blended fuel
Reasons Ethanol Production Is Increasing

- Legislation
  - Production Subsidies
  - **Mandated use**
  - Phase-out of MTBE as oxygenate
- Ethanol production is profitable
  - High cost of crude oil
  - Cheap corn
Mandated Ethanol Use

- 2005 federal energy bill mandates use of 7.5 billion gallons of renewable fuels by 2012
- 0.25 billion gallons of cellulosic derived ethanol by 2013
- Missouri mandate: minimum 10% blend if conditions met (if price = or less than regular gasoline), effective Jan. 1, 2008
Ethanol Production & Renewable Fuels Mandate

Source: FAPRI
Ethanol Production & Renewable Fuels Mandate
Ethanol Production & Renewable Fuels Mandate

Billion Gallons

- Ethanol Production
- Mandate
- Proposed

Years:
- 1998
- 2000
- 2002
- 2004
- 2006
- 2008
- 2010
- 2012
- 2014
- 2016
Reasons Ethanol Production Is Increasing

- Legislation
  - Production Subsidies
  - Mandated use
  - Phase-out of MTBE as oxygenate

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  - Cheap corn
Chart shows approx size of oxygenate market—but does not adjust for ethanol as pure fuel in former non-RFG areas, nor does it add MTBE imports. Point: MTBE volume thru Dec-05still limits increasing ethanol demand, pushes down on ethanol price.

Source: Terry Francl, American Farm Bureau
Reasons Ethanol Production Is Increasing

- **Legislation**
  - Production Subsidies
  - Mandated use
  - Phase-out of MTBE as oxygenate

- **Ethanol production is profitable**
  - **High cost of crude oil**
  - Cheap corn
U.S. Crude Oil Prices, WTI, Cushing, Oklahoma, 1996-2007

Source: U.S. Energy Information Administration
December Brent Crude Oil Futures

Source: New York Mercantile Exchange close on 8/21/07
Forecast of Crude Oil Prices, 2005-16
EIA Refiners Acquisition Cost

Source: USDA/OCE, February 2007
Reasons Ethanol Production Is Increasing

- Legislation
  - Production Subsidies
  - Mandated use
  - Phase-out of MTBE as oxygenate
- Ethanol production is profitable
  - High cost of crude oil
  - Cheap corn
U.S. Corn Price, 1970-06

Source: USDA/NASS
Gasoline-ethanol Price Relationship

- Mandated use
  - Sky’s the limit
- Octane enhancer
  - Equal retail prices
  - Slightly higher rack price for ethanol
- Gasoline substitute
  - Retail price 2/3 that of gasoline
  - Rack price 75% that of gasoline
Ethanol Price with $2 Gasoline Rack Price ~ $2.70 Retail Gasoline

- Mandated use
- E10 octane enhancer
- E85 fuel
Ethanol Bottlenecks

The probability of distribution bottlenecks will limit ethanol demand

- Location of ethanol plants
- Location of cars
- Shipping ethanol
- Gasoline stations
- E85 vehicles
State Avg. Ethanol Rack Prices

Date: Wed., May 30, 2007

Iowa: 2.393
Illinois: 2.398
Kansas: 2.602
Michigan: 2.610
Minnesota: 2.387
Missouri: 2.412
North Dakota: 2.454
Nebraska: 2.479
South Dakota: 2.463
Wisconsin: 2.564

Averages provided by:

ispetro.com

www.ethanol.org
Cost of Producing Ethanol
Cost of Dry Milling Ethanol in 2005
U.S. Dollars Per Gallon of Ethanol Produced

- Corn ($1.95) $0.7074
- Natural gas $0.2107
- Electricity $0.0581
- Enzymes & yeast $0.0465
- Chemicals & Denaturant $0.0897
- Labor & administration $0.1000
- Maintenance $0.0616
- Fixed costs $0.1200
- Other costs $0.0145
- Total cost $1.4085

Less byproduct credit of $0.2234 for DDG & CO₂

Total cost per gallon of ethanol: $1.1851

Source: USDA/OCE

2005 ethanol price: $1.80/gallon
Ethanol Plants Are Very Profitable

In 2006, U.S. plants produced ethanol for about $1.34 per gallon. The average price of ethanol was about $2.58 per gallon.
Iowa Gross Processing Margins for Ethanol, January 2000 - Prelim. June 2007

$ Per Gallon

Gross margin per Bu. of Corn
Gross margin per Gallon of Ethanol

Source: Bob Wisner, Economics Dept, ISU
Forecasted Cost of Ethanol in 2007
U.S. Dollars Per Gallon of Ethanol Produced

- Corn ($4.00/bu) $1.4545
- Natural gas $0.23
- Electricity $0.06
- Enzymes & yeast $0.05
- Chemicals & Denaturant $0.09
- Labor & administration $0.11
- Maintenance $0.062
- Fixed costs $0.12
- Other costs $0.015
- Total cost $2.1915
- Less byproduct credit of $0.44 for DDGS
- Total cost per gallon of ethanol: $1.75

If ethanol averages $2.25, then profit equals $0.50/gal or $1.375/bu
Ethanol Production Cost, 2006-07

Source: LMIC
Iowa Ethanol Prices, 2006-07

$ Per Gallon

Source: LMIC
DTN Ethanol Forecast

E100 Profitability
August 14, 2007

USD / Gal E100

Month of Delivery

Aug-07  Sep-07  Oct-07  Nov-07  Dec-07  Jan-08  Feb-08  Mar-08  Apr-08  May-08  Jun-08  Jul-08

Total Revenue per Gallon E100
Gross Margin per Gallon E100
## Ethanol & Unleaded Gasoline Average Rack Price – FOB Omaha

<table>
<thead>
<tr>
<th></th>
<th>Jan 05</th>
<th>Mar 05</th>
<th>May 05</th>
<th>Jul 05</th>
<th>Sep 05</th>
<th>Oct 05</th>
<th>Nov 05</th>
<th>Jan 06</th>
<th>Mar 06</th>
<th>May 06</th>
<th>Jul 06</th>
<th>Sep 06</th>
<th>Oct 06</th>
<th>Nov 06</th>
<th>Jan 07</th>
<th>Mar 07</th>
<th>May 07</th>
<th>Jul 07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol (66)</td>
<td>1.00</td>
<td>1.50</td>
<td>2.00</td>
<td>2.50</td>
<td>3.00</td>
<td>3.50</td>
<td>4.00</td>
<td></td>
<td>1.50</td>
<td>2.00</td>
<td>2.50</td>
<td>3.00</td>
<td>3.50</td>
<td>4.00</td>
<td></td>
<td>1.50</td>
<td>2.00</td>
<td>2.50</td>
</tr>
<tr>
<td>Gasoline (66)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>1.50</td>
<td>2.00</td>
<td>2.50</td>
</tr>
</tbody>
</table>

Source: [http://www.neo.ne.gov/statshtml/66.html](http://www.neo.ne.gov/statshtml/66.html)
**Ethanol & Unleaded Gasoline**

**Average Rack Price – FOB Omaha**

![Graph showing the average rack price of ethanol and gasoline from 1982 to 2015. The graph includes data points for each year and a forecast line for the years 2016 to 2015.](image)

*Source: FAPRI*
2007 Ethanol-Corn Breakeven Prices

Source: Ron Plain
What does it take to shut down ethanol production?
Ethanol Production, 1980-06

Only 1 dip in ethanol production

Source: Renewable Fuels Association
What does it take to shut down ethanol production?

Why did U.S. ethanol production dip in 1996?

Average price of gasoline in 1996: $1.269/gallon.

Average price of corn in 1996: $3.81/bushel.
What an Average Ethanol Plant Can Pay for Corn...

<table>
<thead>
<tr>
<th>Ethanol Price</th>
<th>And cover variable costs</th>
<th>And cover variable costs plus int., dep., &amp; taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.85/gal.</td>
<td>$4.50</td>
<td>$3.55</td>
</tr>
<tr>
<td><em>DDG prices stable</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1.85/gal</td>
<td>$5.50</td>
<td>$4.15</td>
</tr>
<tr>
<td><em>DDG prices rise</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$2.35/gal</td>
<td>$7.50</td>
<td>$6.10</td>
</tr>
<tr>
<td><em>DDG prices rise</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Keith Collins, USDA
Approximate Maximum Price Ethanol Plants to Pay for Corn with Varying Crude Oil Prices

Source: Bob Wisner, Economics Dept, ISU
2007 Ethanol-Corn Price Relationship

Source: Ron Plain
By-Product Feed
Ethanol By-Product Feed

Billion Pounds

# Feed Value of Ethanol Co-products

<table>
<thead>
<tr>
<th></th>
<th>Whole Corn</th>
<th>Dry DGS</th>
<th>Wet DGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter</td>
<td>87%</td>
<td>88-92%</td>
<td>30-35%</td>
</tr>
<tr>
<td>Protein</td>
<td>8-9%</td>
<td>29-30%</td>
<td>29-31%</td>
</tr>
<tr>
<td>Fat</td>
<td>4%</td>
<td>9-10%</td>
<td>8-12%</td>
</tr>
<tr>
<td>Fiber</td>
<td>2-3%</td>
<td>8-9%</td>
<td>13%</td>
</tr>
<tr>
<td>ME/lb</td>
<td>1551 kcal</td>
<td>1700 kcal</td>
<td>1750 kcal</td>
</tr>
</tbody>
</table>
DDGS as Animal Feed

- DDGS has poor protein quality – the mix of amino acids does not match well with the needs of monogastric animals
- DDGS has a high oil content
- DDGS has a high phosphorus content
- DDGS can have problems with mycotoxins (aflatoxin, vomitoxin, etc)
- DDGS has handling problems
DDGS as Animal Feed

- Inconsistent product quality
  - Varies plant to plant
  - Varies batch to batch
## DDGS Quality (27 U.S. sources)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter %</td>
<td>89.3</td>
<td>87.3 - 92.4</td>
</tr>
<tr>
<td>Crude protein %</td>
<td>31.0</td>
<td>28.7 - 32.9</td>
</tr>
<tr>
<td>Fat %</td>
<td>10.6</td>
<td>8.8 - 12.4</td>
</tr>
<tr>
<td>Calcium %</td>
<td>0.08</td>
<td>0.02 - 0.12</td>
</tr>
<tr>
<td>Phosphorus %</td>
<td>0.75</td>
<td>0.42 - 0.99</td>
</tr>
<tr>
<td>Lysine %</td>
<td>0.89</td>
<td>0.61 - 1.06</td>
</tr>
</tbody>
</table>

Source: G. Shurson, U of Minnesota, 100% D.M. basis
DDGS-Corn Price Relationship
Price Ratio: DDGS/Corn, Illinois, 1996-06

A pound of DDGS is priced close to a pound of corn

Source: LMIC
North Missouri DDGS Prices

$ Per Ton

Source: LMIC
Omaha Corn Prices, weekly

![Graph showing Omaha Corn Prices from 1999-2007. The graph displays weekly prices from January to October for the years 1999 to 2007. The prices are shown in dollars per bushel, with a comparison of average prices for each year.]
Northwest Iowa Prices, 2006-07

$ Per Ton

Source: LMIC
Value of DDGS Depends on Use

<table>
<thead>
<tr>
<th>Feed</th>
<th>Dollars/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy Lactation</td>
<td>$114.24</td>
</tr>
<tr>
<td>Beef Feedlot</td>
<td>$108.00</td>
</tr>
<tr>
<td>Layer Diet</td>
<td>$104.66</td>
</tr>
<tr>
<td>Poultry Finisher</td>
<td>$100.09</td>
</tr>
<tr>
<td>Swine G-F Diet</td>
<td>$ 96.34</td>
</tr>
</tbody>
</table>

Assumptions:
- Corn $2.00 / bu
- SBM $175.00 / ton
- Urea $360.00 / ton
- Non-ruminant diets corn/SBM
- Ruminant diets typical diets with competing by-products.

Source: Tilstra, Land O’ Lakes
Note. PRX calculation of DDG corn displacement began in 02-03. No data on DDG by state is available from USDA.

Source: Terry Francl, American Farm Bureau
Ethanol and Animal Agriculture

- 100 million gallon ethanol plant
  - 37 million bushels of corn
  - 70 workers directly employed
- 37 million bushels of corn
  - Farrow to finish: 800 jobs
  - Beef feedlot: 278 jobs

Source: John Lawrence, ISU Beef Center
Implications of Increasing Ethanol Production

- Much higher corn prices
- Higher land rent and prices
- New grain storage/shipping patterns
- Acreage shift to corn
  - First from soybeans
  - Then other commodity crops
- Higher production cost for livestock
  - Reduced livestock production
  - Higher meat/milk/egg prices
- Feeding lots of distillers grain
Cellulosic Ethanol
Cellulosic Ethanol

- Cellulosic ethanol is ethanol made from cellulose. It is the same as grain ethanol: $\text{C}_2\text{H}_5\text{OH}$. The only difference is the source material.

- The interest in cellulosic ethanol comes from the huge supply of low-value source material:
  - Wood – trees, limbs, paper, cardboard
  - Grass - switchgrass, corn stalks, straw, fescue
  - Distillers Grains
Cellulosic Ethanol

- Producing ethanol from cellulose is something we’ve known how to do for over 100 years.
- Doing it in a cost-competitive manner is something we have yet to learn.
- However, there are many people seeking research grants who claim to be close to solving the cost problem.
Biodiesel
Soydiesel

Although soybean oil is a liquid, you should not blend it with diesel fuel. The glycerine in soy oil will ruin a diesel engine. Soy oil must be transesterified before blending with diesel fuel.
Biodiesel Production

Vegetable Oil → Methanol + Catalyst

Alcohol recovery → Alcohol recovery

Purification → Washing → Reactor

Settler → Neutralization

Settler → Evaporation

Fatty acids → Glycerine

Biodiesel
Biodiesel Production, 1999-07

Source: USDA/OCE
Economics of Soydiesel

- Soy oil is worth 35¢ per pound
- Diesel is worth 27¢ per pound
- Cost of conversion is 8¢ per pound
- There is a federal government subsidy of 13¢ for each pound of soy oil converted to diesel fuel
October 2007, Soy Oil Futures
Biodiesel

- The rapid rise in soy oil prices means that biodiesel plants are looking for other feedstocks
Questions?
References