

Biofuels: The Environment and the Economy

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Daniel O'Brien & Mike Woolverton
K-State Research and Extension
Douglas Karlen, USDA-ARS

Biofuel Economic Issues

- U.S. Energy Independence Act
- Ethanol Impact on Water Use in Kansas
- Net Output/Input Efficiency by Energy Source
- Grain-Based Ethanol Industry
- Kansas Grain Transportation Impacts
- Biodiesel
- Cellulosic / Biomass Ethanol
- U.S. Farmland Availability

Energy Independence & Security Act

Type of Fuel (Categories)	BGY
Total Renewable Fuels by 2022	36 BGY
Corn Ethanol (Starch Based)	15 BGY <u>cap</u>
Advanced Biofuels <ul style="list-style-type: none"> ■ Includes imported biofuels and biodiesel ■ Must achieve $\geq 50\%$ reduction of GHGs from baseline* 	21
Cellulosic Fuels <ul style="list-style-type: none"> ■ Includes cellulosic ethanol, biobutanol, green diesel, green gasoline ■ Must achieve $\geq 60\%$ reduction of GHGs from baseline* 	16

* Baseline = average lifecycle GHG emissions for gasoline or diesel sold or distributed as transportation fuel in 2005

Ethanol Impact on Water Use in Kansas

Profit Maximization & Irrigation

- **Increased water use** due *primarily* to increased corn acreage, *secondarily* to more intensive irrigation / acre ➔ *Effect of Ethanol Demand*
- **Greater Irrigated Corn Acreage**
 - *Higher profitability of corn vs alternative crops*
- **More Intensive Irrigation per Acre**
 - *Impact of ↑ corn\$ on irrigation cost-benefit decisions*
 - *Greater water use for corn vs alternative crops*
- Other Analysis: Jeff Peterson @ KSU

Water Use by Ethanol Plants

For Grain Dry Milling Processes

- **Process Water** ≈ 33% of Plant Use
 - *Water in contact with grain*
 - *Mixing, slurry, fermentation, saccharification processes*
- **Non-Process Water** ≈ 67% of Plant Use
 - *Water not coming in contact with grain*
 - *90% of non-process water used in heating-cooling*
- **Plant Water Use:** 4.23 gal. / gal. ethanol
 - *Water use for a 40 mln gal. capacity Ethanol Plant ≈ water use by 2 ¾ pivot irrig. systems / yr (18-20 a.i.)*

Net Output/Input

Efficiencies

of Alternative

Energy Sources

Net Energy Balance / Efficiency

<u>Product</u>	<u>Energy Out/Energy In</u>
Gasoline	0.81
Ethanol from grain	1.67
Ethanol from cellulose	2.00
Diesel	0.83
Bio-diesel	3.50

Source: Congressional Research Service, RL32712, May 18, 2006 and an update for bio-diesel by the USDA and the University of Idaho, February 2008.

Starch / Grain-Based Ethanol Industry

U.S. Ethanol Industry Development

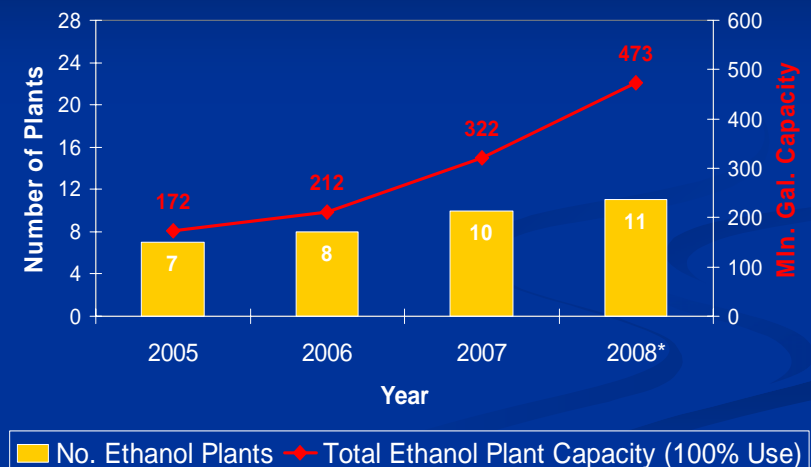
- | | 2006 | 2008 |
|---------------------------------------|------|------|
| ■ No. operating Ethanol Plants: | 97 | 179 |
| ■ Plants under construction: | 35 | 24 |
| ■ Current production capacity: (BGPY) | 4.8 | 11.0 |
-
- Projected production capacity: 12.4 BGPY end of 2008
13.6 BGPY end of 2009
 - Max starch-based ethanol inclusion of 15 bln. gal. by 2015
-
- Corn Used for Ethanol Production & % U.S. Corn Crop:

Mktg. Year	Mln. Bu.	% of Crop
2006/07	2,119	20%
2007/08	3,000	23%
2008/09	3,700	31%
2014/15	5,000	33%

Kansas Grain Ethanol Production

- 2007 Ethanol Production Capacity (Dec. '07)
 - 10 plants, 322 million gallons capacity
 - Needing 115 mln. bu. corn @ 100% capacity
- Current Ethanol Capacity (July 2008)
 - 11 plants, 472.5 million gallons capacity
 - Needing 169 mln. bu. corn @ 100% capacity

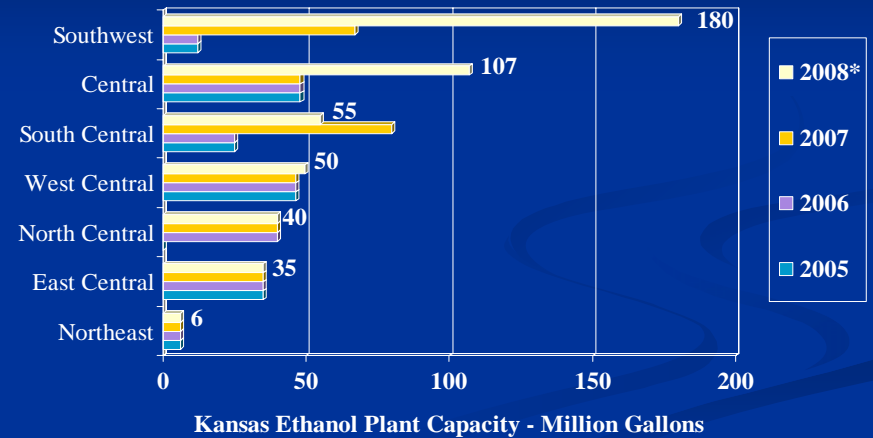
Kansas Ethanol Production (2005-2008*)



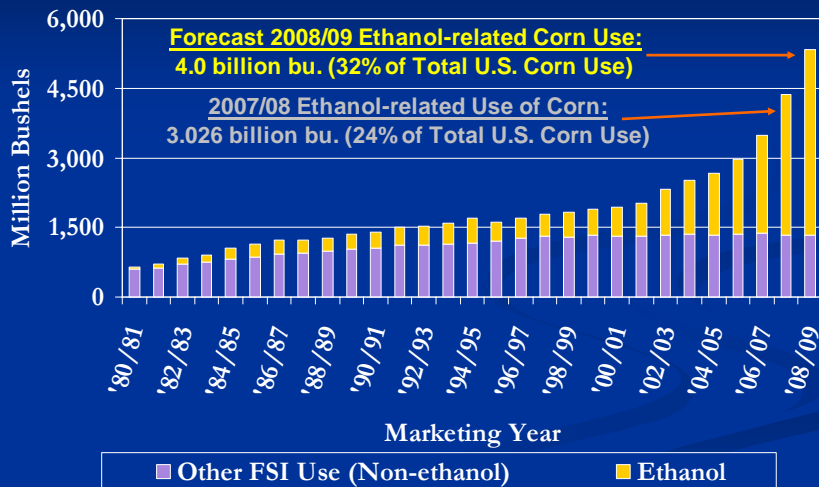
Kansas Feedgrain Supply-Use

- Grain ethanol production at current plant capacity would use **169 million bushels** of feedgrains / year
 - 30% of 2005-2007 avg. corn production (566 mln. bu.)
- Livestock feeding estimates averaged **158 million bushels** / year over 2005-2007 period
- Kansas Imports of Supplemental Feedgrains
 - Predominant inter-state sources: Iowa & Nebraska
 - Projected feedgrain deficits in Nebraska & Iowa in the near future due to in-state ethanol development

Ethanol Production Capacity by Crop Reporting District (2005-2008*)



U.S. Corn Food, Seed & Industrial Use 1973/74 thru 2008/09 Marketing Years



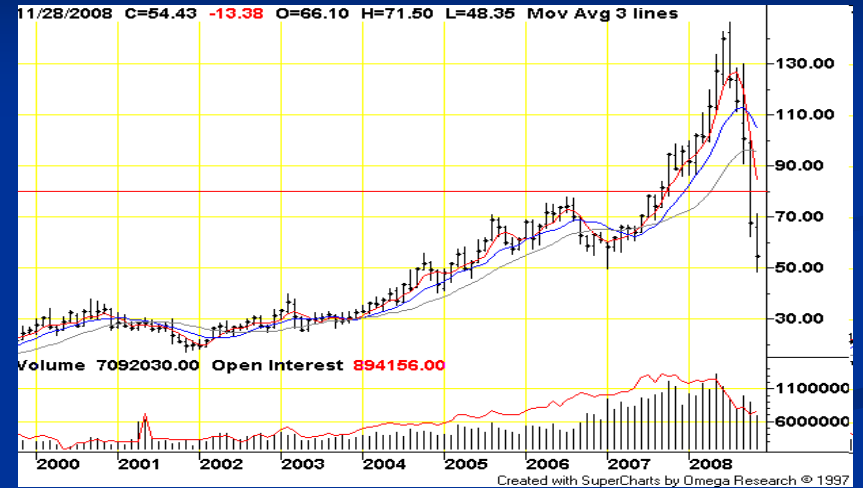
U.S. Corn Supply-Demand 2006/07 through 2008/09 Marketing Years

	2006/07	2007/08	2008/09
Planted Ac. (mln.)	78.3	93.6	85.9
Harvested Ac (mln.)	70.6	86.5	78.2
Yield (bu./ac.)	149.1	151.1	153.8
Beg. Stocks	1,967	1,304	1,624
Production	<u>10,535</u>	<u>13,074</u>	<u>12,020</u>
Total Supplies	12,514	14,398	13,659
Ethanol	2,119	3,026	4,000
Other Food, Seed, Indust.	1,371	1,338	1,335
Exports	2,125	2,436	1,900
Feed & Residual	5,595	5,974	5,300
Total Use	11,210	12,773	12,535
End Stocks (%S/U)	(12%) 1,304	(13%) 1,624	(9%) 1,124
U.S. Ave. Farm \$	\$3.⁰⁴	\$4.²⁰	\$4.⁰⁰ - \$4.⁸⁰

CBOT Corn Futures 2000 through 2008



Light Crude Oil Futures: 2000-2008 Monthly Price Chart (CL - NYMEX)



Ethanol Profit Margin

Estimated Profit Margin (\$ / gallon)

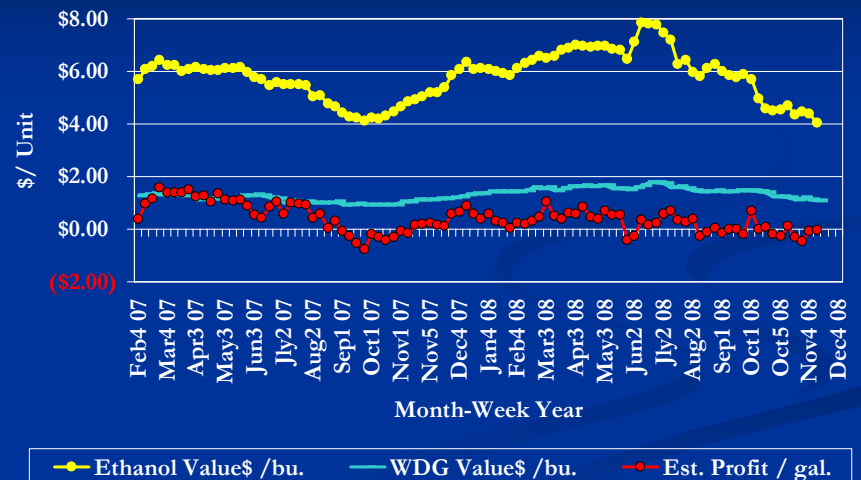
Prices	July '07	Nov '08	Change
Corn (\$/bu.)	\$3.27	\$3.83 ¹	+17%
Ethanol \$/gal	\$1.91	\$1.72	-10%
RBOB Gas \$/gal	\$1.98	\$1.35	-32%
Profit Margin	+0.26	-0.03 ²	

¹ Prices Nov. 10, 2008. Breakeven corn price - \$3.71

² Ethanol profit for a 100 million gallon plant = - \$3 million
Distiller's Grain revenue would be about \$50 million.

To compete with gasoline as substitute, ethanol \$ would need to fall to \$0.89/gal

Corn Ethanol & WDG \$Value vs Corn \$ Nebraska / Kansas #s, Feb. 2007 - Dec., 2008



Ethanol's Impact on Transportation of Grain, Ethanol & Co-Products in Kansas

Josh Roe
Kansas State University

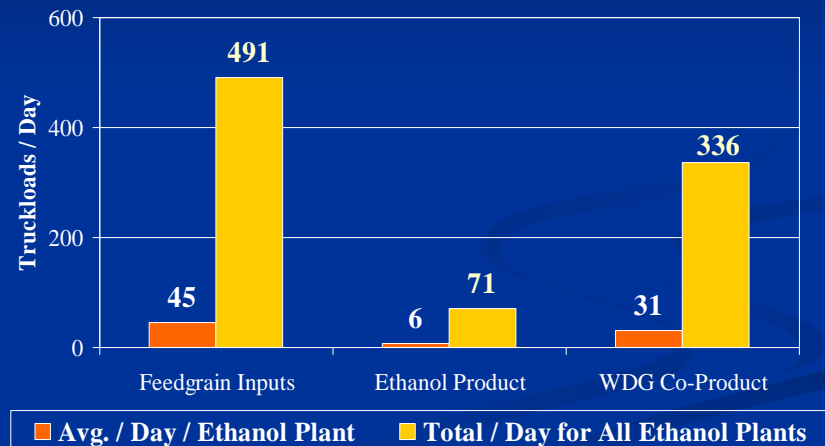
Comparative Transportation Advantages of Kansas Ethanol Plants

- WDGs Sold to Local Cattle Feeders
 - *Lower drying / natural gas costs*
- Selling 50% of Denatured Ethanol via Truck to Blenders within 150 miles of Plants
 - *Reduced cost vs plants relying on rail transportation*
- Reduced Rail Transportation Cost of Denatured Ethanol to Western U.S.
 - *Geographic cost advantage for the Western Corn Belt*

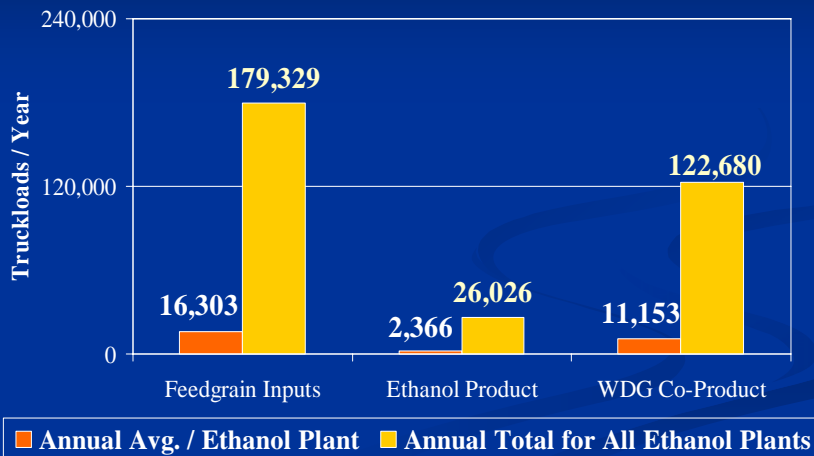
Trucking Needs of Kansas Ethanol Plants

- Assumptions
 - 100% of feedgrains transported by truck to plants
 - 50% of ethanol transported by truck (50% by rail)
 - 90% of Distiller's Grains sold in "Wet Cake" form (i.e., Wet Distillers Grains)
- Quantities per Truckload
 - 1 truckload of feedgrains = 950 bushels
 - 1 truckload of Ethanol = 9,000 gallons
 - 1 truckload of WDGs = 25 tons

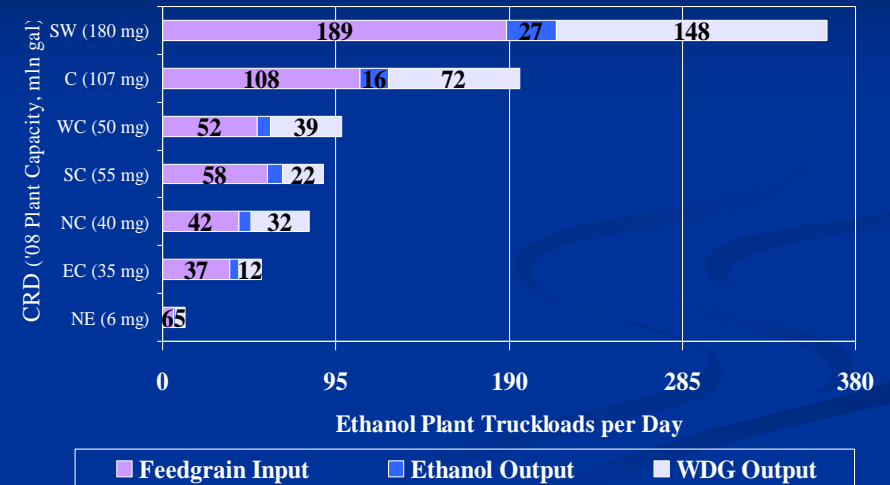
Daily Trucking Use by Ethanol Plants Kansas, estimates as of July 2008*



Annual Trucking Use by Ethanol Plants Kansas, estimates as of July 2008*



Daily Ethanol Truck Use by CRD Kansas, estimates as of July 2008*



Bio-diesel

BD Profit Margin Calculation

Soybean oil to Bio-diesel Conversion:

- Soybean oil (\$.34 per pound) -\$2.55
- Diesel wholesale per gallon \$2.085
- Cost of methanol = Glycerin credit
- Cost to process \$0.00
- BD Net Processing Margin -\$0.47

Biodiesel producers receive a \$1 dollar per gallon subsidy for converting vegetable oil or animal fat to biodiesel fuel.

U.S. Soybean Supply-Demand

2006/07 through 2008/09 Marketing Years

	2006/07	2007/08	2008/09
Planted Ac. (mln.)	75.5	64.7	75.9
Harvested Ac (mln.)	74.6	64.1	74.4
Yield (bu./ac.)	42.7	41.2	39.3
Beg. Stocks	449	574	205
Production	3,188	2,676	2,921
Total Supplies	3,647	3,260	3,133
Crushings	1,808	1,801	1,745
Exports	1,116	1,161	1,020
Seed & Residual	149	92	162
Total Use	3,073	3,054	2,928
End Stocks (%S/U)	(19%) 574	(6.7%) 205	(7.0%) 205
U.S. Ave. Farm \$	\$6.⁴³	\$10.¹⁰	\$9.¹⁰ - \$10.⁶⁰

Cellulosic / Biomass Ethanol

Corn vs. Cellulosic Ethanol

	<u>Corn</u>	<u>Cellulosic</u>
Capital cost per gallon	\$2.00	\$5-6.00 est.
Raw mat. cost per ton	\$137	\$75
Enzyme cost per ton	\$3.15	\$33.00
Ethanol yield per dry ton	100-110 gal.	75-90 gal.
Conversion process	simple	complex
Water use per gallon	3-5	6-10
Processing time, days	2	7
Cost of prod. per gallon	\$1.75	\$2.25 est.

Sources: Testimony of Keith Collins, USDA Chief Economist, 26 Aug. 2006; Popp and Hogan presentation at Farm Foundation Conference 12-13 April 2007; and M. Woolverton recent calculations.

Questions???

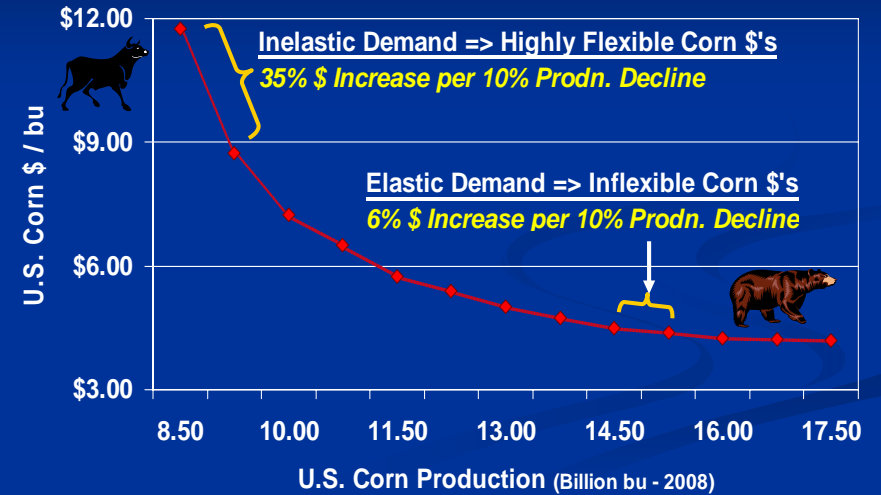
Daniel M. O'Brien, Ph.D.

K-State Extension Agricultural Economics:

www.AgManager.info

U.S. Corn Price Flexibility Example

\$ Response to 2008 U.S. Corn Production



Inelastic – Highly Flexible Demand

Implications for Farm & Other Commodity Prices

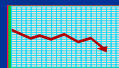
■ Record High-Low Price Swings (Volatility)

- **Low** Stocks/Use “*pushed*” grain markets into the **Inelastic, highly Flexible** regions of market demand



■ P_{Grains} responded to their own & other grain's tight S/D prospects

- **Fall 2008**: Small--moderate \uparrow Supply / \downarrow Demand has helped cause a large decline in grain prices



■ Expect Market Volatility to Continue

- Farm markets to remain *Inelastic* with *high Price Flexibility*

U.S. Cropland Inventory

Millions of Acres

	5 yr. Ave.	07/08	USDA Proj. 08/09 ¹
Corn	79.6	93.6	85.9 (-8%)
Soybeans	74.2	64.7	75.9 (+17%)
Hay	62.4	61.6	60.2 (-2%) ??
Wheat	59.5	60.4	63.0 (+4%)
Cotton	14.1	10.8	9.4 (-13%)
Grain Sorghum	8.1	7.7	8.3 (+8%)
Principle Crops	297.9	298.8	302.7
CRP		35.9	34.9 (-3%)

Total U.S. Cropland = 441.6 million acres

¹ USDA, WASDE, Released November 10, 2008.

Crop Acres Coming Out of CRP

2007–2017 (Source: USDA, FSA)



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