Biofuels Update: Implications for Crop and Livestock Producers

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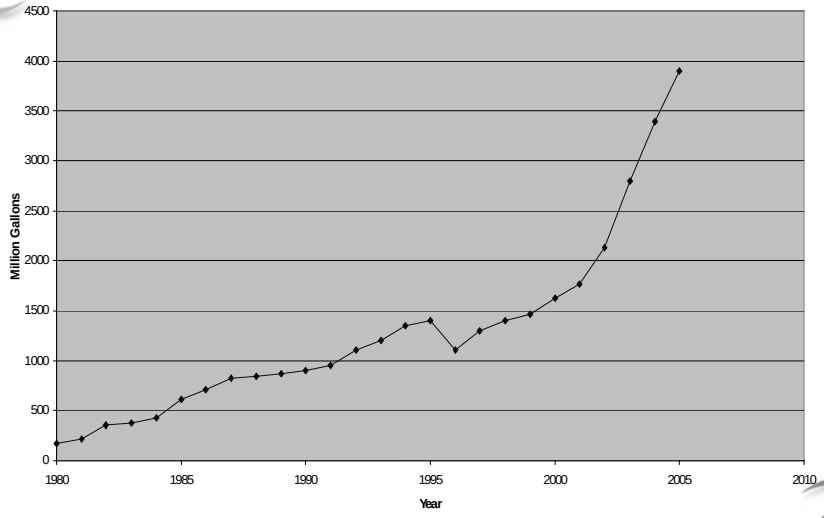
My comments will:

- discuss the current status and the economics of ethanol and biodiesel production in the U.S.,
- speculate about the rate of growth of these two biofuels over the next five years, and
- note some likely implications of this growth for management of farms in the Midwest.

Ethanol

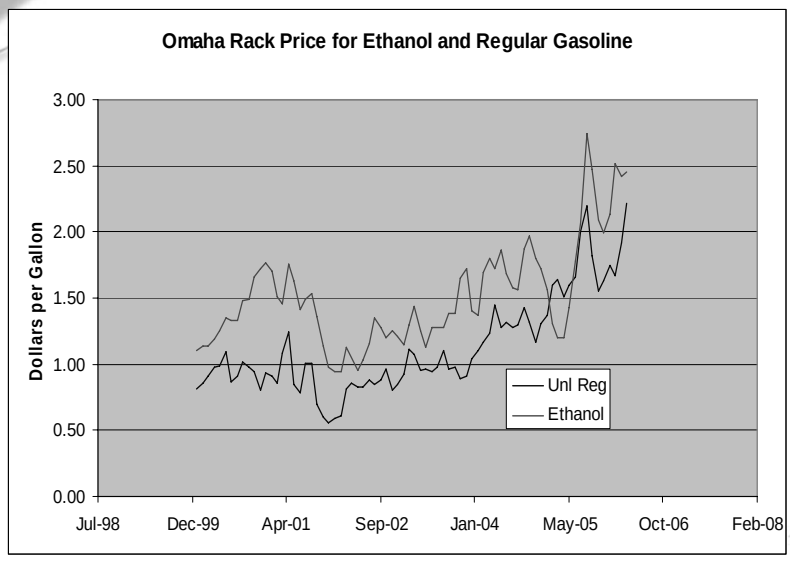
Ethanol Production Has Been Growing Rapidly



The U.S. Grain Ethanol Industry is Growing Very Rapidly

- Industry very profitable for past 2.5 years
  - Higher petroleum and wholesale gasoline prices
  - Phase out of MTBE – need 6 billion Gallons/Yr.
  - Ethanol production costs have been relatively constant.

- Industry is expanding rapidly
  - Will produce 4.8 billion gallons during 2006
  - Plant capacity will reach
    - 6 billion gallons 1/1/07
    - 7 billion gallons 1/1/08



The Relation of Ethanol to Petroleum and Wholesale Gasoline Prices

- Expect ethanol prices to decline to $.10 to over the wholesale price of gasoline

Refiners Acquisition Cost $/Barrel	Wholesale Gasoline Price $/Gallon*	Ethanol w/$0.10 Premium $/Gallon
40	1.20	1.30
50	1.49	1.59
60	1.78	1.88
70	2.07	2.17
80	2.36	2.46

*Wholesale price of Regular gasoline = $0.036 + $0.029(Price of Crude oil/brl)

Source: McCullough, Robert and Daniel Etra. *When Farmers Outperform Sheiks: Why Adding Ethanol to the U.S. Fuel Mix Makes Sense.* McCullough Research, Portland, Oregon, April, 2005, 12pp.

The Grain Ethanol Industry Is Expected to Continue Expanding Until Profitability Returns to Normal Levels

•Net cost per gallon of ethanol depends on price of corn and fuel for the plant

Corn Price	Net Cost/Gallon
$2.00	$1.27
2.50	1.45
3.00	1.63
3.50	1.80
4.00	1.98
4.50	2.16
5.00	2.34

•The profit opportunities will be reduced if the blenders credit of $0.51/gallon is changed.

Other Developments in Ethanol from Grain Industry

- Changes in Industry Structure
  - Larger companies are being formed to attract capital from financial markets to own multi-plant firms.
  - Developing much larger plants – 100 million gallons
  - New plants are more geographically dispersed- destination & origination
- Our work indicates economies in investment and operating costs of about $0.035 per gallon of ethanol for NG plants as plant size increases from 50 to 100 mmgpy. The larger plants are expected to obtain additional economies in marketing, transportation and risk management.

Ethanol plants are considering alternative boiler fuels. Our work indicates

•Each increase of $1.00 per mmbtu raises the cost of ethanol $0.034.

•Investment and operating costs per gallon of ethanol for plants burning corn stover @ $50/ton would be about $0.15 less than the cost with NG at $10 per mmbtu. $50/ton corn stover breaks even with NG at $5.59 per mmbtu.

•DDGS at $66 per ton and corn stover at $50 per ton have the same cost per gallon of ethanol.

•Coal fired plants with coal at $1.80/mmbtu have a cost advantage of $.207 per gallon of ethanol compared to NG plants at $10/mmbtu.

New Technologies To Increase Plant Efficiency

- Remove oil from stillage – backend processing

  - Process runs thin stillage through a centrifuge type process to remove about 75% of oil (1.2 pounds per bushel of corn).

  - Resulting oil can be feedstock for biodiesel, providing another source of revenue for the plant.

  - Improves flowability of DDGS
  - Reduces the energy content and quantity of DDGS

New Technologies to Increase Plant Efficiency

- Fractionation

  - There are several competing technologies, some more mechanical, others take more time to steep and then separate the kernel components.

  - The mix of output varies by process, but in general they include a high fiber output, a smaller amount of high protein feed, and corn oil. The promise of fractionation is that it will enable the industry to develop feeds better adapted to diets of poultry, swine and dairy. (The outputs per bushel from wet milling are 12.4 pounds of corn gluten feed, 3.0 pounds of corn gluten meal, and 1.6 pounds of corn oil.)

How Rapidly Will Ethanol Production Increase ? (FAPRI July2006 Update)

Projected Ethanol Production and Corn Use By Marketing Year						
Marketing Year	9/1 – 8/31	2004/05	2005/06	2006/07	2007/08	2010/11
Ethanol Produced	Bill.Gal.	3.7	4.6	5.9	7.0	9.7
Corn Required	Bill.Bu.	1.323	1.645	2.110	2.505	3.455
CoProduct Feeds (Dry Equivalent)	Mill.Tons	11.024	13.705	17.580	20.870	28.787
Corn Crop	Bill.Bu.	11.807	11.112	10.740	11.476	12.498
% Corn Crop	%	11.2	14.8	19.6	21.8	27.6
U.S. Farm Price	$/Bu.	2.06	1.98	2.33	2.54	2.64
Acres Planted	Mill. Ac.	80.9	81.8	79.4	82.9	87.0
Yield Per Acre	Bu./Ac.	160.4	147.9	149.0	150.9	156.4

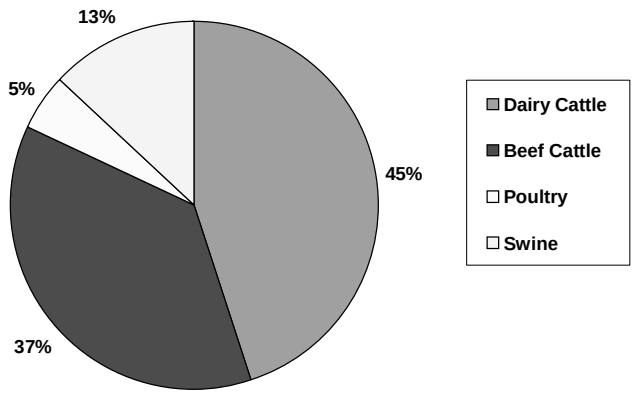
Some Soybean Impacts

- Soybeans
  - - Planted Acreage decreases 3.3 million acres from 06/07 to 10/11
  - - Oil withdrawn for biodiesel doubles from 805 million lbs.in 05/06(107 million gallons) to 1,602 million lbs in 10/11 (216 million gallons)
  - - Oil price increases 27%
  - - Meal price decreases 8%
  - - Farm price of beans increases 4%

Some Livestock and Poultry Impacts

- Production of all livestock species are up , but net returns to all species are down, with turkeys, broilers and swine taking the biggest reduction in net returns.
- The cost of energy in animal feed increases over the 5 years while the cost of protein decreases. Some nutritionists are saying we will be using more protein feeds as an energy source, especially in animal feeds. We need to learn how to feed each species efficiently with different protein/energy price ratios. The model may not reflect those new diets.

2005 DDGS Usage by Livestock Class
(Source: Commodity Specialists Co.)



Expect 26.1 million metric tons of co-product feeds by 2010/11. Which U.S. livestock will consume it?

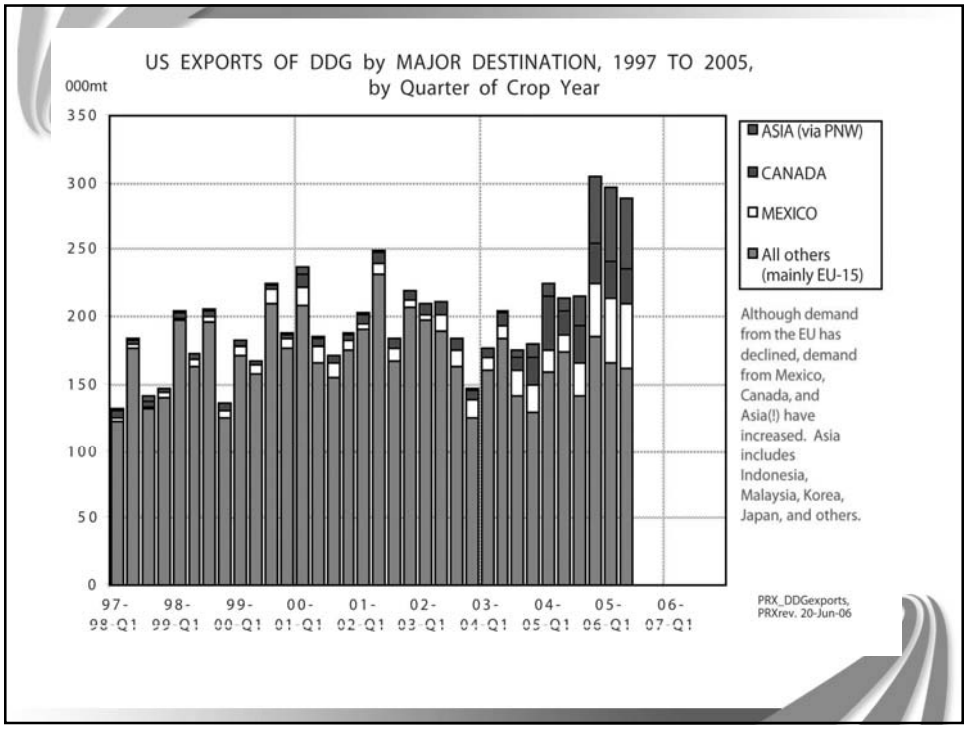
Co-Product Usage Possibilities for U.S. Animal Species

(Based on Geoff Cooper, NCGA, Distillers Grains Quarterly, 1st 2006)

	Grain-Consuming Animal Units (Millions)	Max. Rate of Inclusion In Diet	1,000 metric Tons by % Market Penetration		
			50%	75%	100%
Dairy	10.2	20%	1,887	2,831	3,774
Beef	24.8	40%	9,176	13,764	18,352
Pork	23.8	20%	4,348	6,521	8,695
Poultry	31.1	10%	2,877	4,315	5,754
Total			18,288	27,431	36,575

Use of Co-Product Feeds (Cont.)

- Feeding the maximum recommended amount of DDGS to 75% of the dairy and beef plus 50% of the poultry and swine would consume 23.8 million metric tons. This suggests that DDGS will remain inexpensive.
- Exports of DDGS were 1.05 million metric tons in 2005.
- Potential nonfeed uses of distillers grains
  - Fuel use for process heat and/or drying
  - Industrial uses
    - fertilizer
    - fiber board or other construction uses
  - Human food use (limited to food grade facilities)



Ethanol from Lignocellulosic Biomass

- Analysis based on Aden, *et.al. Lignocellulosic Biomass to Ethanol Process Design and Economics Utilizing Co-Current Dilute Acid Prehydrolysis for Corn Stover. NREL/TP-510-32438. 2002.*
- Plant designed to process 2,205 tons per day (2000 metric tons).
- Estimated costs are for the nth plant.
  - start up after 2010
  - project investment ($2005) of $250,797,000.
  - Operating costs of $81,200,800 including buying the biomass at $30 per ton.
- Production
  - Initial conversion rate of 67.8 gallons per ton.
  - Later conversion rate of 89.7 gallons per ton
  - Also produce 3.7 kWH per gallon of anhydrous ethanol, use 1.42 in the plant and sell 2.28 @ $.041

Costs and Development of Lignocellulosic Industry

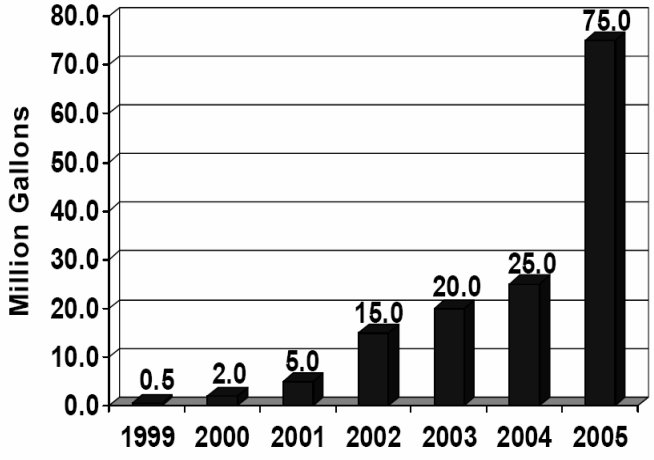
- The cost per gallon of ethanol with the Aden et. al. plant (with a conversion rate of 67.8 gallons per ton, enzyme cost of $.20 per gallon and corn stover cost of $50 per ton) is $1.91 per gallon.
- Commercial lignocellulosic plants are being built.
  - 50 mmgpy plant in Georgia using forest product wastes as the feedstock. Production to begin summer 2007.
  - Idaho plant to produce ethanol from 400,000 tons of barley straw. Construction to begin summer 2007.
  - Colusa Biomass plans a 12 mmgpy plant to convert rice straw in Sacramento Valley to ethanol. Plan to start production in 2007.
- Don't anticipate much commercial production before 2015.
- Much of the crop residue and bioenergy crops may be processed using other technologies, such as combustion, gasification, etc.

Ethanol Summary

- It appears periods of favorable profits are ahead, but not at the levels of the past 2.5 years. Future profits highly dependent on future energy prices, and corn prices.
- Major efforts to substitute biomass for natural gas in ethanol plants are underway, but development problems remain.
- Dry-mill technologies are evolving and will produce a wider range of co-product feeds over the next several years.
  - oil recovery from thin stillage
  - fractionation
- It appears the U.S will produce 10 billion gallons of ethanol from grain within 5 years and co-product utilization in livestock production will become more common.
- Lignocellulosic conversion becomes more competitive with higher priced corn.

Biodiesel

Estimated US Biodiesel Production



Estimates of Biodiesel Production Costs

- Based on Hass, et. al. "A process Model to Estimate Biodiesel Production Costs." Elsevier. 2005.
  - 10 million gallon annual capacity
  - continuous-process vegetable oil transesterification plant w/ ester and glycerol recovery.
  - Investment cost of $11.5 million.
  - Operating and capital costs of $0.505 per gallon
  - No credit for sale of glycerol.

Biodiesel Costs for a 10-Million Gallon Per Year Plant

Biodiesel From Degummed Soybean Oil Cost Per Gallon		
Degummed Soybean Oil $/lb.	w/o Tax Credit	W/$1.00/Gallon Tax Credit
$0.20	$1.98	$0.98
0.25	2.35	1.35
0.30	2.73	1.73
0.35	3.09	2.09

Biodiesel Demand

- Many niche markets including 400 fleets of vehicles associated with school districts, city and state governments, and federal agencies will grow to 6.5 million/year by 2010.
- State mandates – MN for 17 million/year.
- Potential demand as a lubricity agent for ultra-low sulfur diesel fuel, but industry has rejected the possibility.

Table 6. U.S. Supply of Biodiesel Feedstocks

Oil Type	Million Pounds*	Million Gallons**
Crops		
Soybean Oil	18,309	2,446
Cottonseed Oil	847	113
Sunflower Oil	558	74
Peanut Oil	84	11
Corn Oil	2,436	325
Canola Oil	603	80
Total	22,836	3,044
Other		
Yellow Grease & Grease	2,656	332
Lard	1,090	131
Edible Tallow	1,894	228
Inedible tallow	3,696	445
Poultry Fat	4,204	507
Total	13,540	1,643
Total Supply	36,376	4,687

Biodiesel Summary

- Minnesota Biodiesel Mandate became effective Sept. 29, 2005.
- Increase in sales and profitability highly dependent on biodiesel tax credit and or further mandates.
- U.S. Feedstock supply is rather limited for biodiesel production. (711 to 984 million gallons)
  - soybean oil (100 to 200 million gallons)
  - Yellow grease (116 to 164 million gallons)
  - Other vegetable oils (50 to 60 million gallons)
  - Tallow and poultry fat (445 to 560 million gallons)

Thank You !

Energy Balance and greenhouse Gas Impacts of Ethanol and Biodiesel

	Energy Out/Fossil Energy Input	% GHG Reduction vs. Gasoline/Diesel
Gasoline	0.81	-
Ethanol from Grain	1.35	26
Ethanol from Cellulose	4.17	85
Diesel	0.91	-
Biodiesel from Soybean Oil	3.24	53

Sources: International Energy Agency. *Biofuels For Transport,* OECD, Paris, France, April 2004, Tables 3 & 7.

Michael Wang, " An Update of Energy and Greenhouse Emissions: Impacts of Fuel Ethanol," Center for Transportation Studies, Argonne National Laboratory, Feb. 8, 2005.

Estimated Production Cost per Gallon of Denatured Ethanol Produced From Lignocellulosic Biomass, based on Aden, et.al.

Conver-sion Rate	**Cost of Feedstock**	**Enzyme**	**Plant Output Million Gallons / Year**		**Denatured**	**Investment**
Gal/Ton	**$ / Ton**	**Cost / Gal**	**Anhydrous**	**Denatured**	**Cost/Gal.**	**Cost/Gal.**
Base Case						
67.8	30	0.10	52.3	53.4	1.52	4.70
		0.20			1.62	
	50	0.10			1.81	
		0.20			1.91	
Future Case 89.7	30	0.10	69.3	70.7	1.15	3.55
		0.20			1.25	
	50	0.10			1.37	
		0.20			1.47