

Global Biofuels Developments & Limits to Expansion

8/21/07

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8/21/07

Global Biofuels Developments

- **Dramatic changes emerging in global Ag**
- **Rapid expansion-- in U.S., Brazil, EU**
- **About 90% of Global Ethanol -- from U.S., Brazil**
- **EU leading in biodiesel use**
- **Rapid growth of palm oil production for biodiesel**
- ***Major constraint: cropland availability***
- **Global forces will determine size of industry**

Grain-Oilseed Biofuels Only Partial Solution to Energy Challenges

Need for other bioenergy related research:

- New automotive technology**
- Other biofuels feedstocks – chemistry, handling, environmental**
- New incentives for fuel conservation**
- Other forms of renewable energy**
- Efficient biofuels infrastructure**

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**

41 countries encourage biofuels

Major Countries with Ethanol Fuels

- **U.S.**
- **Brazil**
- **Canada**
- **China**
- **EU-27**
- **Thailand**

Countries considering ethanol fuels

- **South Africa**
- **Ukraine**
- **Japan, others**

Major Countries with Ethanol Fuels

- **U.S.** – likely production of 14-15 bil. gal. from corn in 3.5 to 5 years
- **Brazil** current 5.34 bil gal. –89 new ethanol plants to be built, 2007-2011 (51 under construction)
 - 2% biodiesel mandate by 2008 & 5% by 2013
- **China** – 3 corn-based plants, emphasis shifting to other feedstocks (9 mil. T. maize for ethanol)

U.S. Corn-Ethanol Plant



Chinese Corn-Ethanol Plant

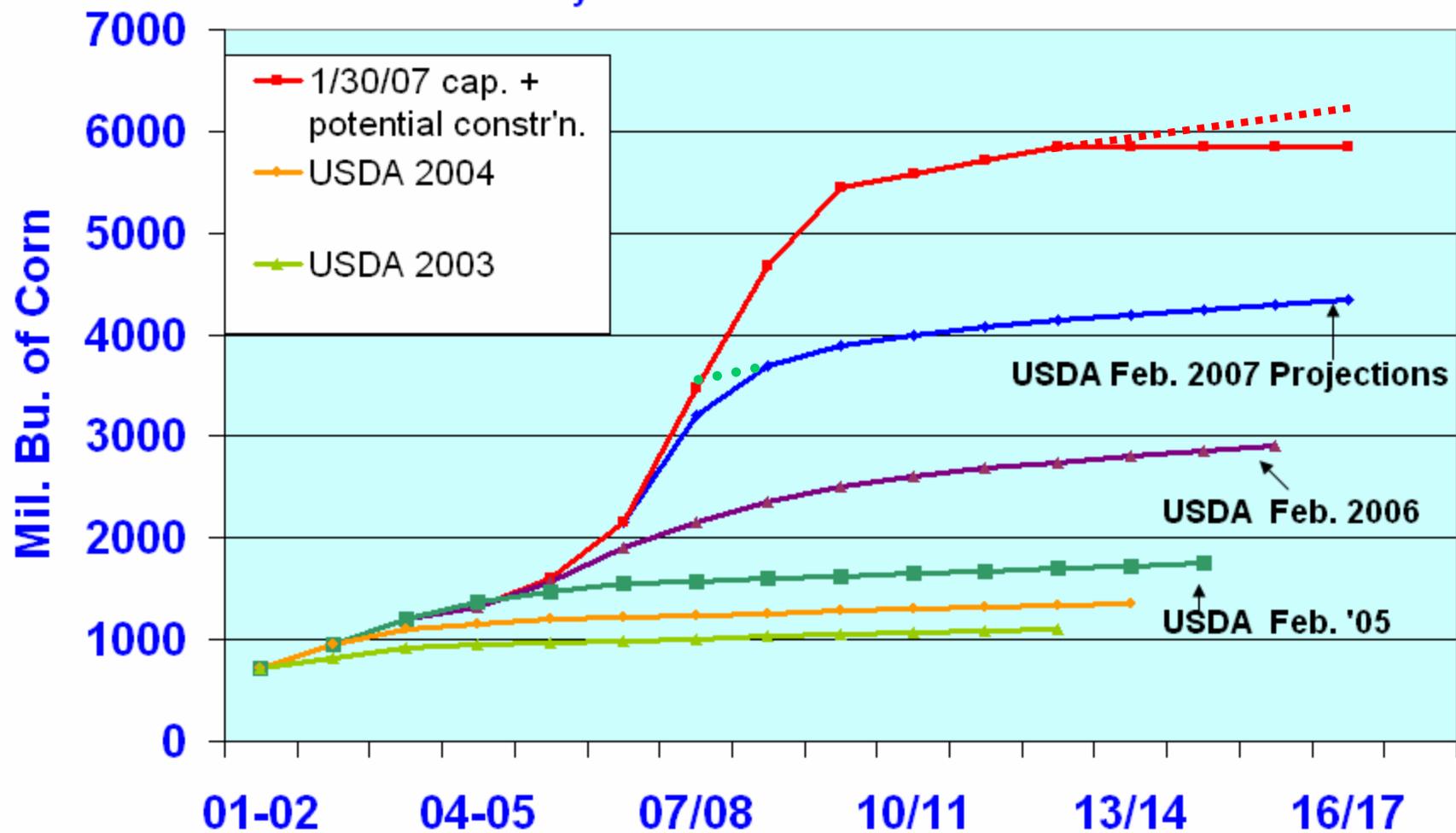


Major Countries with Ethanol Fuels, cont.

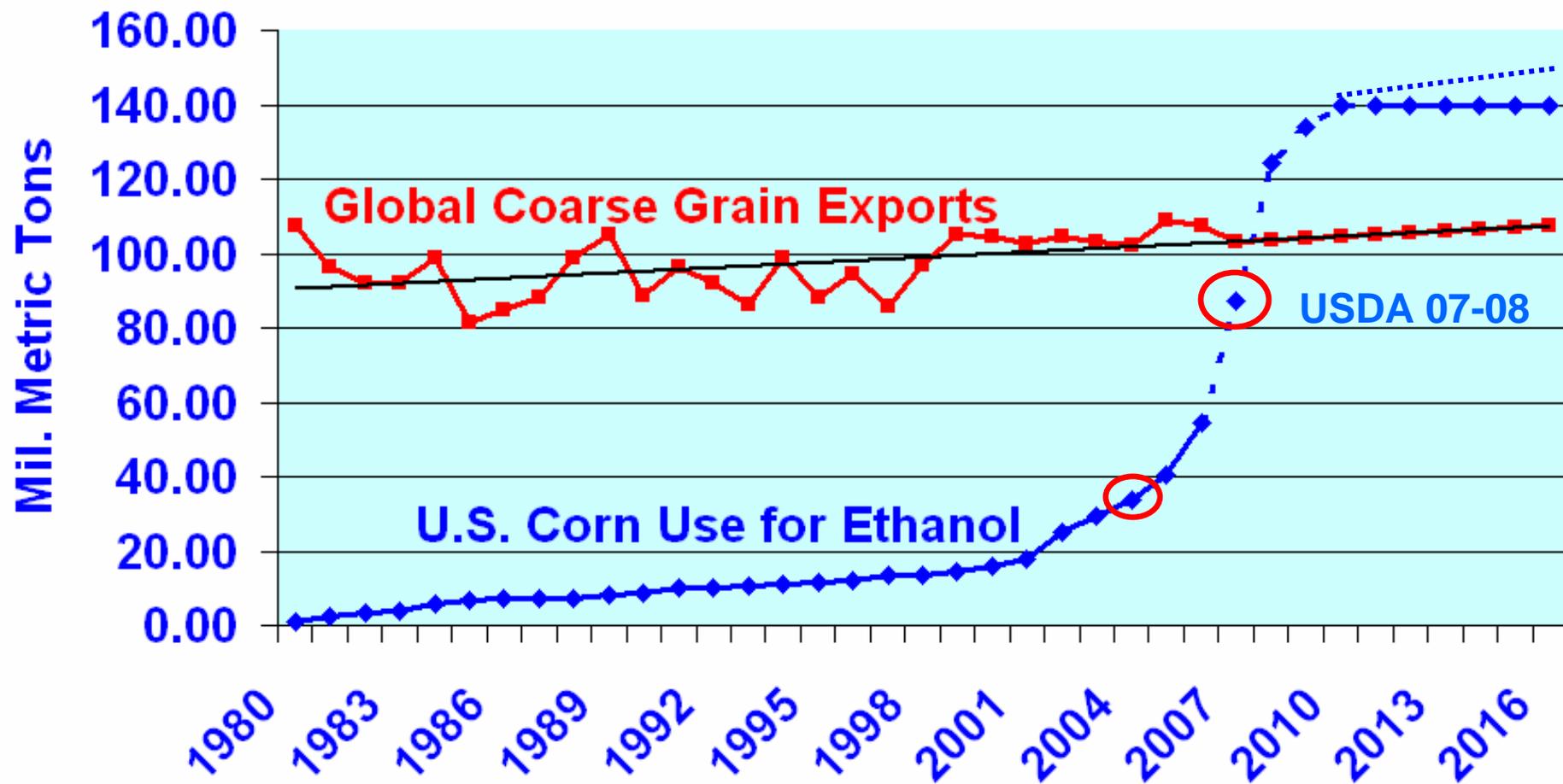
- **EU-27** – 5.75% of motor fuel to be renewable by 2010, 10% in 2020
- **Canada** – 5% ethanol mandate by 2010, 2% biodiesel by 2012
- **Thailand** – ethanol from sugar, casava

Biodiesel– Competition for crop land

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



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



USE OF GRAINS IN BIOFUEL

- **World industrial grain use @ 229 m. tons in 2007-08
up 23%**
- **Almost 107m. tons will be used to make ethanol --
50% above 2006-07**
- **Ethanol production in the EU: smaller (1.6bn. litres
in 2006) but growing rapidly**

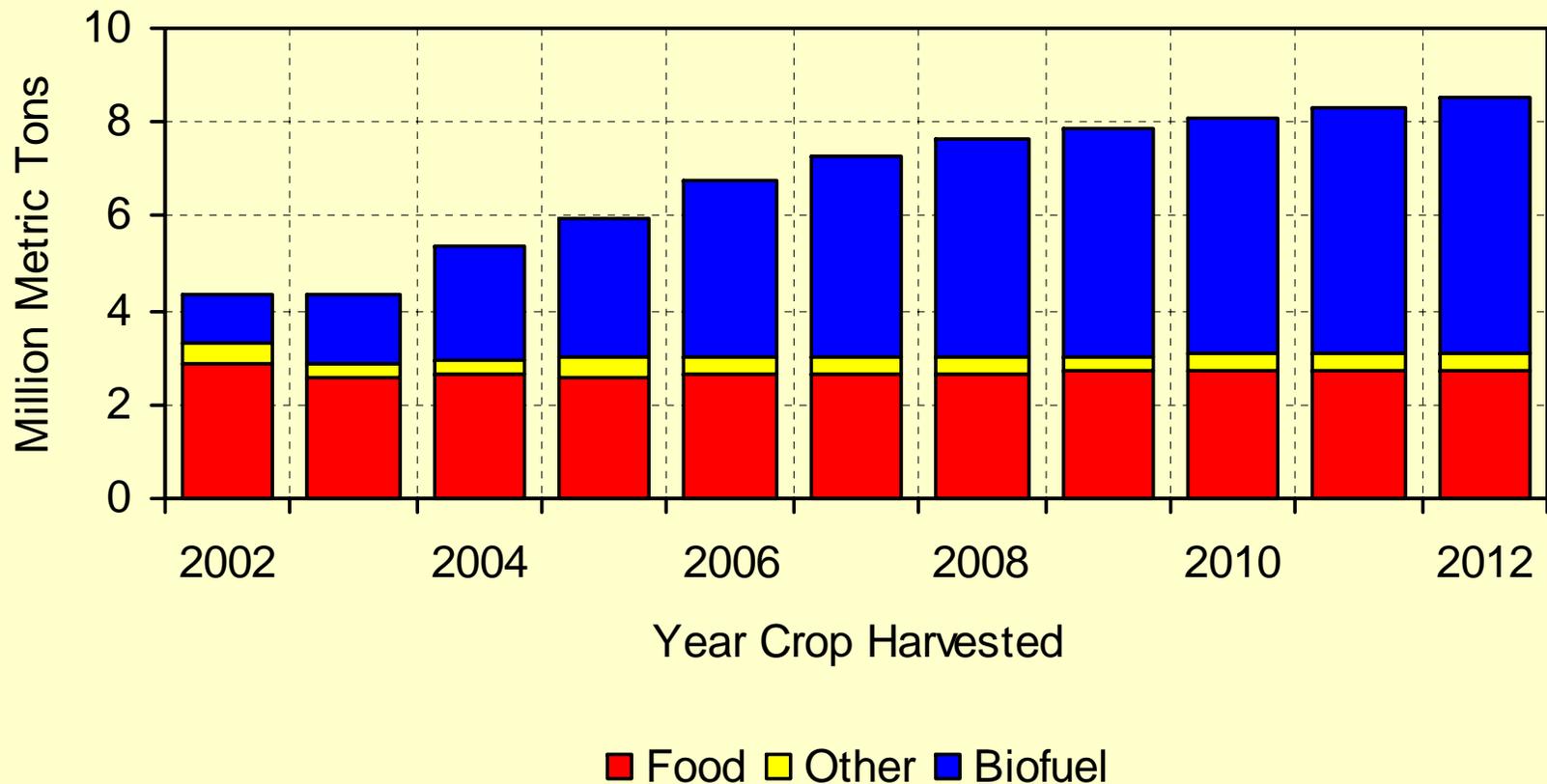
Source: World Grains Council

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.**
- **Higher food costs ahead**
- **Major risk-management challenges in Ag. & bioenergy**

**(Growth 2007-12 = 147% of U.S. soybean oil exports)
(Food demand for vegetable oil highly inelastic)**

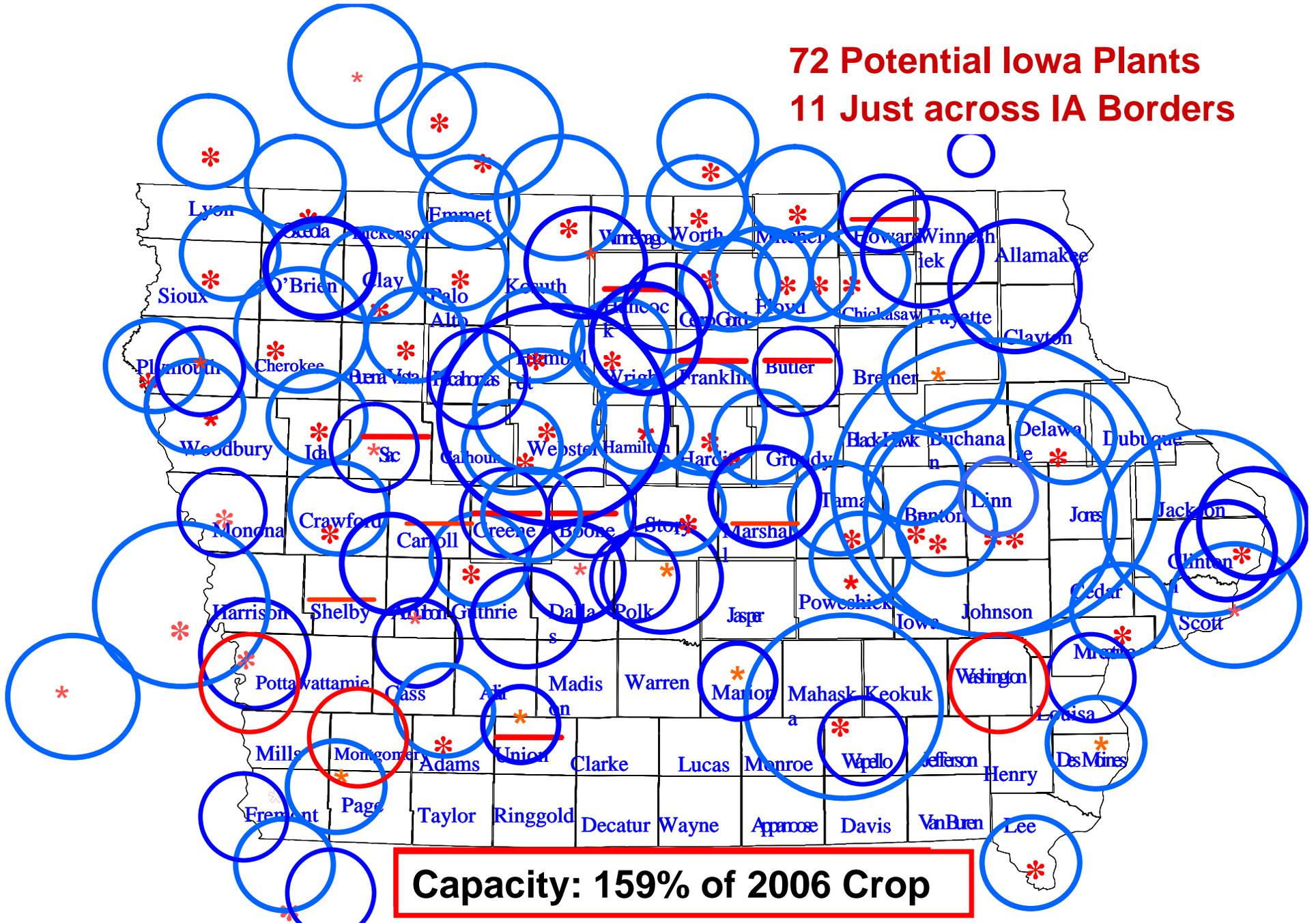
EU Use of Rapeseed Oil



Source: FAPRI estimates

Pulls land away from food uses

**72 Potential Iowa Plants
11 Just across IA Borders**

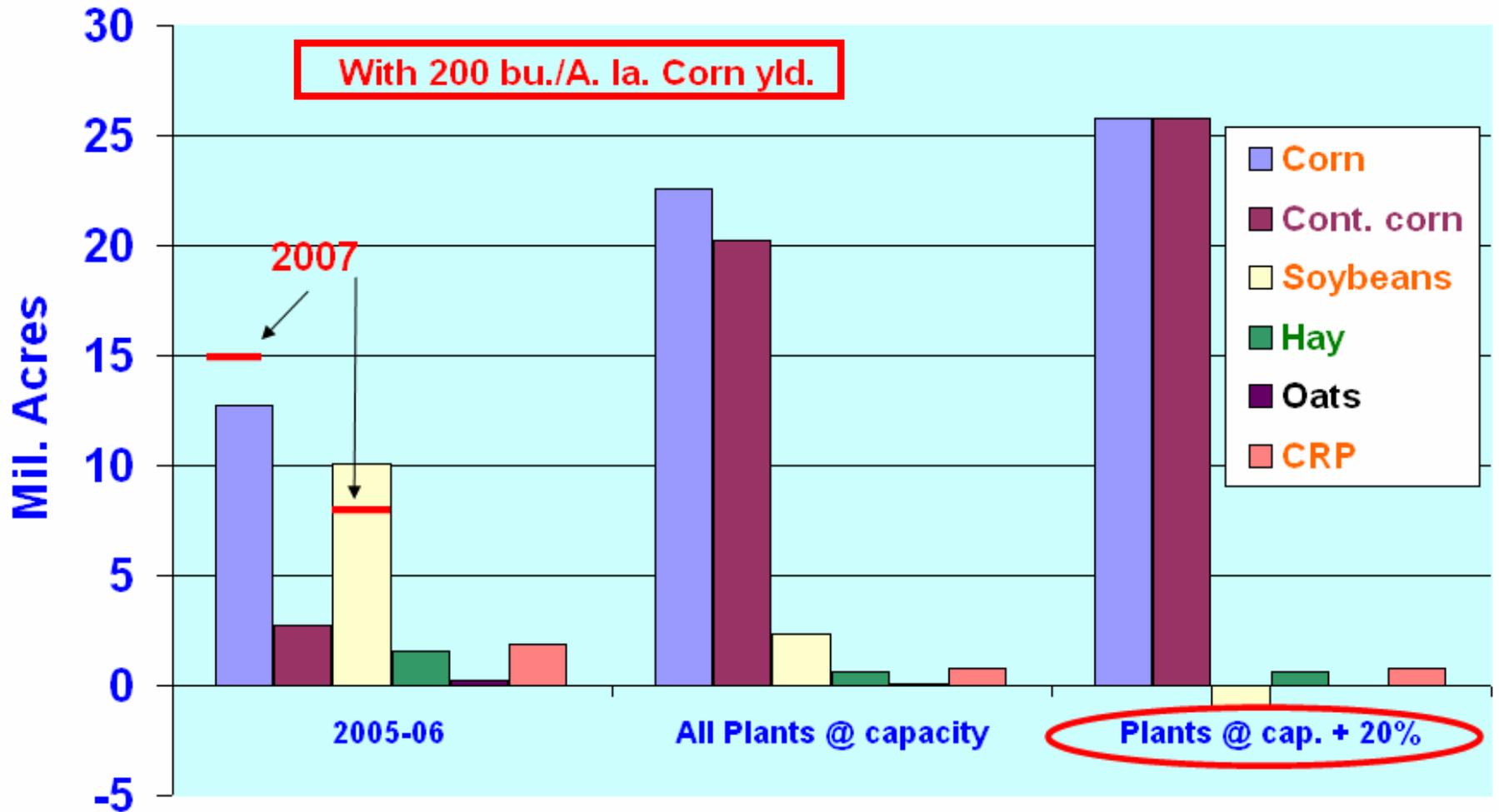


Iowa Corn Processing Plants, Current & Planned, 7/25/07

Iowa Corn Processing, 7/23/07				No. plants	Mil. Bu.	of '06 Crop
Total operating				30	1,294	63%
Total Under Construction or expansion				10	447	22%
Total Planned, not yet under construction				34	1,513	74%
Grand Total (adjusting for plant expansions)				71	3,254	159%

7/26/07

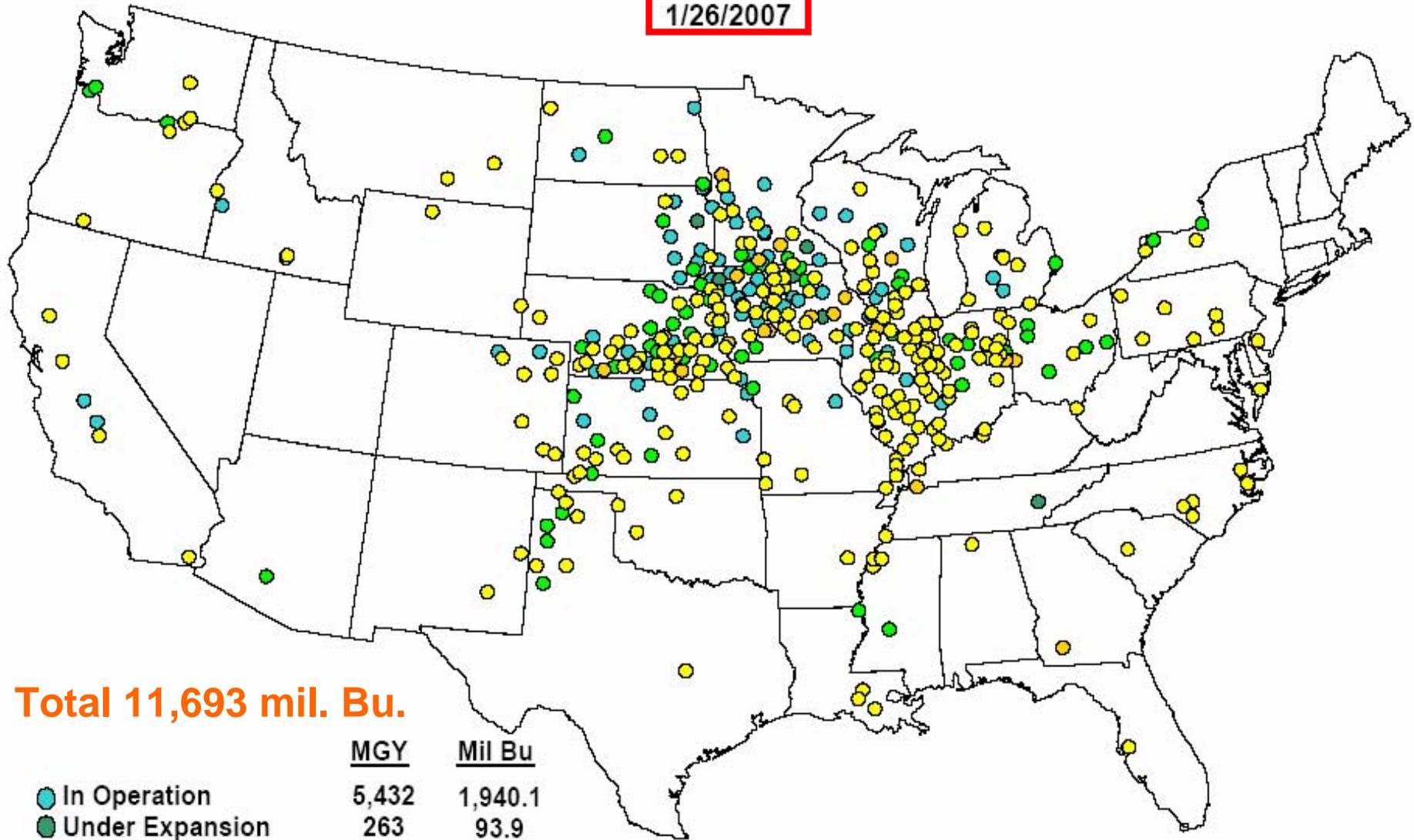
Iowa Current & Potential 2010 Crop Acreages



US Ethanol Plants



1/26/2007

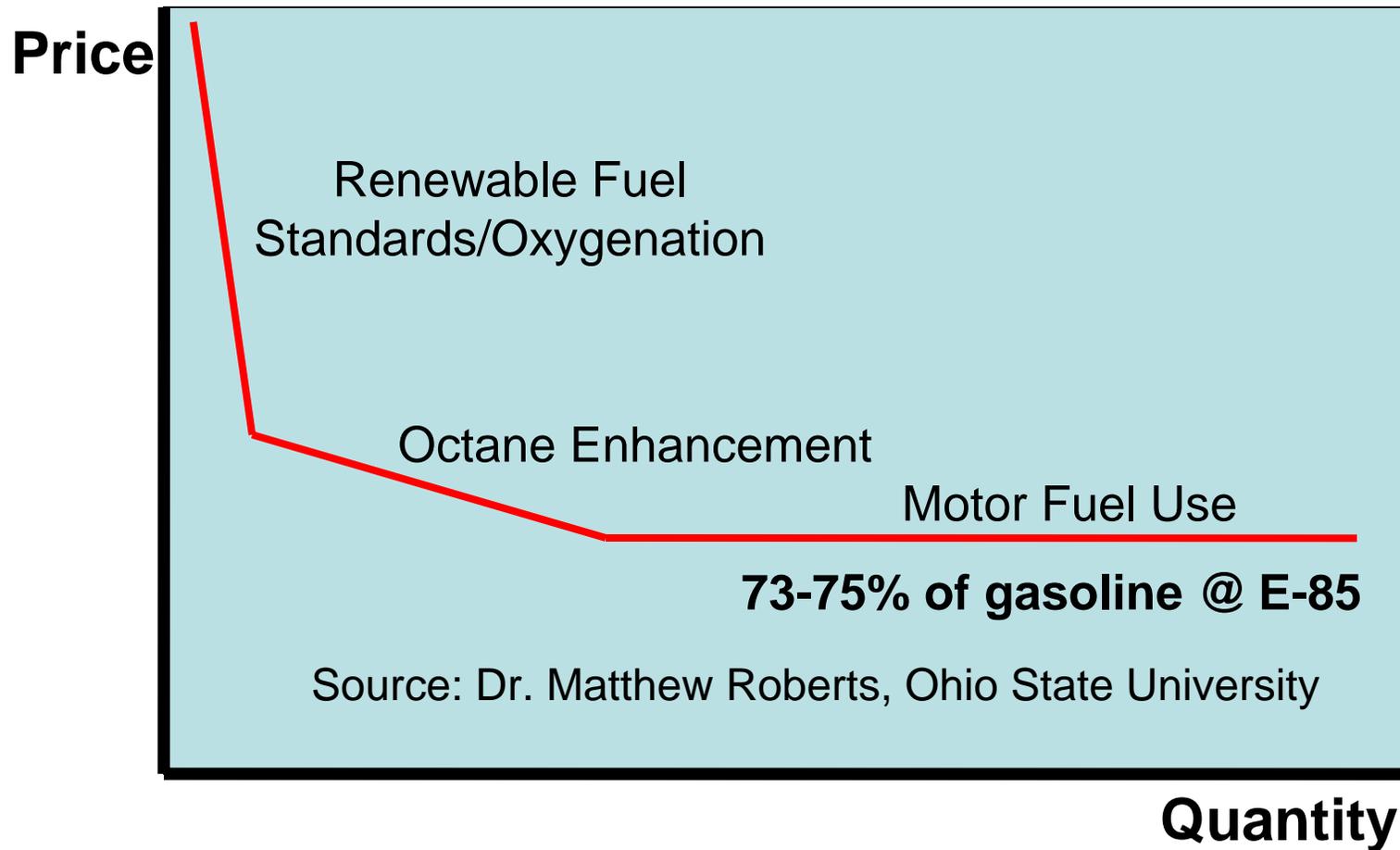


Total 11,693 mil. Bu.

	<u>MGY</u>	<u>Mil Bu</u>
● In Operation	5,432	1,940.1
● Under Expansion	263	93.9
● Under Construction	4,872	1,740.0
● Ground Broken	2,463	879.6
● Planned	19,710	7,039.3

Plants "Under Construction" have broken ground and have poured concrete. Plants that have "broken ground" have begun site work but no actual construction. Plants that are "planned" have been talked about or announced in the news.

Demand Curve for Ethanol



2007-08 U.S. corn supplies adequate to meet demand

- **But at expense of:**
 - **15% decline in soybean planted area**
 - **28% decline in cotton area**
 - **11% decline in non-durum spring wheat**
 - **Declines in other minor crops**
- **Soybean supplies to tighten substantially, needing increased plantings in 2008**
- **Cotton may need more planted area in 2008**
- **More U.S. corn likely will be needed in 2009**

**Prospective Number of future Ethanol Plants,
7/25/07 (Excludes Current Plants)**

			Under Constr'n	Planned Plants	Total to build
Iowa			13	27	40
Indiana			7	30	37
Illinois			4	56	60
Kansas			6	10	16
Michigan			3	5	8
Minnesota			6	7	13
Missouri			1	9	10
Nebraska			14	36	50
Ohio			12	7	19
S. Dakota			4	4	8
Wisconsin			4	10	14
Corn Belt Total			74	201	275
Non-Corn Belt					
California			3	14	17
Colorado			1	14	15
Idaho			2	1	3
New York			3	6	9
N. Carolina			1	6	7
Penn.			1	7	8
Texas			5	11	16
Other non-Corn Belt			11	83	94
Total non-Corn Belt			27	128	155
U.S. Total			101	329	430

Plant Numbers Sources: Renewable Fuels Association

<http://www.ethanol.org/index.php?id=37&parentid=8#USEthanolFacilities> & DTN Ethanol

Web Site,

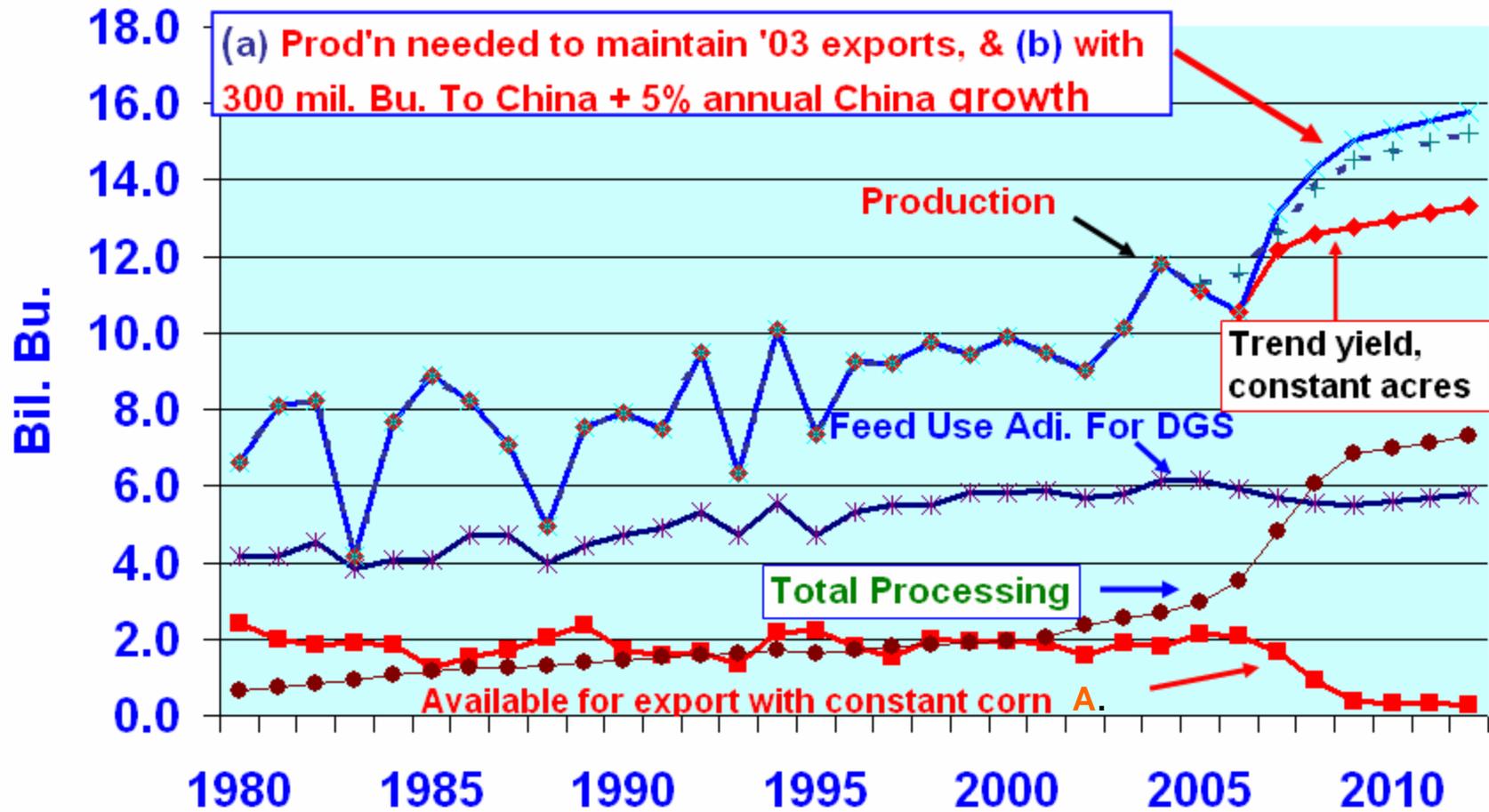
<http://www.dtnethanolcenter.com/index.cfm?show=47&mid=48>

Prospective Number of future Ethanol Plants, 7/25/07 (Excludes Current Plants)						
	M. Bu. Current	Mil. Bu.	No. Planned	2006 Mil. Bu.	Corn needed @ avg. 70	
	Plnt. Cap.	Constr'n	Plants	Corn Prod'n	mil. Gal./planned plant	
Iowa	931	447	27	2,050	2,891	
IA. Non-eth. Plants	363					
Iowa total	1,294		1,513 mil. Bu.	2,050	3,254	
Indiana	114	212	30	845	1,091	
Illinois	136	106	56	1,818	1,670	
Kansas	77	127	10	345	459	
Michigan	77	25	5	288	230	
Minnesota	191	157	7	1,103	526	
Missouri	56	15	9	363	301	
Nebraska	228	391	36	1,178	1,537	
Ohio	--	164	7	471	343	
S. Dakota	228	4	4	312	334	
Wisconsin	102	4	10	400	361	
Corn Belt Total	3,796	1,652	201	9,173	10,573	
Non-Corn Belt						
California	23	45	14	18	425	
Colorado	31	18	14	134	406	
Idaho	--	26	1	11	52	
New York	--	55	6	62	208	
N. Carolina	--	26	6	98	179	
Penn.	--	73	7	117	252	
Texas	--	98	11	175	379	
Other non-Corn Belt	144	177	69	221	2,081	
Total non-Corn Belt	198	518	128	836	3,980	
U.S. Total	3,994	2,170	329	10,535	14,554	
Note: Non-IA states exclude other corn processing (Total of 1,200 mil. Bu. Plant Numbers & Capacity Sources: Renewable Fuels Association				(Potential about 40 bil. Gal. of ethanol if all are built)		
http://www.ethanol.org/index.php?id=37&parentid=8#USEthanolFacilities			& DTN Ethanol			
Web Site,		http://www.dtnethanolcenter.com/index.cfm?show=47&mid=48				

5.9 Bil. Bu. Corn for Ethanol

Figure 1. U.S. Corn Production, Domestic Use, & Availability for Exports--Proj. to 2012

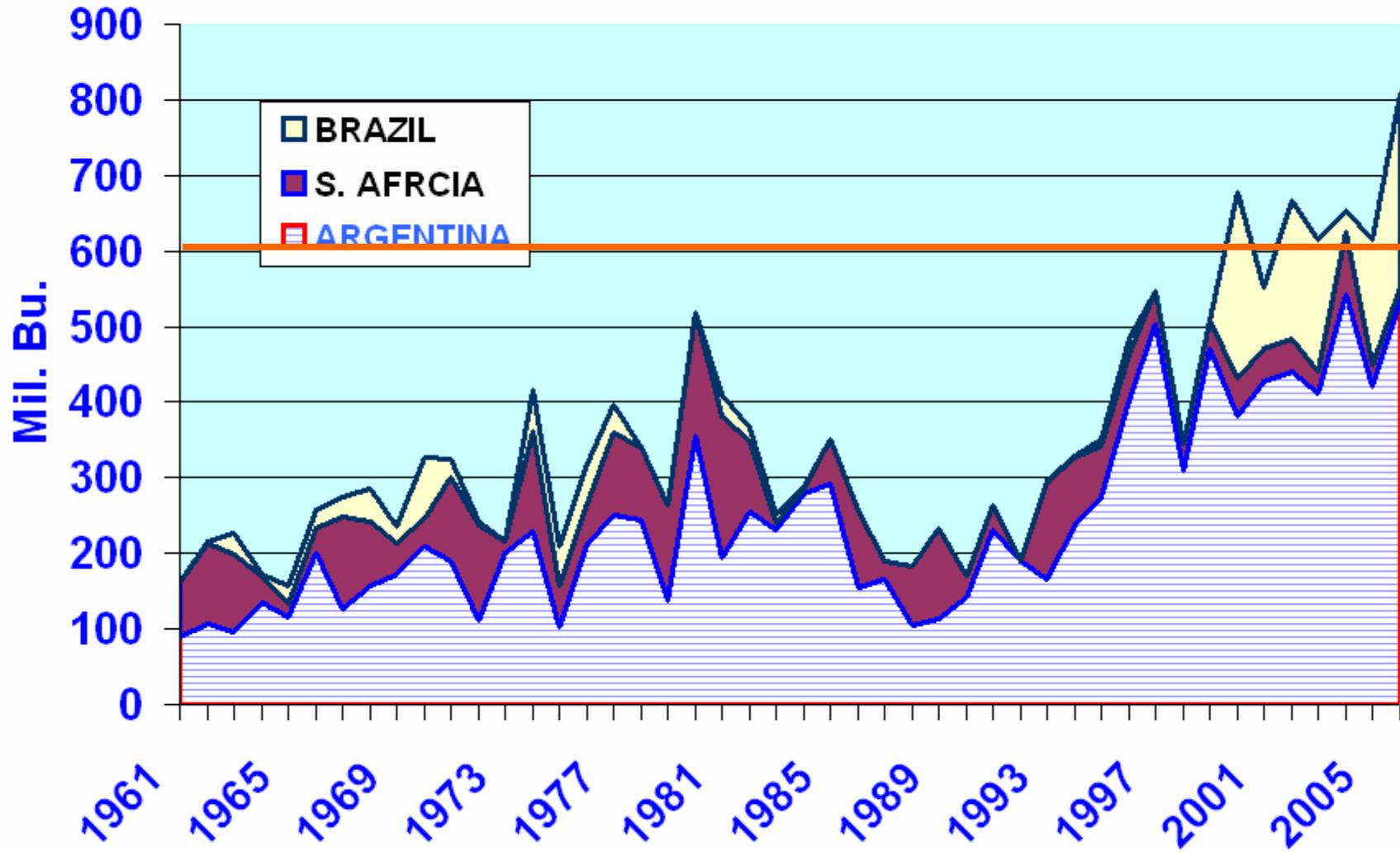
5-29-07



Will increased South American exports more than offset U.S. decline?

4/09/07

Southern Hemisphere Corn Exports



Newly Cleared Land In Brazil

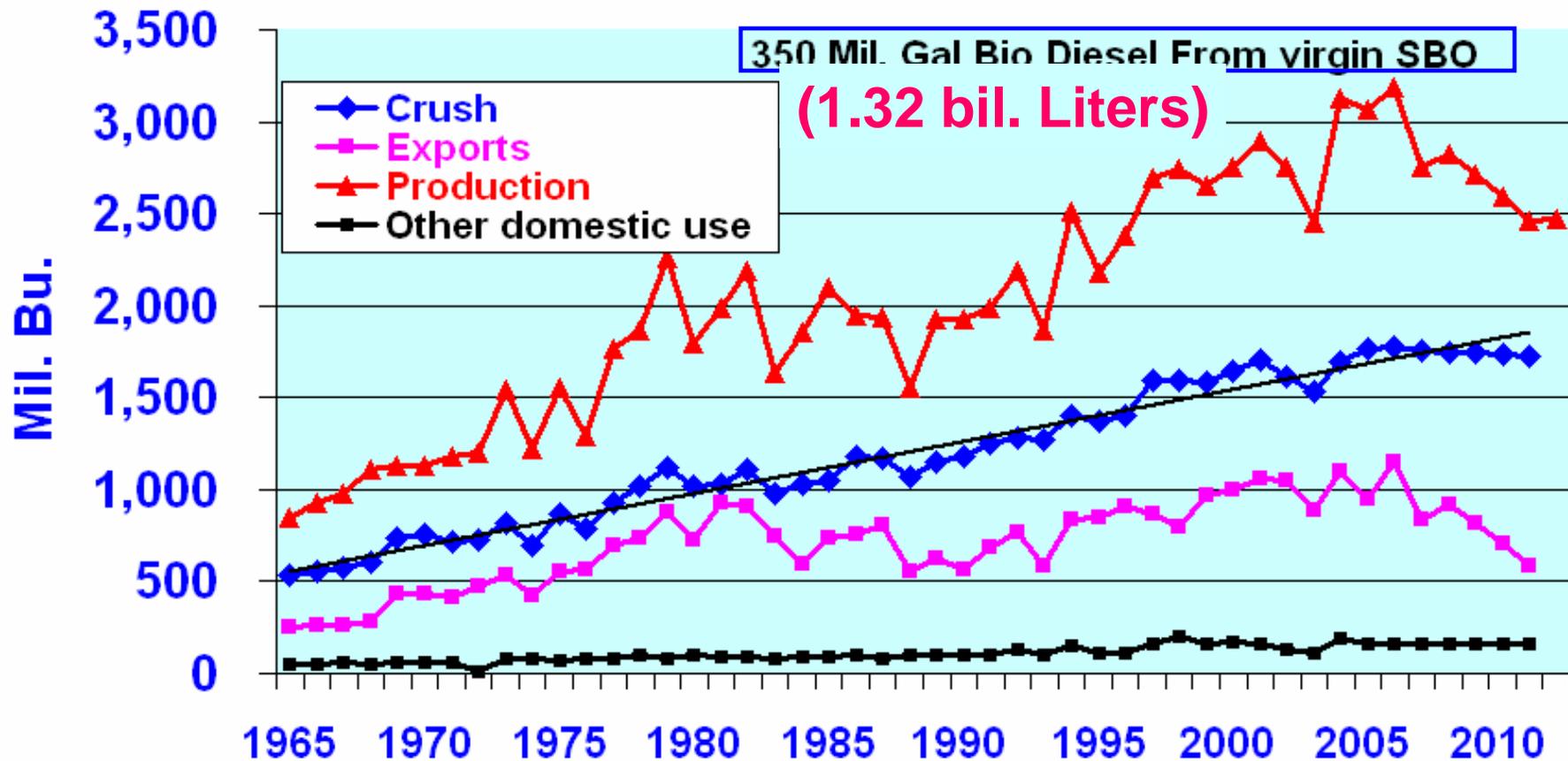
Planted to Upland Rice



Argentines developing taste for grain-fed beef



**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

MINIMUM SOYOIL PRICE FOR BIODIESEL BREAKEVEN at GIVEN WORLD CRUDE OIL PRICE

PRX_C_US_BA, GTB-06-03, Mar-14-06

		Crude Oil Price, \$/bbl								
		\$30.00	\$35.00	\$40.00	\$45.00	\$50.00	\$55.00	\$60.00	\$65.00	\$70.00
Add biodiesel		Profitability of Biodiesel at given crude oil and soyoil prices, %\$/lb								
Soybean	\$0.19	(\$0.10)	\$0.02	\$0.14	\$0.25	\$0.37	\$0.49	\$0.61	\$0.73	\$0.85
Oil Price	\$0.20	(\$0.18)	(\$0.06)	\$0.06	\$0.18	\$0.30	\$0.42	\$0.54	\$0.66	\$0.78
\$/lb	\$0.21	(\$0.25)	(\$0.13)	(\$0.01)	\$0.11	\$0.23	\$0.35	\$0.47	\$0.58	\$0.70
	\$0.22	(\$0.32)	(\$0.20)	(\$0.08)	\$0.04	\$0.15	\$0.27	\$0.39	\$0.51	\$0.63
	\$0.23	(\$0.39)	(\$0.28)	(\$0.16)	(\$0.04)	\$0.08	\$0.20	\$0.32	\$0.44	\$0.56
	\$0.24	(\$0.47)	(\$0.35)	(\$0.23)	(\$0.11)	\$0.01	\$0.13	\$0.25	\$0.37	\$0.48
	\$0.25	(\$0.54)	(\$0.42)	(\$0.30)	(\$0.18)	(\$0.06)	\$0.05	\$0.17	\$0.29	\$0.41
	\$0.26	(\$0.61)	(\$0.49)	(\$0.38)	(\$0.26)	(\$0.14)	(\$0.02)	\$0.10	\$0.22	\$0.34
	\$0.27	(\$0.69)	(\$0.57)	(\$0.45)	(\$0.33)	(\$0.21)	(\$0.09)	\$0.03	\$0.15	\$0.27
	\$0.28	(\$0.76)	(\$0.64)	(\$0.52)	(\$0.40)	(\$0.28)	(\$0.16)	(\$0.05)	\$0.07	\$0.19
	\$0.29	(\$0.83)	(\$0.71)	(\$0.59)	(\$0.48)	(\$0.36)	(\$0.24)	(\$0.12)	\$0.00	\$0.12
	\$0.30	(\$0.91)	(\$0.79)	(\$0.67)	(\$0.55)	(\$0.43)	(\$0.31)	(\$0.19)	(\$0.07)	\$0.05
	\$0.31	(\$0.98)	(\$0.86)	(\$0.74)	(\$0.62)	(\$0.50)	(\$0.38)	(\$0.26)	(\$0.15)	(\$0.03)

For Blue Sky Scenario, PRX adopts a crude oil price of \$50/bbl and thus a minimum 24 cent/lb soyoil price, to evaluate impact of subsidized biodiesel market.

Source: Dr. Terry Francel, American Farm Bureau Federation

Differential Impacts by livestock species

Approximate Future Potential DDGS Corn Replacement by Species

(Based on 2005-06 U.S. Corn Feeding, Current Animal Numbers, & 5.5 Bil. Bu. Corn for Ethanol)

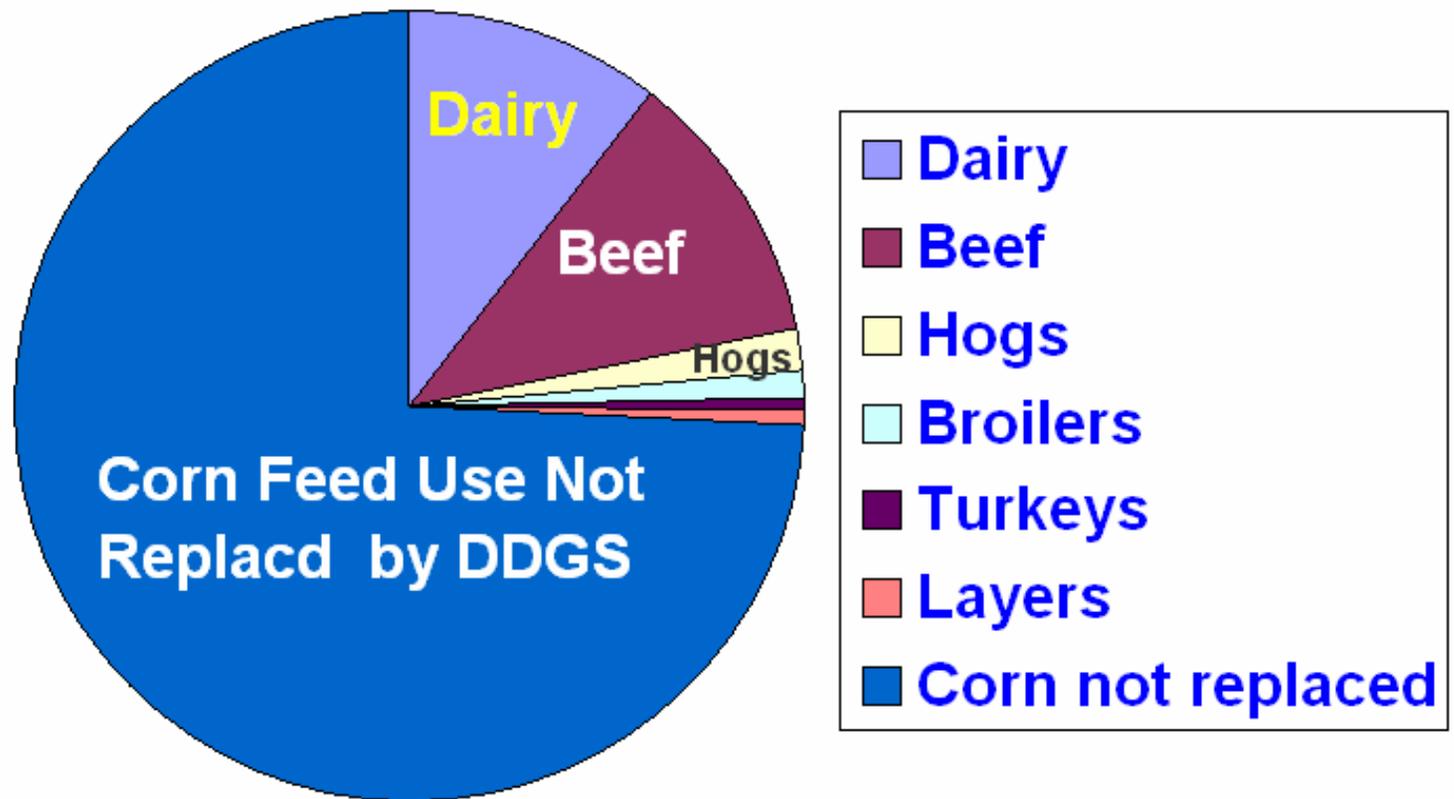
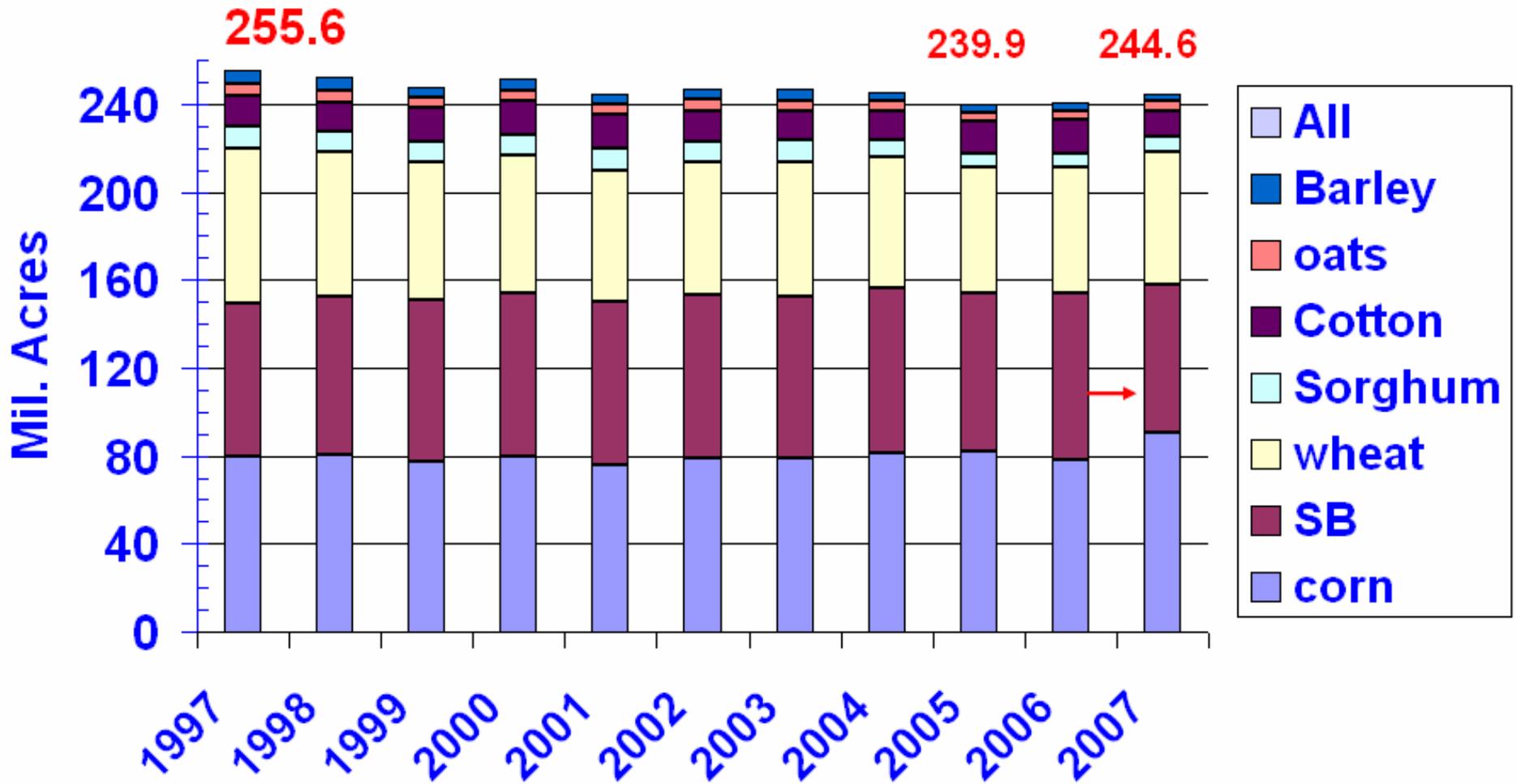


Figure 3. U.S. Planted Acreage of Major Grains, Oilseeds, and Cotton



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.	

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

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**

Summary

- **Rapid biofuels expansion to bring dramatic crop rotation changes, more monoculture**
- **Large demand for crop-based fuel to dramatically impact global livestock**
- **Maximum biofuels industry size determined by (1) crude oil & corn prices, (2) government mandates, & (3) ethanol price**
- **Large risk-management challenges**
 - **Need for new feedstocks soon**

What Could Change Prospects of Tightening Global Grain Supply?

- Accelerated corn yield increases
- *Biodiesel from algae?*
- 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

Thanks

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

...and justice for all

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