

Global Economic Impacts of Ethanol Industry Growth

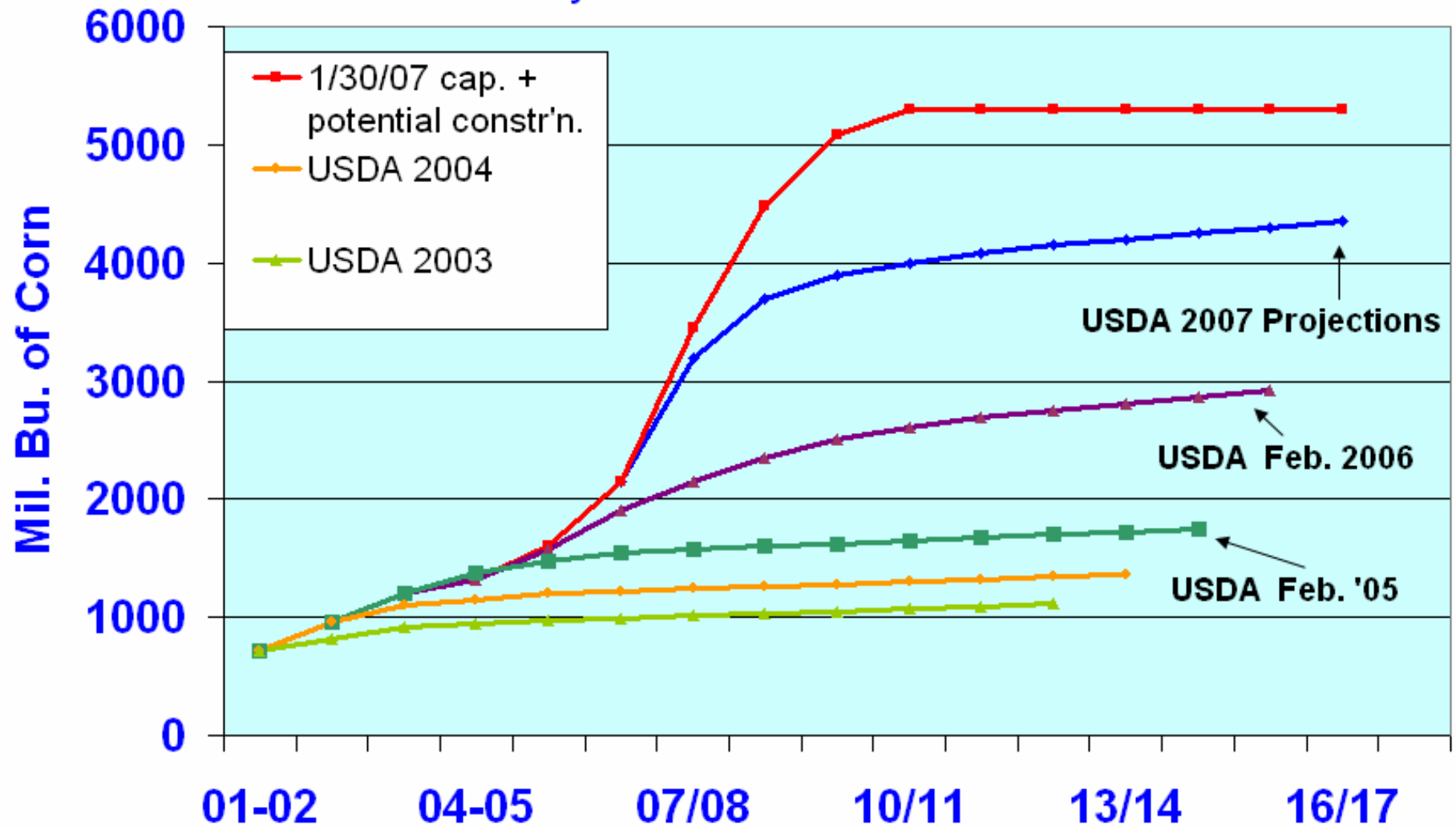
**By Dr. Robert Wisner, University
Professor of Economics and Coles
Professor of International
Agriculture**

**Iowa State University
Ames, Iowa, U.S.A.**

Some perspectives

- **Iowa** – the epicenter of biofuels growth
- **The U.S.** – rapid expansion & huge agricultural changes
- **Brazil** – also expanding very rapidly
- **Global impacts**

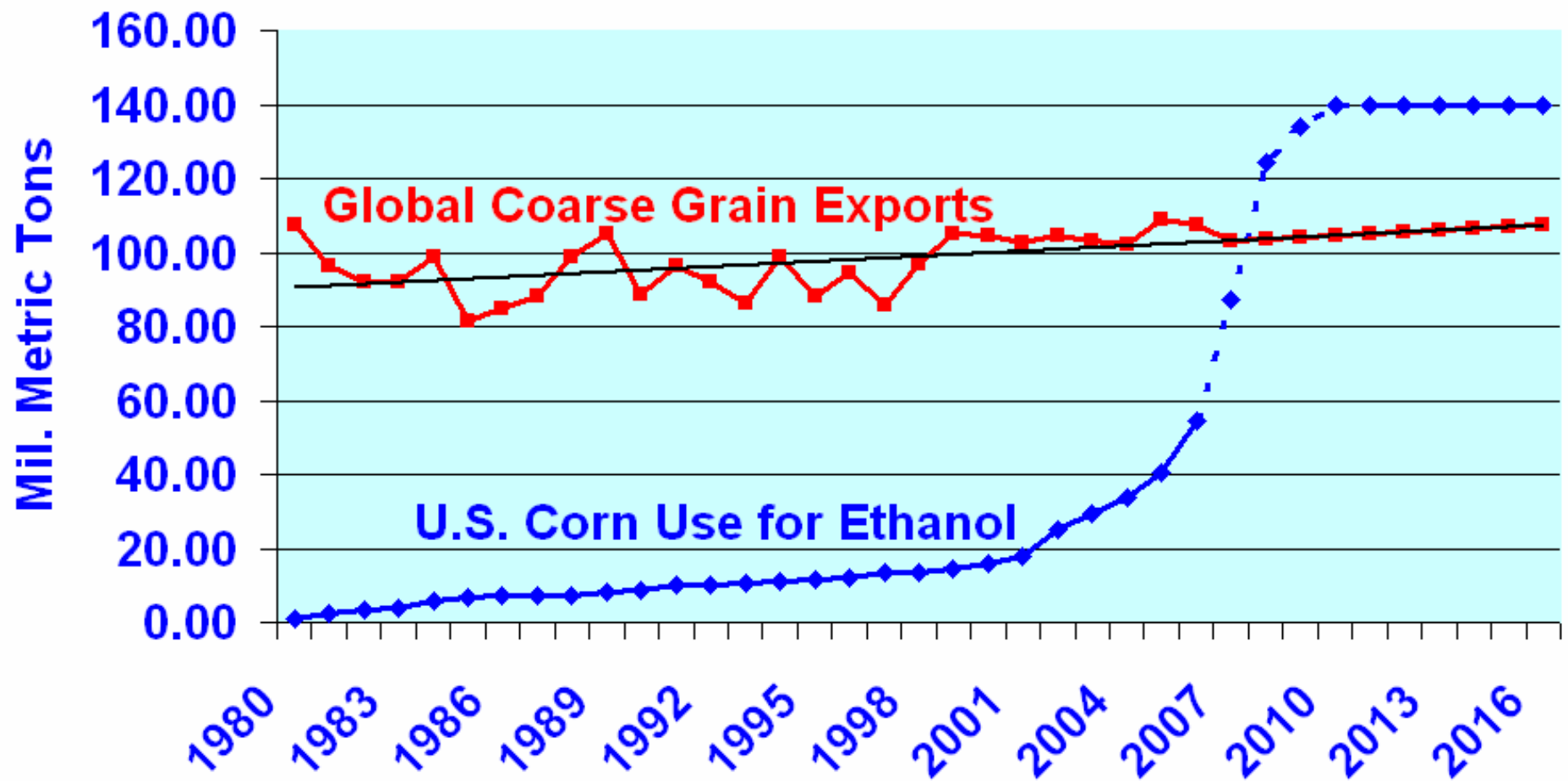
Figure 1. USDA Feb. '07 & Previous 10-Yr. Projections of Corn for Ethanol, Plus Existing & Under Construction Capacity + Likely Construction to 2010



International Impacts

- **U.S. ethanol plants under construction to use 58 mil. tons of corn (doubling use)**
 - **3.5 times the volume of Japan imports of U.S. corn**
 - **130% of 2006 EU corn crop**
 - **70% of global corn exports**
- **Other countries are expanding ethanol & biodiesel**
- **Strong negative impacts on animal ag.**
- **Sharply higher food costs**
- **Major risk-management challenges in Ag. & bioenergy**

Mil. Tons U.S. Corn Use for Fuel Ethanol & Global Coarse Grain Exports



Other Countries with Ethanol Fuels

- **Canada**
- **China**
- **EU**
- **Thailand**

Countries considering ethanol fuels

- **South Africa**
- **Ukraine**
- **Japan**

Chinese Corn-Ethanol Plant



U.S. Corn-Ethanol Plant



Background of U.S. Bioenergy Programs

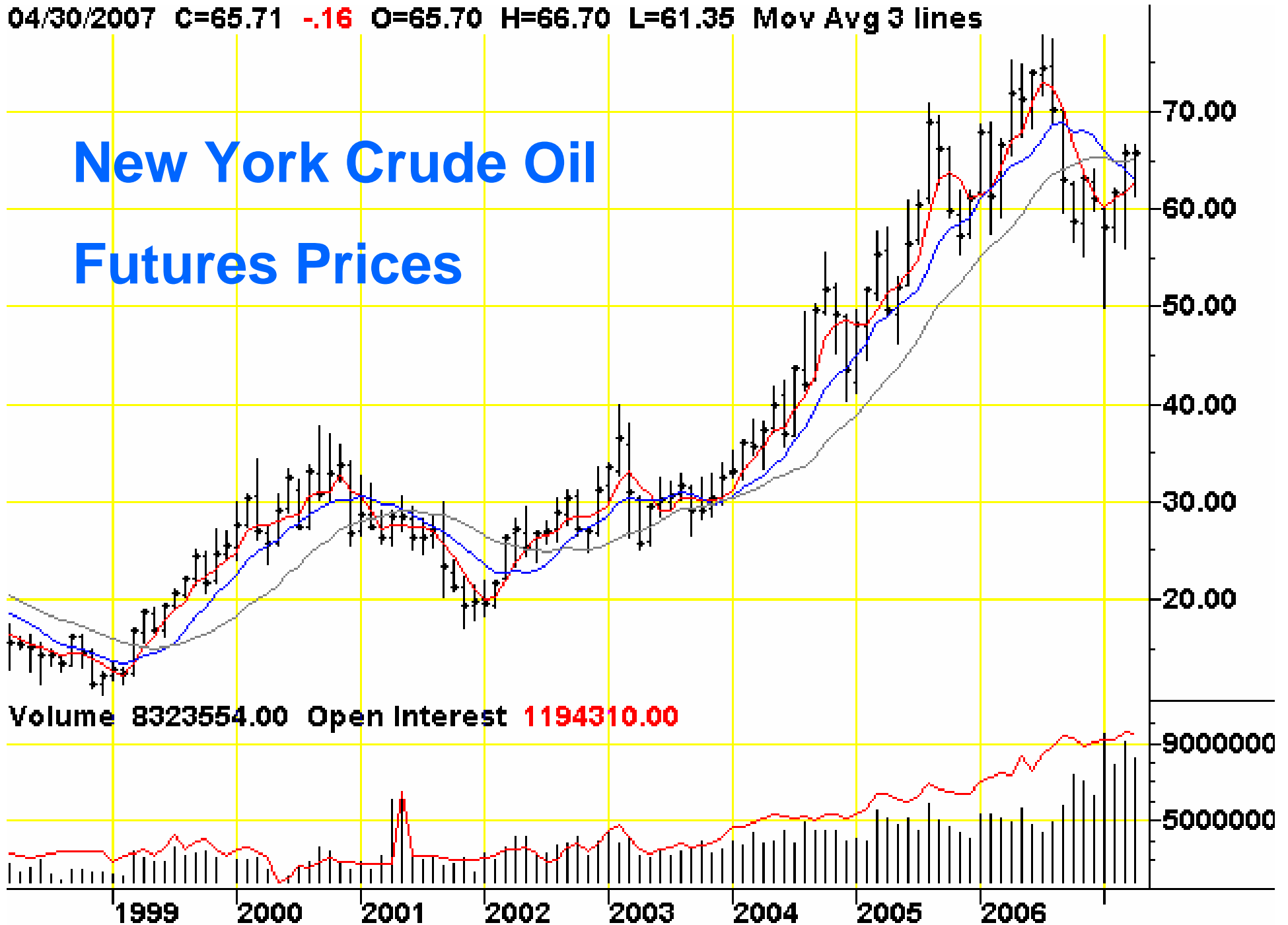
- Began in early 1980s -- corn to ethanol
- Initial technology: wet milling
- Owned by large multinational firms
- Continual expansion since 1980s (except 1995-96 tight corn supplies)
- 10% ethanol, 90% gasoline blend in Midwest
- Ethanol use since 2003 expanding to coasts
- E-85 use small but expanding

U.S. Bioenergy Industries

- 2006-07 growth, 34% annually in ethanol, more rapid in biodiesel
- Primary feedstocks: corn & soy oil
- Investors: farmers, outside firms
- Both political parties strongly support expansion
- Availability of crop land -- limiting factor
- Some cellulose-ethanol plants being planned
- 10% ave. U.S. ethanol/gas in 4 years
- Major implications for livestock & food prices

04/30/2007 C=65.71 **-0.16** O=65.70 H=66.70 L=61.35 Mov Avg 3 lines

New York Crude Oil Futures Prices



Volume 8323554.00 Open Interest **1194310.00**

Goals of U.S. Bioenergy Programs

- **1980s: expand corn demand**
- **Now:**
- **Facilitate clean air programs**
- **Create rural jobs**
- **Diversify energy sources**
- **Create closed carbon circuit,
recycling CO²**
- **45% of U.S. gasoline has ethanol blend**

Corn-ethanol only partial solution to energy challenges

- **Other feedstocks needed**
 - Municipal wastes
 - Animal agriculture wastes
 - Forest product wastes
 - New crops
- **New automotive technology**
 - Hybrid gas/electric vehicles
 - New engine & vehicle designs
 - Hydrogen fuels & fuel cells
- **Diversification of energy sources**
- **Incentives for increased mass transportation**
- **Wind power use increasing**

U.S. government incentives for ethanol

- Blending tax credit: \$0.51/gallon (\$0.135/liter)
- Tariff on imports: \$0.54/gal. (\$0.143/liter)
- Rural development loans for small plants
- Operating capital grants up to \$300,000
- State incentives & motor fuel tax reductions
- Local government help for roads, utilities
- Local government property tax exemptions for several years
- Minnesota, Montana E-10% mandate
- Iowa-Minnesota goal of E-20% avg. blend
- Financial incentives for E-85 retail outlets
- Federal mandated production levels

Size of U.S. biofuels industry

- **121 processing plants**
- **About 75 plants under construction or expanding**
- **About 235 more planned**
- **Processes 20% of U.S. corn crop for motor fuel**
- **Potential corn for ethanol, Sept. 2007-Aug. 2008: 30% of 2006 crop**
- **High corn prices pull land from other crops**

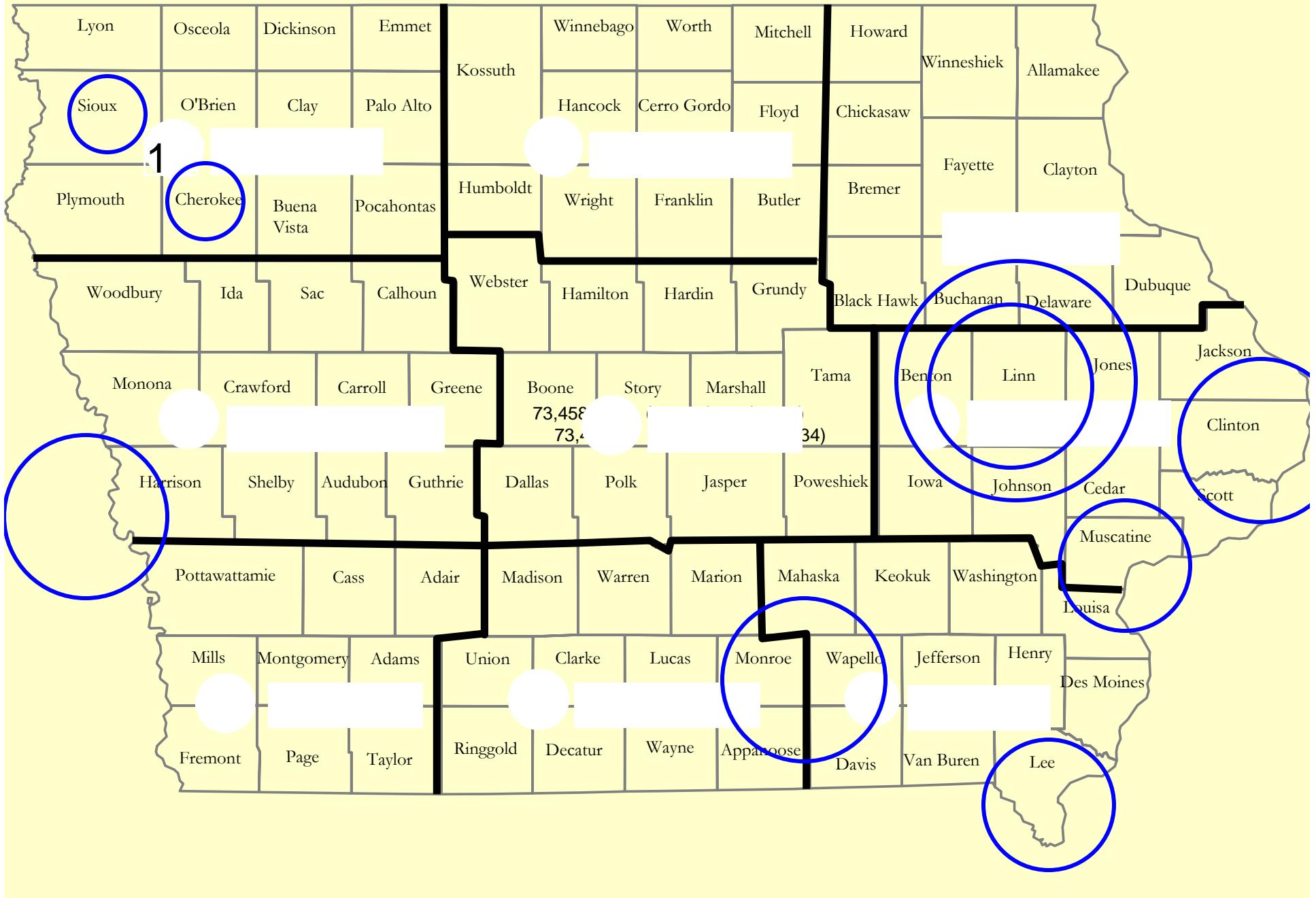
Products of ethanol industry

- ***Ethanol***
- **Ethanol yield: 2.75 gal./bu., 410 liters/metric ton of corn**
- ***CO₂***
- ***Dry Distillers Grain & Solubles (DDGS)***
 - **0.3 ton/ton of corn**
 - **Protein content: 24-26%**
 - **Limited in some amino acids**

Corn Processing Plants in and Near Iowa, 5/04/07, Est. Mil. Bu.			
Processing Capacity, Ethanol & Other Processing Excl. Feed			
Operating Plants		Planned or under construction, II	
Albert Lea, MN*	15	Ashton - E	20
Albert City	36	Atlantic - P	19
Ashton	36	Belmond - P	38
Blair, NE*	32	Blair, NE* - E	38
Blairstown	3	Blenco - P	38
Cedar Rapids	203	Buffalo - P	38
Charles City	40	Butler County - P	36
Clinton	180	Burlington expansion E	36
Coon Rapids	18	Cedar Rapids -Penford - C	15
Corning (may go to 38 mil. Bu.)	23	Columbus Junction- P	27
Denison	20	Coon Rapids - E- P	20
Eddyville	76	Council Bluffs - C	42
Emmetsburg	19	Creston - P	18
Faribank	38	Des Moines P	38
Ft. Dodge	40	Dexter - C	38
Galva	10	Dyersville- P	37
Goldfield	19	Emmetsburg- E	18
Gowrie	22	Fairmont, MN (1/2 of 76 mil. Bu.)* C	38
Hanlontown	20	Ft. Dodge new plant - P	73
		Ft. Dodge Expansion - C	38
Hopkinton (Uses sugar & strach)	0	Garner-P	38
Iowa Falls	40	Green County - P	70
Jewell	24	Grinnell - C	38
Keokuck	47	Hancock co.-P	38
Lakota	36	Hartly - C	40
Luvurne, MN*	8	Hinton - P	38
Marcus	18	Manchester- P	38
Mason City	18	Marcus expansion - E	18
Muscatine	49	Marion co. - P	20
Nevada	19	Marshaltown - P	38
Sioux Center	8	Merrill - C	18
Steamboat Rock	7	New Hampton - P	18
W. Burlington	19	Odebolt - P	45
Sub-total, operating	1,088	Ogden - P	36
*Total excludes out-of-state		Ottumwa - P	18
Processing		Pleasantville- P	38
P = Proposed, C = Under Construction,		Pocohontos Co. - P	38
E= Expansion of existing plant		Quad Cities - Galva, IL 38- P	38
Planned, Part I		Red Oak - p	18
ADM Expansion (cedar rapids & clinton)	190	Salix - P	19
Akron - P	38	Shenandoah - C	18
Arthur - P	36	Spencer - P	38
Wesley - P	37	Staceyville - P	38
W. Des Moines - P	36	St. Ansgar - C	38
		Superior - C	18
		Tama - C	38
Partial Sub-total, planned	337	Winnesheik county - P	38
		Total, planned	1,776

Iowa Corn Processing, 5/3/07				No. plants	Mil. Bu.	of '06 Crop
Total operating				30	1,088	53.1%
Total Under Construction or expansion				10	447	21.8%
Total Planned, not yet under construction				33	1,329	64.8%
Grand Total (adjusting for plant expansions)				70	2,864	139.7%

Iowa Corn Processing Plants, 2002



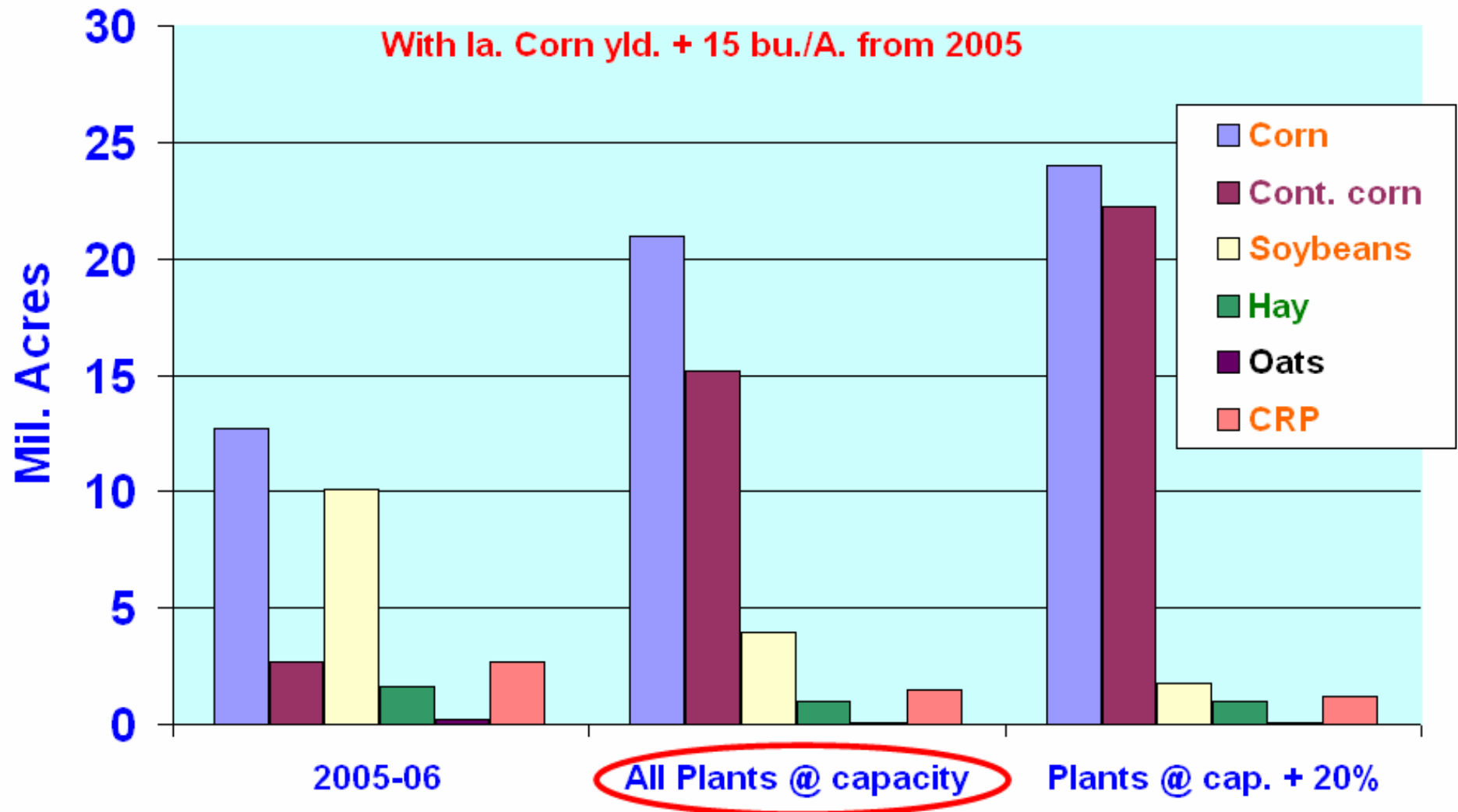
Iowa Corn Production, Use & Excess for Export out of State, Mil. Bu.

5/04/07	2005-06 06/06 processing Capacity	Current & Planned plants @ rated capacity	Current & Planned plants @ 120% capacity
2005 corn crop	2,163	2,163	2,163
Less feed use	700	700	700
Less processing	1,088	2,864	3,437
Plus corn replaced by DGS	45	45	45
Avail. For Export	420	-1,356	-1,929
2006 Mil. Harv. Acres	12.4		
Yield, 2005, Bu./A.	173		
2005 Trend Yield, Bu./A.	159		
2009 Trend Yld., Bu./A.	167		
Yield needed to maintain exports (@ '05 A.)		317.7	363.9
Acresage needed @ 2005 yield		22.8	26.1
Acresage needed @ 2009 trend yield		23.6	27.0
Acresage needed @ 2005 yield+15 bu./A.		21.0	24.0
2006 Iowa acres:	corn	12.7	12.7
Mil. Planted A.	soybeans	10.1	10.1
	Oats	0.2	0.2
	Hay	1.6	1.6
	Returning CRP est.	1	1
At 2005 corn yld. + 15 bu.:	Total acres	25.6	25.6
Implied Soybean Acres*		5.8	1.7
Change in Corn Acres vs. 2006		10.1	13.4
Acres of Corn after Corn	2.7 mil. A.	15.2	22.3

*Needed corn Acres @ 188 bu./A. state avg. in 2010

5/04/07

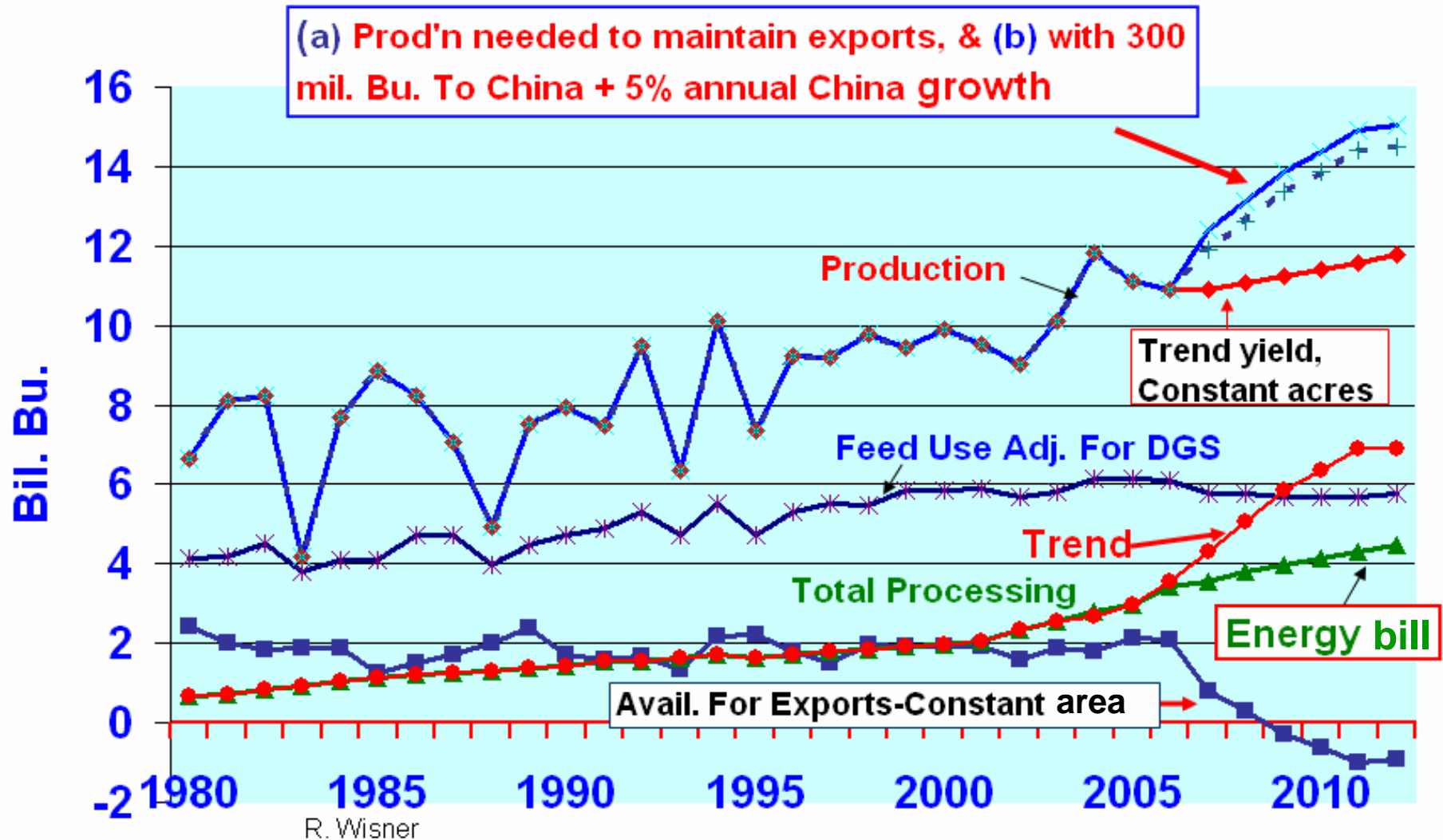
Iowa Current & Potential 2012 Crop Acreages



5.5 Bil. Bu for ethanol

Figure 3. U.S. Corn Production, Domestic Use, & Availability for Exports--Proj. to 2012

10-16-06



How Much More U.S. Construction to Reach 5.5 Bil. Bu. (140 mil. T.) Corn for Ethanol?

- **Operating plants:**
 - 2.15 Bil. Bu. (54.6 mil. Tons)
- **Plants under construction:**
 - 2.0 Bil. Bu. (50.8 mil. Tons)
- **Plants soon to build:**
 - 0.2 Bil. Bu. (5.08 mil. Tons)

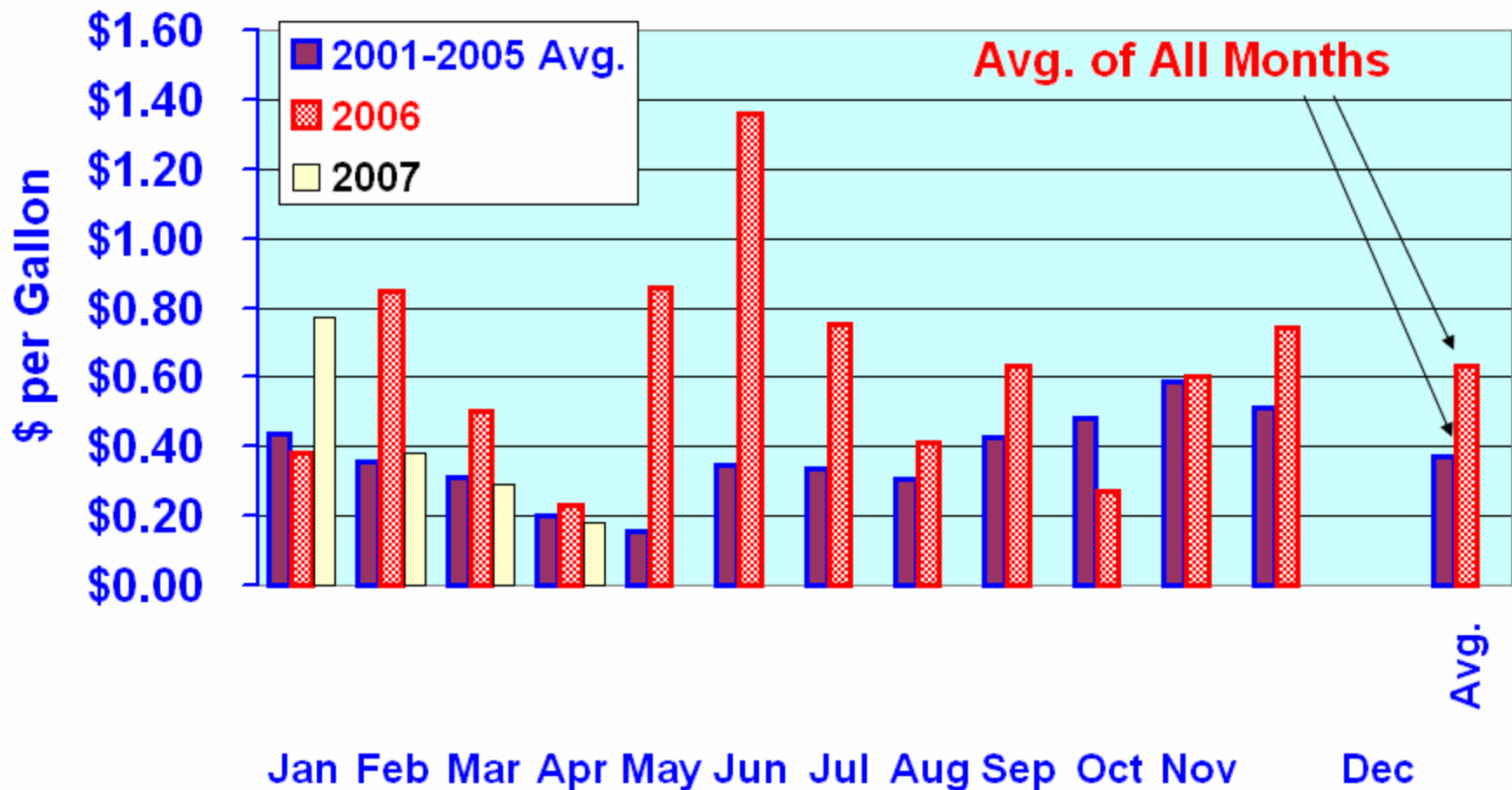
Total: 4.35 Bil. Bu. (110.4 mil. Tons)

Capacity needed:

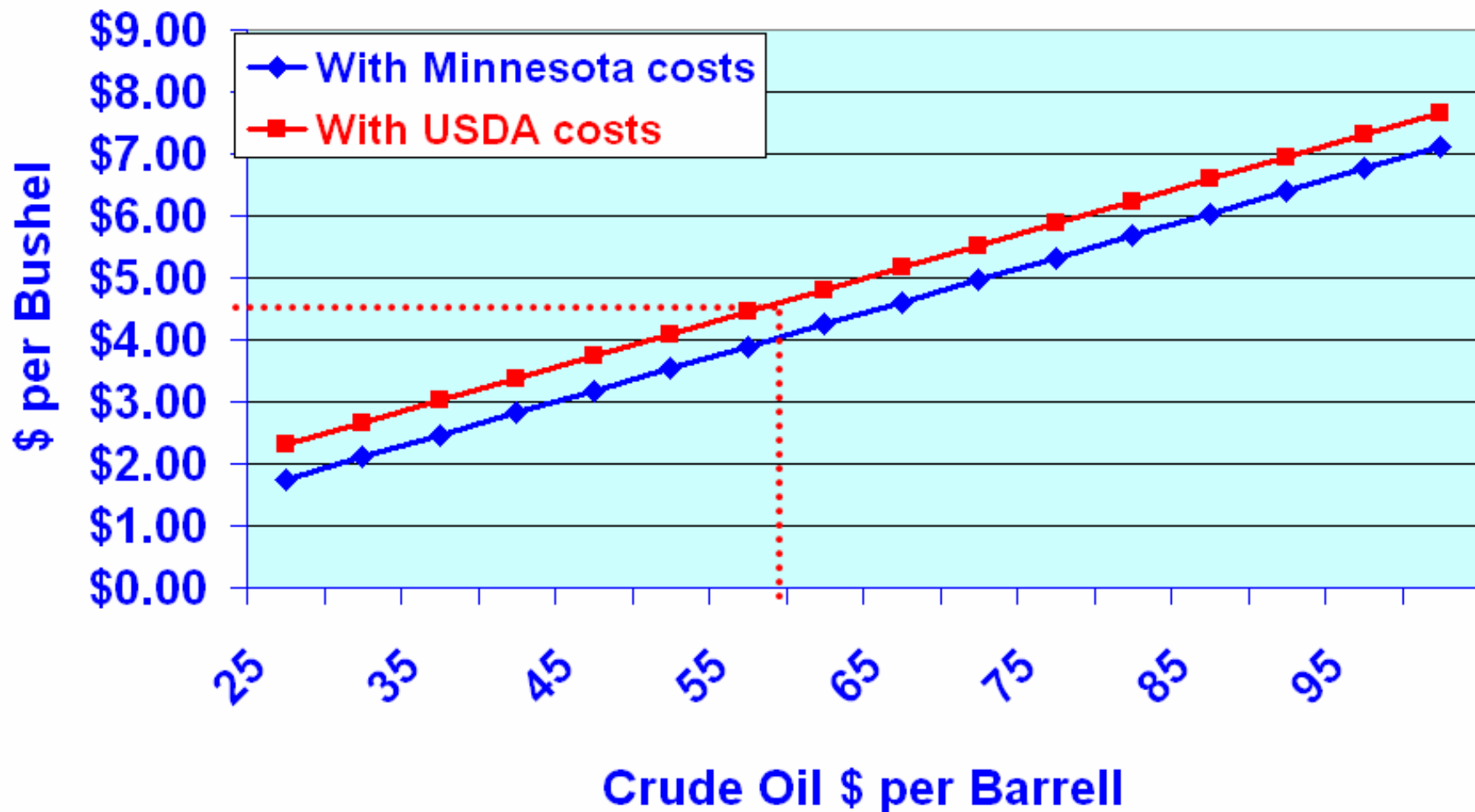
1.15 Bil. Bu. (29.2 mil. Tons)

(About 29 plants @ 423 mil. Liters/yr.)

Monthly Premium of Ethanol over Unleaded Gasoline, Omaha Rack Prices,

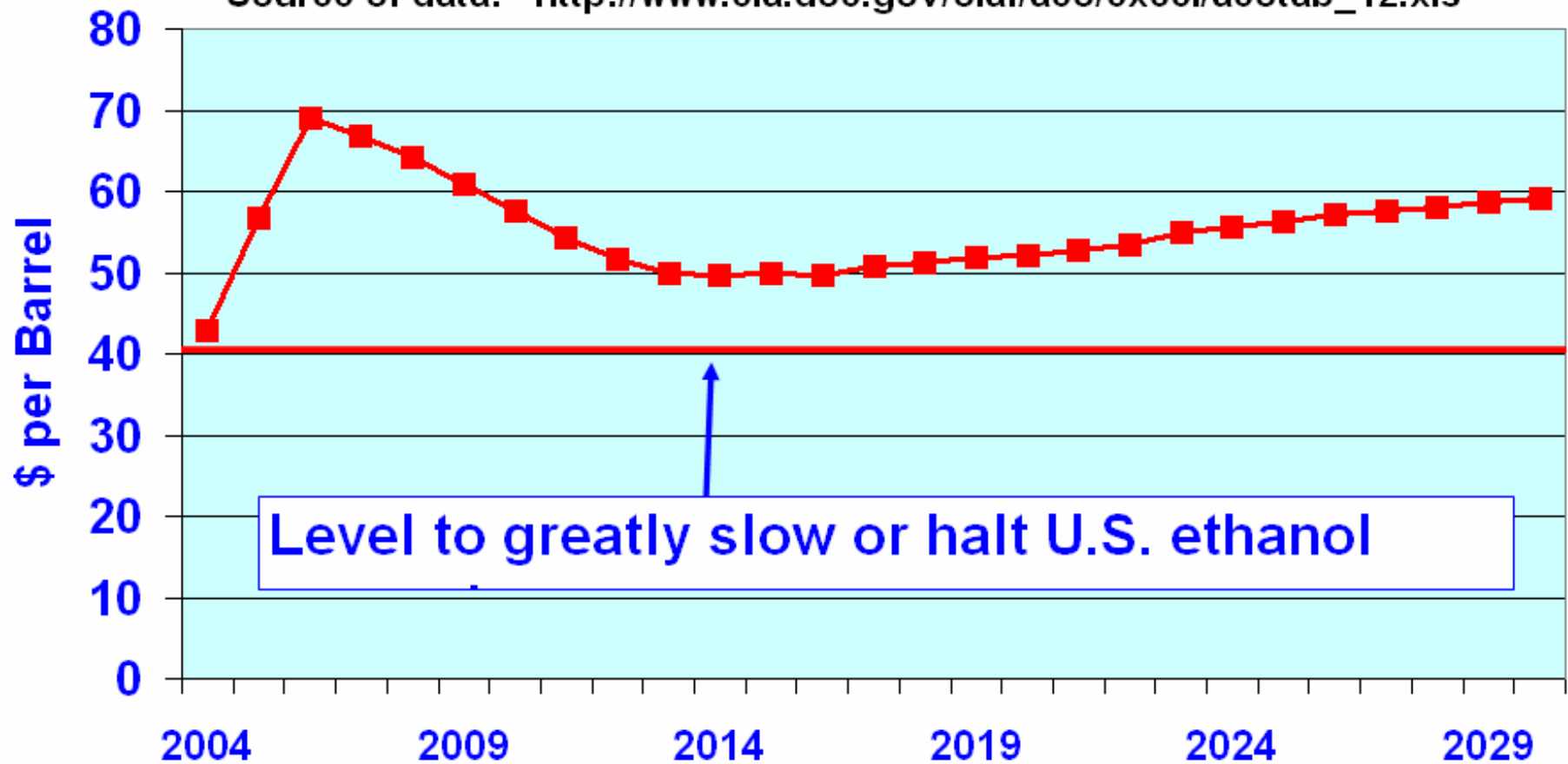


Approximate Maximum Price Ethanol Plants to Pay for Corn with Varying Crude Oil Prices

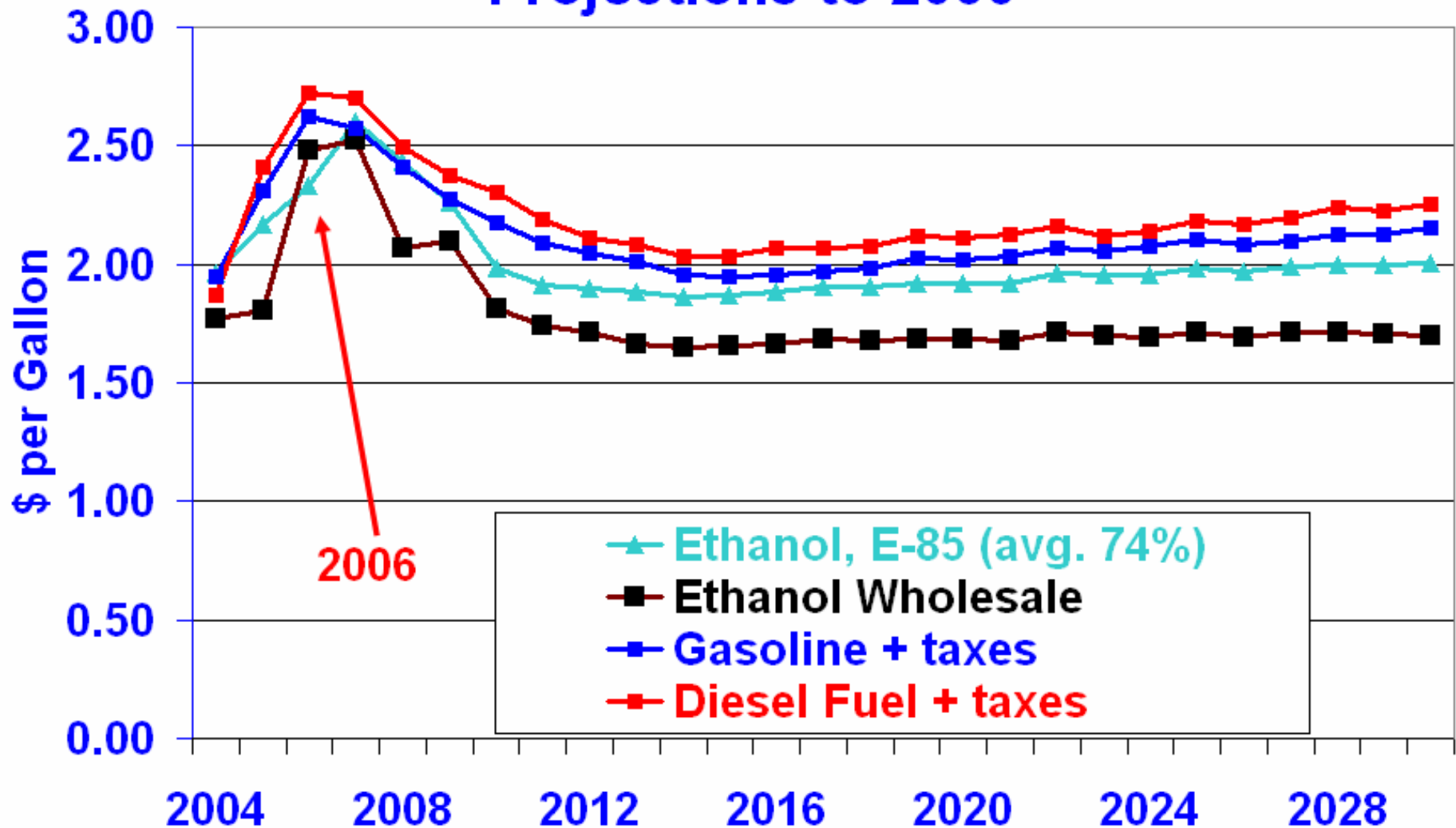


U.S. Department of Energy Crude Oil Price Projections - January 2007

Source of data: http://www.eia.doe.gov/oiaf/aeo/excel/aeotab_12.xls



U.S. Energy Administration Fuel Price Projections to 2030

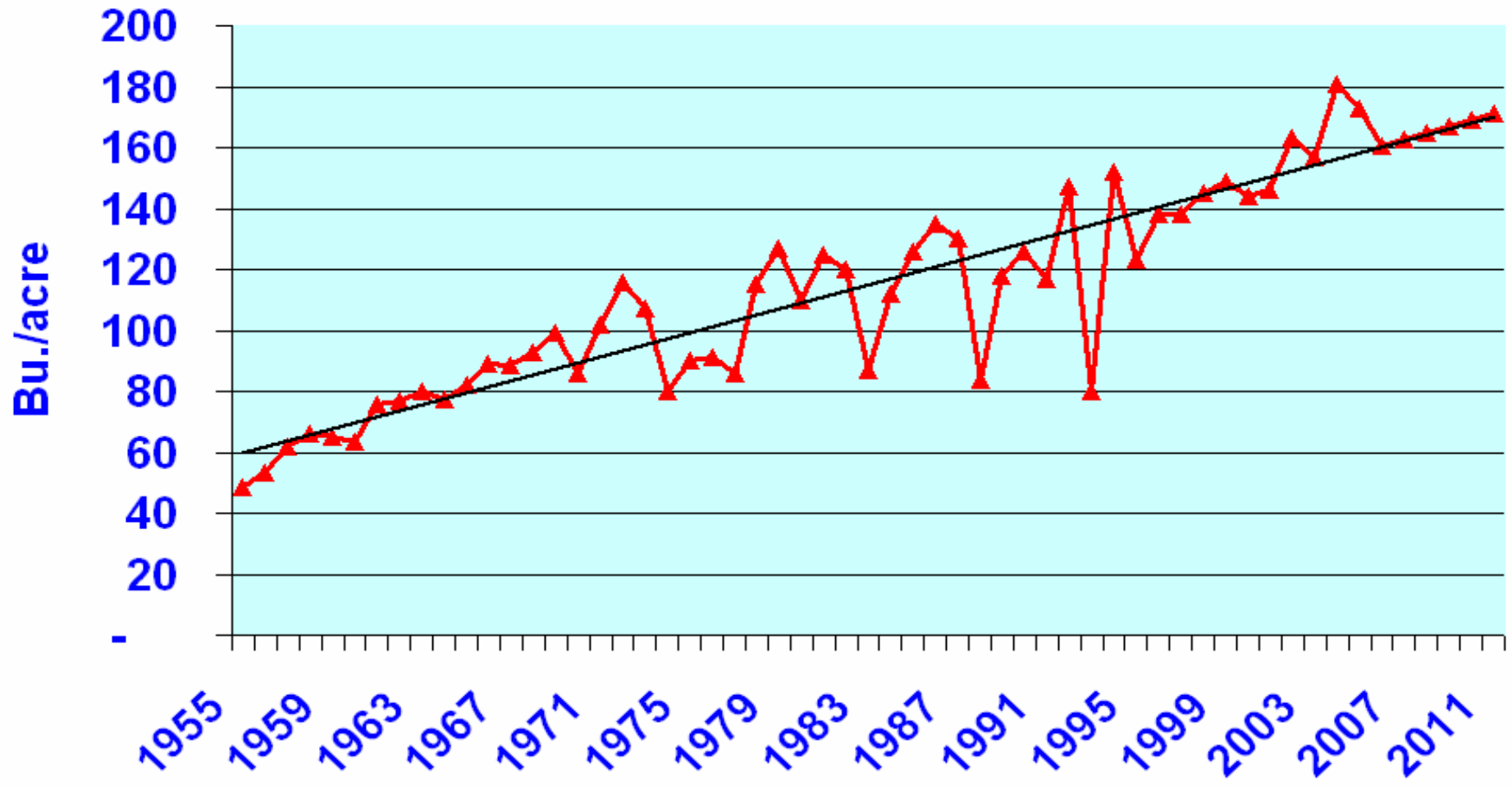


Ethanol Economics

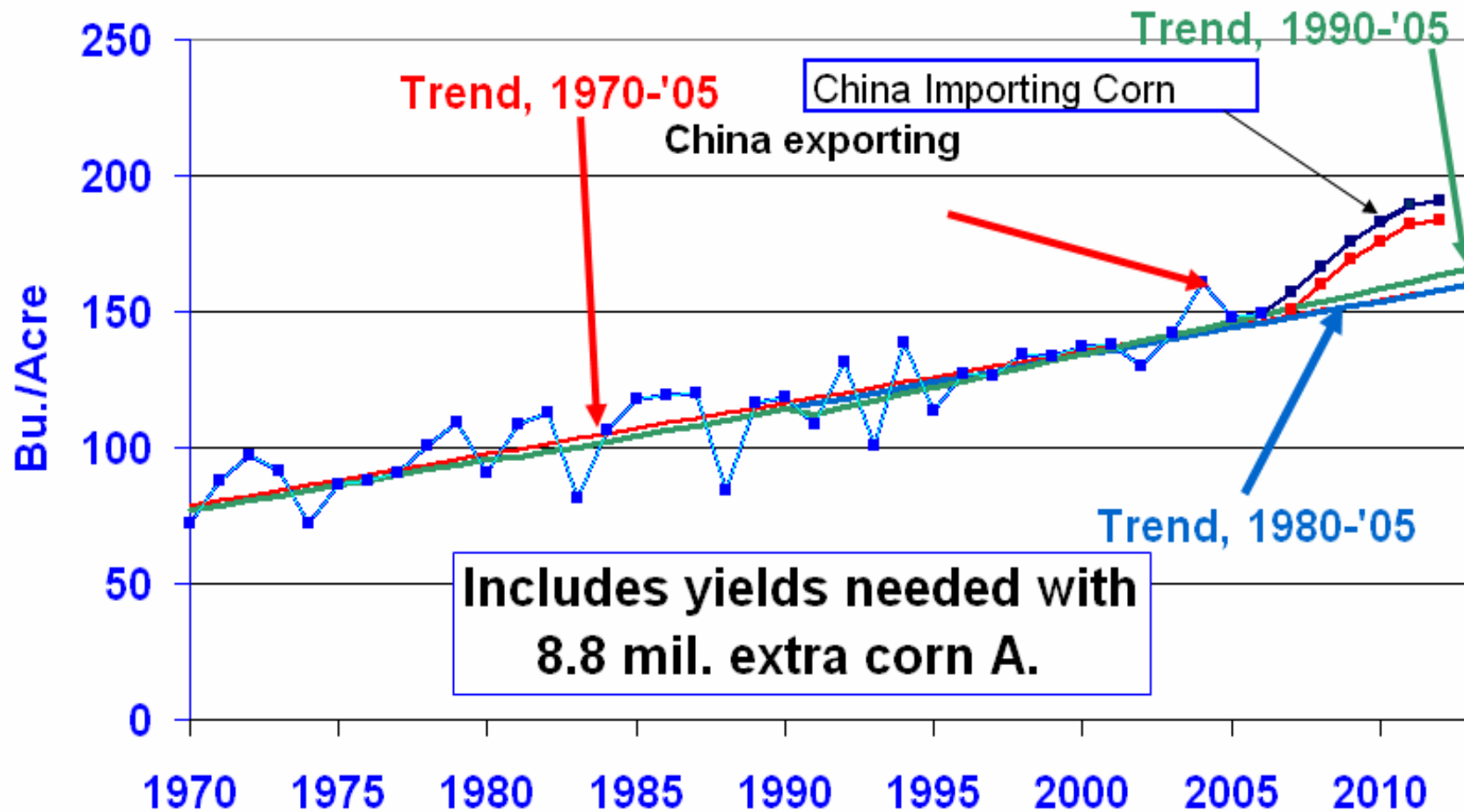
- **\$0.026/liter increase in ethanol price raises break-even Corn price \$11.03/ton**
- **\$39.40/ton rise in corn price increases cost/gal. \$0.095/liter**
- **Ethanol prod'n cost \$0.318/liter (Univ. of Minnesota-@ \$80/ton corn)**
- **May 8, '07 Iowa ethanol price: \$0.556/liter**
- **Recent margin: \$0.143/liter (34%) (incl. \$0.119/liter subsidy)**
- **Drops to zero @ corn price of about \$200/ton in IA -- up 48-50% from May 4 price**
- **Other variables: DDGS price, Natural Gas**
- **Note: Plant construction costs have risen sharply**

Needed Yld. @ current Acres

Iowa Corn Yield Per Acre



140 Mil. Tons Corn for ethanol
**Figure 2. US CORN YIELD 1970-2005 &
Projected to 2012**



5.5 Bil. Bu. For Ethanol

Figure 4. Extra U.S. Corn Acres Needed to Maintain Exports & Projected Ethanol

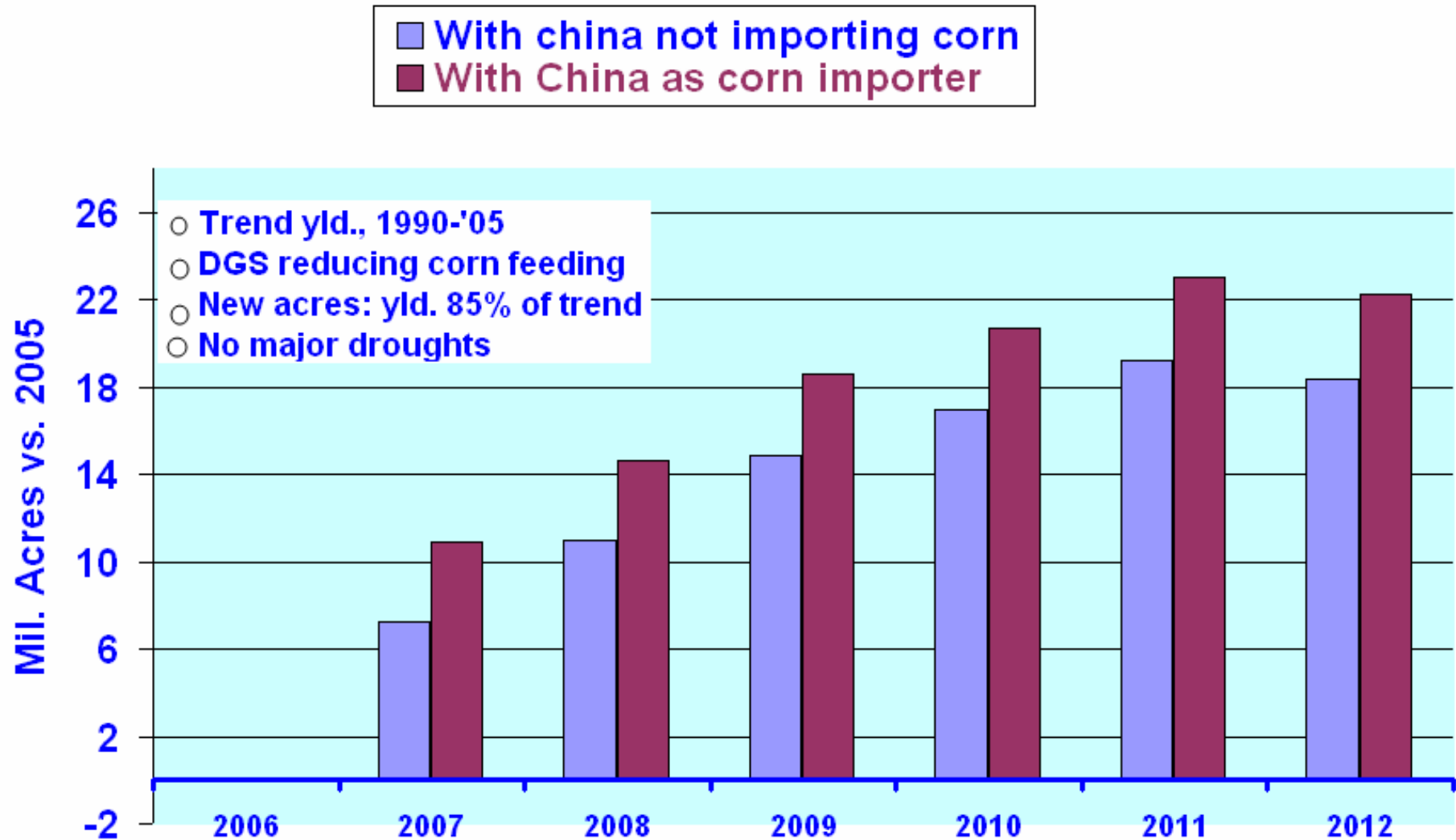
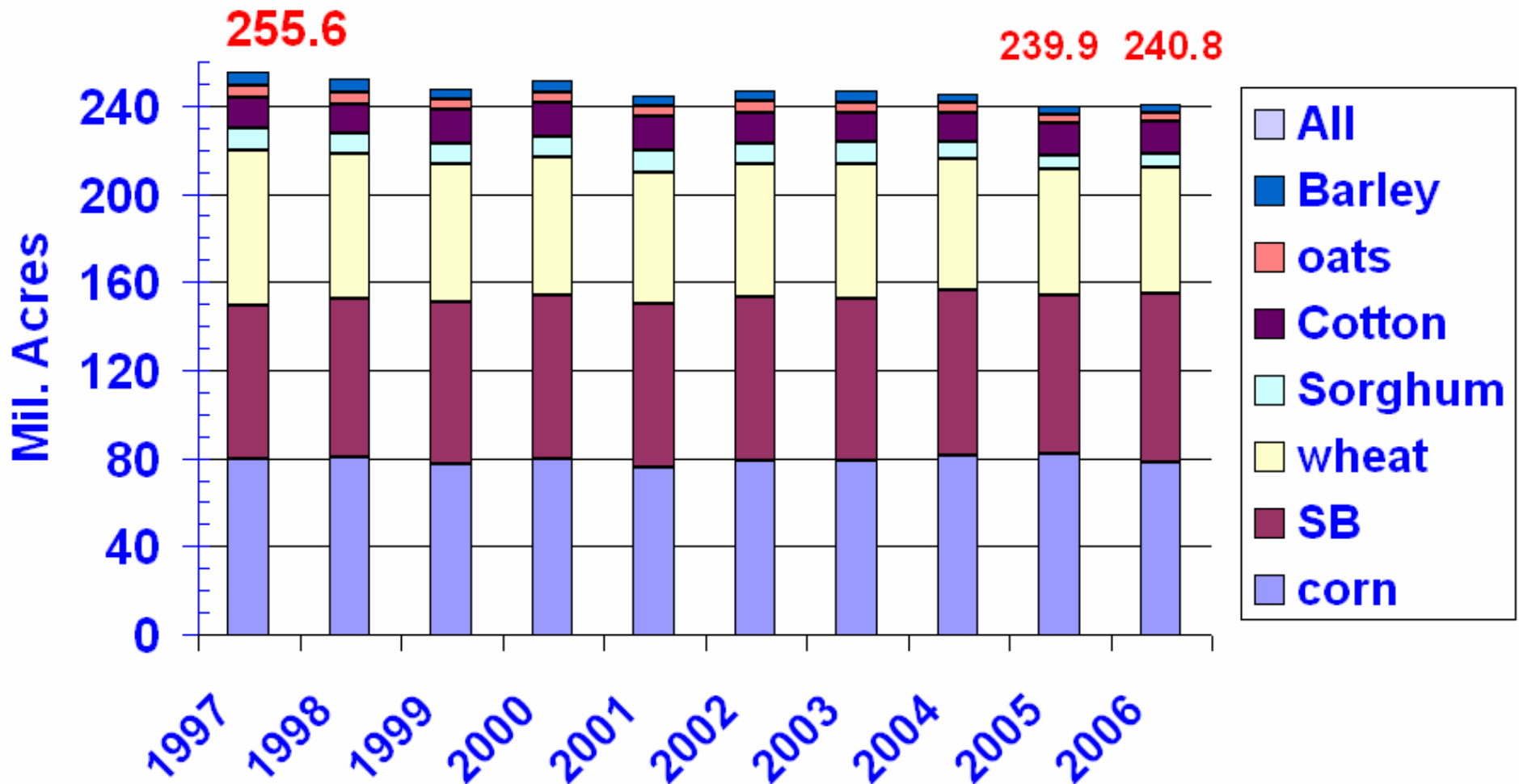


Figure 3. U.S. Planted Acreage of Major Grains, Oilseeds, and Cotton

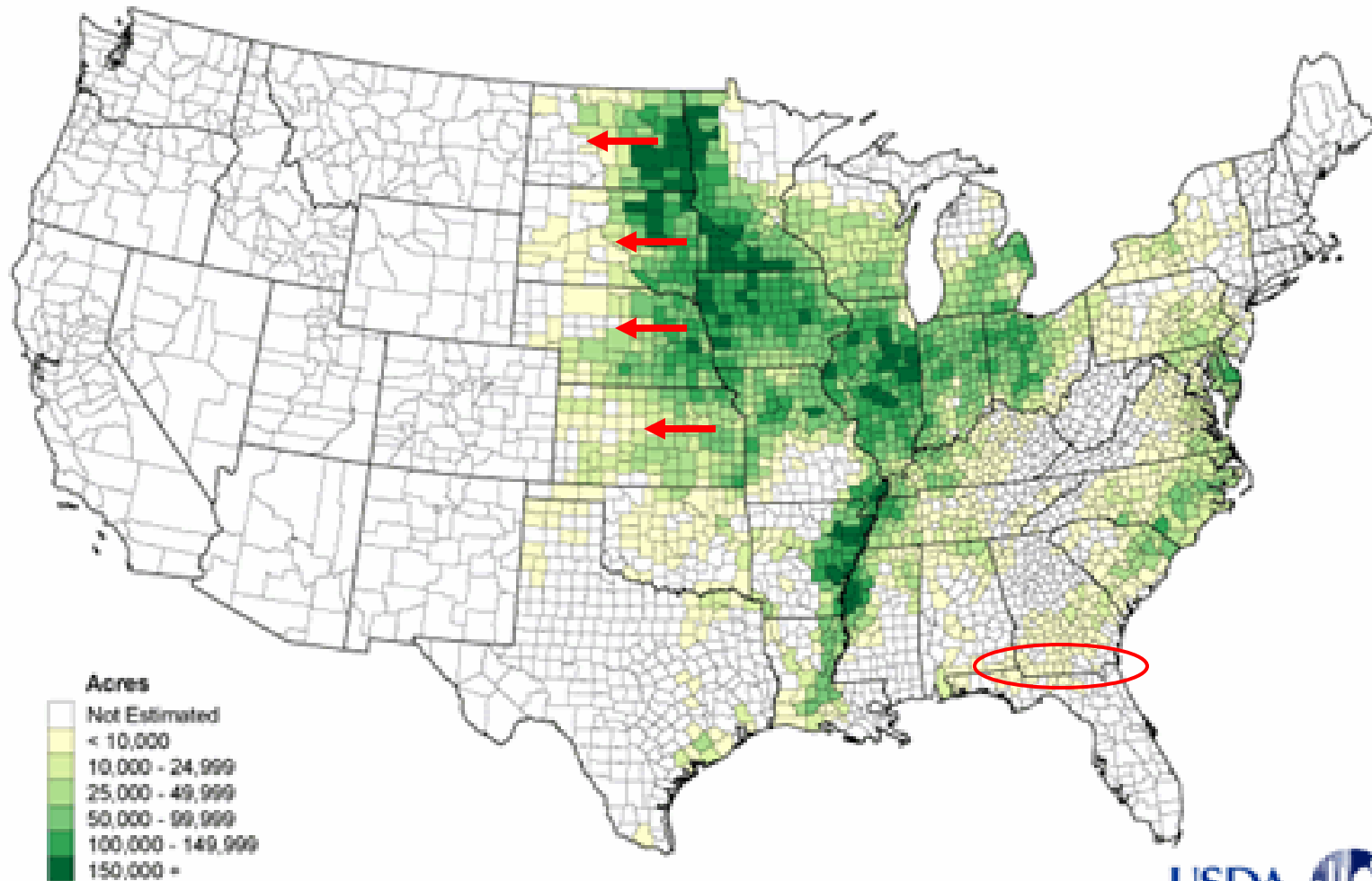


Source of data: USDA, NASS

Potential CRP Acres for Corn?

	Mil. Acres
ILLINOIS	1.03
INDIANA	0.29
IOWA	1.92
MICHIGAN	0.26
MINNESOTA	1.76
MISSOURI	1.55
OHIO	0.29
Total	7.10
Includes wetlands, buffer strips, etc.	

Soybeans 2004 Planted Acres by County



U.S. Department of Agriculture, National Agricultural Statistics Service



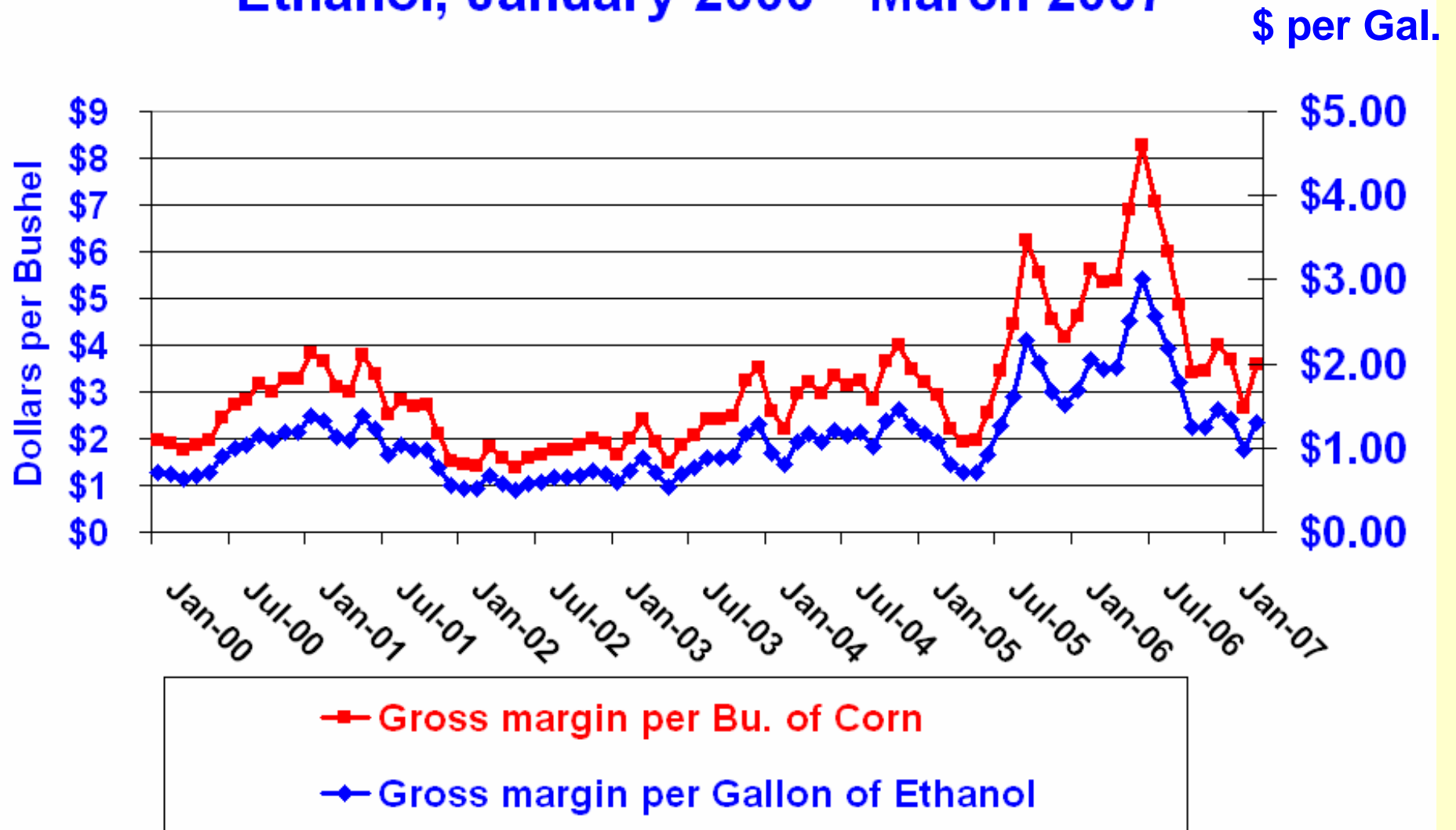
How Weather Resistant is Today's Corn?

	Avg. Corn Yield/Bu.		% chg. Vs.
	2001	2002	2001
IL	152	136	-10.5%
IN	156	121	-22.4%
KS	127	116	-8.7%
KY	142	102	-28.2%
MO	133	105	-21.1%
NE	147	128	-12.9%
NC	125	83	-33.6%
OH	138	88	-36.2%
PA	98	68	-30.6%
SD	109	95	-12.8%
TN	132	107	-18.9%
TX	118	113	-4.2%
US	138.2	130	-5.9%
Trend Yld. 25 yr.	138	140	
Trnd. 1970-05	137.3	139.2	

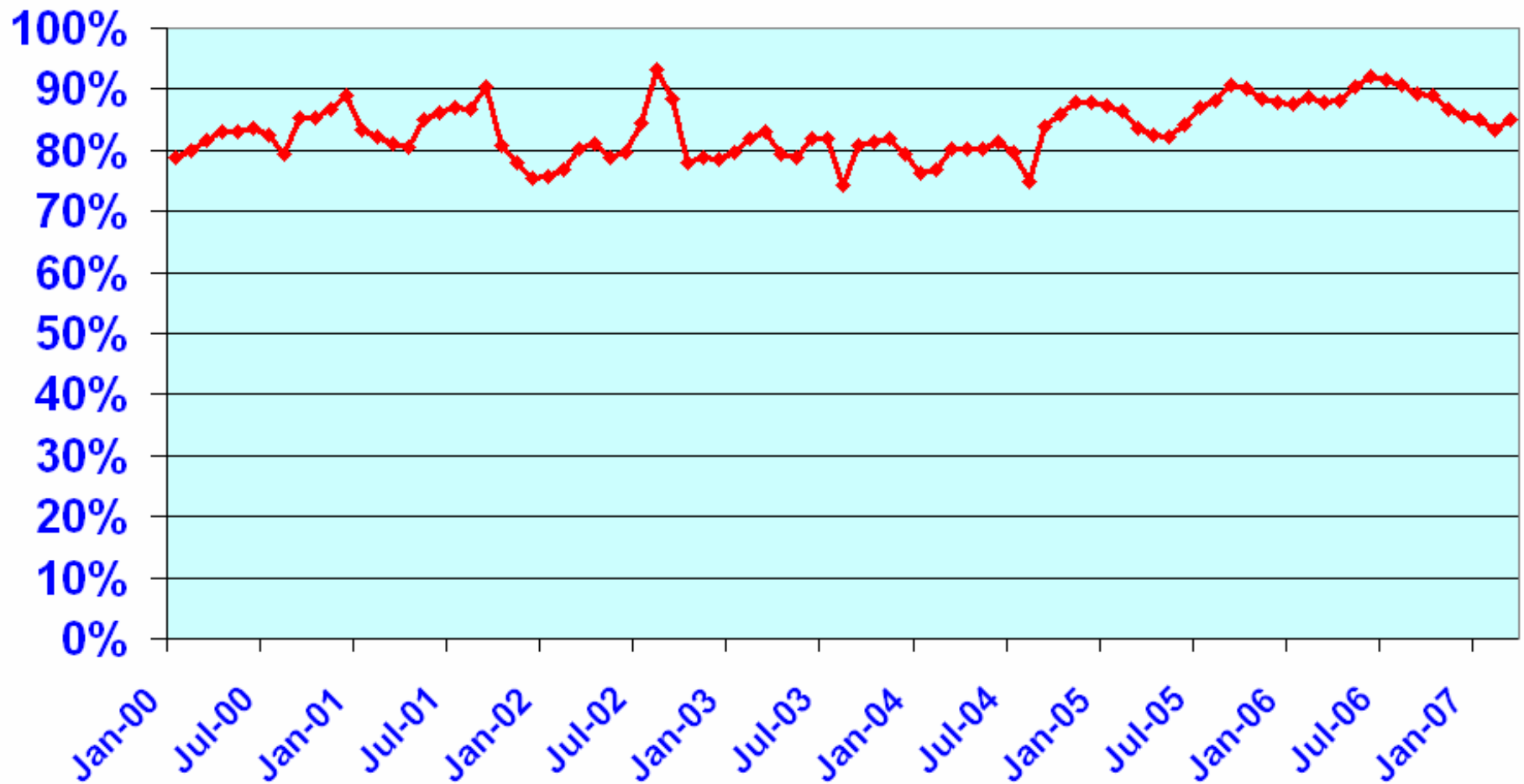
Illinois Corn Yields Drought Tolerant?

	<u>2004</u>	<u>2005</u>	% chg.
• NW	184	140	-24
• NE	174	129	-26
• WEST	192	141	-27
• E.SE.	175	139	-21
• SW	158	133	-16
• SE	158	130	-18

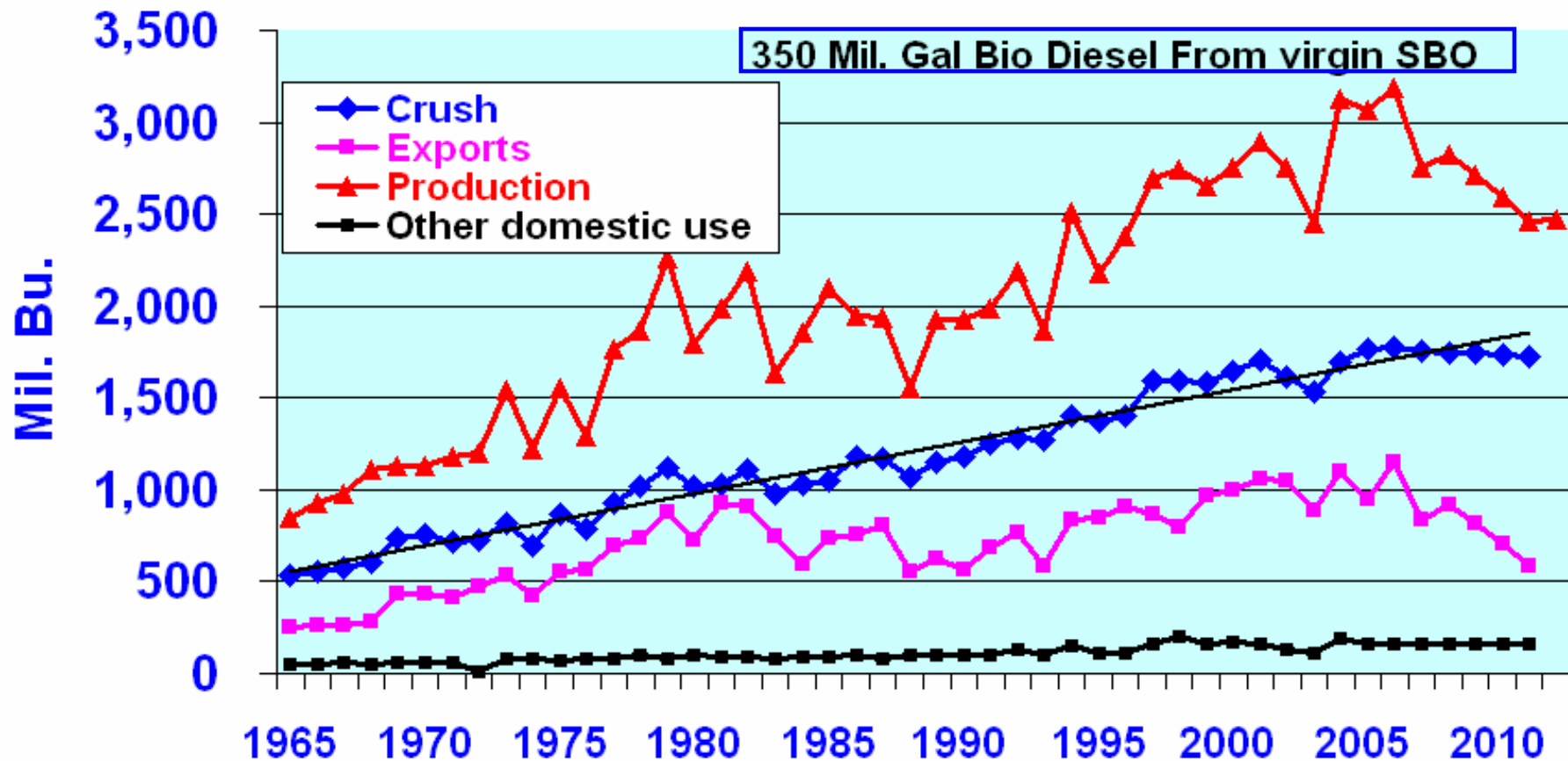
Iowa Gross Processing Margins for Ethanol, January 2000 - March 2007



Iowa Ethanol Plants: Percent of Total Revenue Originating From Ethanol Sales



**Figure 6. U.S. Soy Production, Use, & Exports to 2012
With 5.5 bil. Bu. Corn for ethanol**

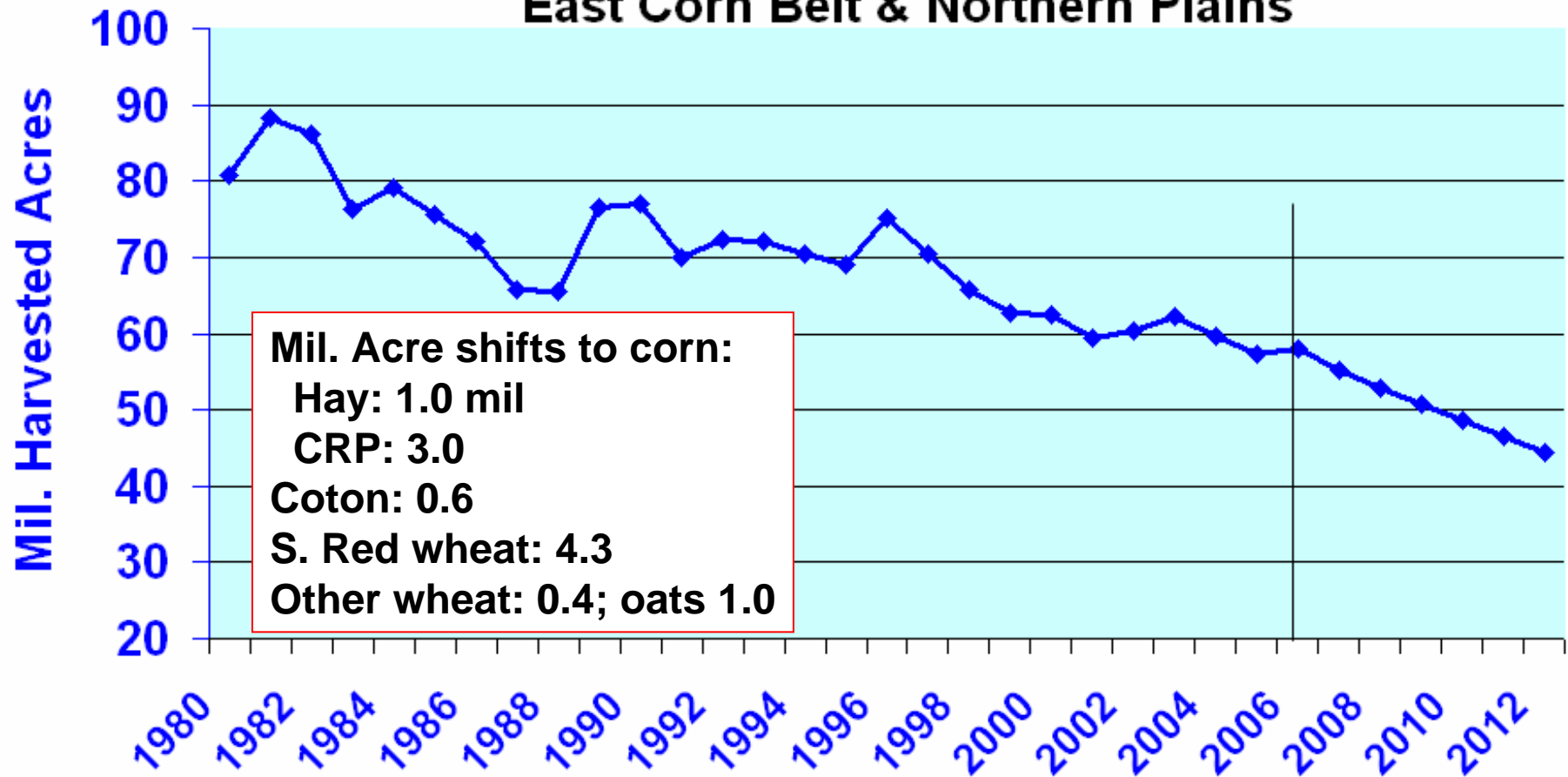


Assumes trend yields. Increased DGS Prod'n in 2012-13 replaces soybean meal from about 440 mil. bu. of soybeans

9/06/06

5.5 bil. Gallons of Ethanol U.S. Wheat Acres & Projections to 2012 With Expanding Corn Ethanol

Wheat acres shift to soybeans, & to corn in
East Corn Belt & Northern Plains



5.5 Bil. Bu for ethanol

Potential U.S. DGS demand by 2012

COF @ 20% of ration	7.1 mil. T.
Dairy @ 20% of ration	6.13 mil. T.
Hogs @15% of ration	6.72 mil. T.
Total	19.95 mil.T.

Potential production 46.8 Mil. T.

With 6.5 bil. Bu.: 51.8 Mil. T

Implications for U.S. and World Livestock, Poultry & Food Costs

- **U.S. supplies 2/3 of world corn exports, 20-25% of wheat & 35-40% of cotton exports**
- **Costs of livestock & poultry feed to double**
- **Large increase in variability of feed & food costs**
- **Food aid availability?**
- **Accelerated ag expansion into areas with fragile eco systems**
- **Shift livestock industries from U.S. to South America?**
- **Rural employment implications in U.S.**

Infrastructure Needs of bioenergy Market (Time Frame: 3 to 4 years)

Sharp Increases in:

- *Inputs for corn production*
- Corn receiving, drying, storage, farm transporting infrastructure
- Efficient rail shipping of ethanol & DDGS
- More tank cars for ethanol movement
- Electric power generation
- Water supply systems
- Research on pipelines for ethanol
- Retail facilities for E-85, E-20 & E-30 stations

U.S. Cellulose Ethanol

- **At least 2 pilot plants being developed**
- **Expect extensive U.S. government emphasis**

Potential Feedstocks:

- **DDGS**
- **Corn stover**
- **Prairie grasses**
- **Forest wastes**
- **Municipal wastes**

Research for Major handling & storage challenges

Environmental Issues for Research: ethanol

- **Impact on groundwater supplies**
- **Long-term effects, mono-culture ag.**
- **Allowable maximum removal of
corn stover & grasses**
 - **Soil erosion impacts**
 - **Soil organic matter impacts**
 - **Diminished wildlife habitats**
 - **Water quality impacts from
more fertilizer**

Key Issues for Agriculture

- **Alternative feedstocks: which ones, how soon?** Biomass, sweet sorghum, sugar beets, high-oil crops, cane sugar, others
- **Differential impacts on livestock & poultry species**
- **Environmental: continuous corn, off-take of biomass, erosion-prone land**
- **Efficient use of distillers grain, including new uses**
- **Risk Management: livestock, crops, ethanol**

Key Issues for Agriculture, II

- **Future transition of corn-ethanol plants to other feedstocks**
- **Policy issues: import tax, blending credit, LDPs, CCPs, E-85 vs. E-10, pipeline possibilities, vehicle redesigning, Hydrogen sources**
- **Global developments: EU biodiesel, Brazil export potential, Asia, S. Africa bioenergy & global grain supply, demand & prices**
- **Infrastructure needs: grain handling & storage, transportation, ethanol & ddgs transport**
- **High Prices encourage oil exploration & conservation**

What Could Change Prospects of Tightening Global Grain Supply?

- Accelerated corn yield increases
- Crude oil price collapse
- Early break-through in economical cellulose conversion
- U.S. Ethanol import tax removed – longer term impacts
- U.S. \$0.51 blending credit reduced or made variable
- Declining global livestock feeding

<http://www.econ.iastate.edu/faculty/wisner/>