World Grain 1975-2025: Episodes and Aftermaths

NGFA Country Elevator Conference
Kansas City, December 7, 2015
Bill Hudson • PRX

- **Preamble: EPA Ethanol Final Rule**
- **Wealth Build Episode 2007-08 to 2013-14**
- **Aftermath 2014-15 to 2025-26**

EPA Ethanol Final Rule on Nov-30-2015 —Key General Points

- **Final Rule leaves rationale of Proposed Rule unchanged: E-10 Blend Wall and substantial shortfall of cellulosic and other advanced biofuels means that EPA must apply general waiver of "inadequate domestic supply."**
- **Final Rule corrects errors in determining D6 RVO for 2014, and updates 2015 and 2016 calculations with EIA data since May-2015.**
- **"The fundamental objective of the RFS remains clear: To increase the use of renewable fuels every year through at least 2022 in order to reduce greenhouse gas emissions and increase energy security."**
- **"The RFS program can be thought of as a market forcing policy. The market is capable of responding to the ambitious standards set in the Final Rule by expanding all segments of the market needed to increase renewable fuel supply and modify pricing to provide incentives for the production and use of competitive renewable fuels."**

RENEWABLE VOLUME OBLIGATIONS IN EPA FINAL RULE, Nov-30-2015

	Item	Source	Unit	Type	Calendar Years 2014	2015	2016	2017
Original Applicable Volumes								
1	Total Renewable Fuel	EPA, NPRM	bil	RINs	18.150	20.500	22.250	
2	Advanced Biofuel	EPA, NPRM	bil	RINs	3.750	5.500	7.250	
3	Conventional Biofuel	EPA, NPRM	bil	RINs	14.400	15.000	15.000	
EPA Proposed Waivers May, 2015								
4	Total Renewable Fuel	EPA, NPRM	bil	RINs	15.930	16.300	17.400	
5	Advanced Biofuel	EPA, NPRM	bil	RINs	2.680	2.900	3.400	
6	Conventional Biofuel	EPA, NPRM	bil	RINs	13.250	13.400	14.000	
EPA Final Rule, Nov-30, 2015								
7	Total Renewable Fuel	EPA, Final	bil	RINs	16.280	16.930	18.110	
8	Advanced Biofuel	EPA, Final	bil	RINs	2.670	2.880	3.610	
9	Conventional Biofuel	EPA, Final	bil	RINs	13.610	14.050	14.500	
10	Advanced Biofuel	EPA, Final	bil gals	eth equiv	2.670	2.880	3.610	
11	Cellulosic Biofuel	EPA, Final	bil	RINs	0.033	0.123	0.230	
12	Biomass-based diesel	EPA, Final	bil gals	actual	1.630	1.730	1.900	2.000
13		EPA, Final		energy ratio	*1.50*	*1.50*	*1.50*	
14		EPA, Final	bil gals	eth equiv	2.445	2.595	2.850	
15	Other Advanced Biofuel (4 - (5 + 8))	EPA, Final	bil gals	eth equiv	0.192	0.162	0.530	
16	Gasoline demand	EPA, Final	bil gals	actual	136.480	139.380	139.960	
17	Renewable gasoline blended	EPA, Final	bil gals	actual	13.420	13.810	13.850	

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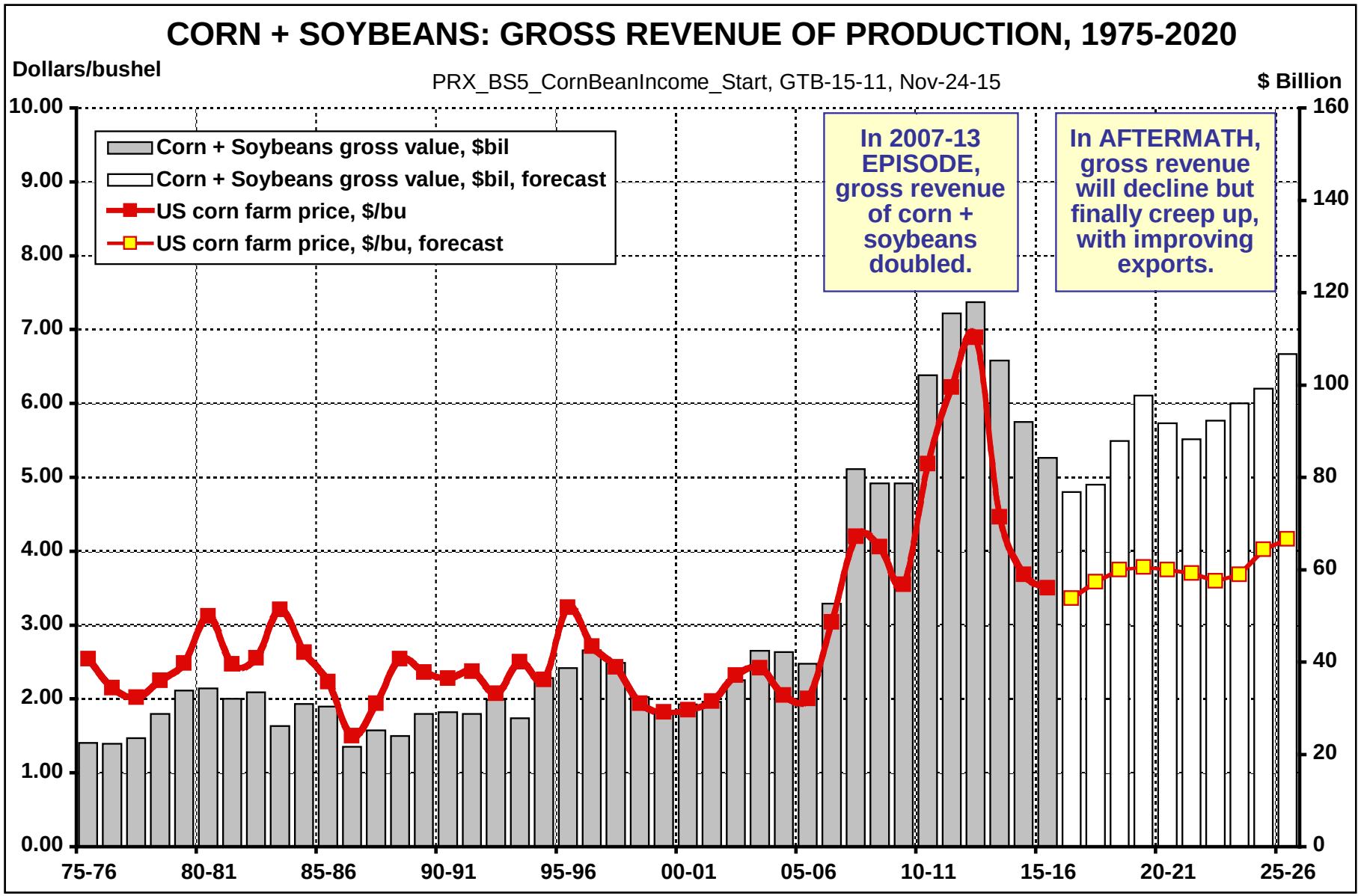
	PRX Forecasts				Crop Years 2014-15	2015-16	2016-17	2017-18
18	Gasoline demand	STEO, PRX	bil gals		136.756	139.656	140.269	139.989
	Conventional Ethanol							
19	Production	STEO, PRX	bil gals		14.651	14.679	14.951	15.226
20	Exports	DOC, PRX	bil gals		0.850	0.900	0.950	1.025
21	Imports	DOC, PRX	bil gals		-0.050	-0.062	-0.074	-0.086
22	Cellulosic Production, Use	PRX	bil gals		-0.050	-0.075	-0.100	-0.100
23	Conventional Domestic Use	PRX	bil gals		13.701	13.642	13.827	14.015
24	Calculated inclusion rate	PRX	pct		10.02%	9.77%	9.86%	10.01%

EPA's Analysis of RFS Impact on Global Temperature Change from full 36-billion gallon RFS Implementation by 2022, in 2050*

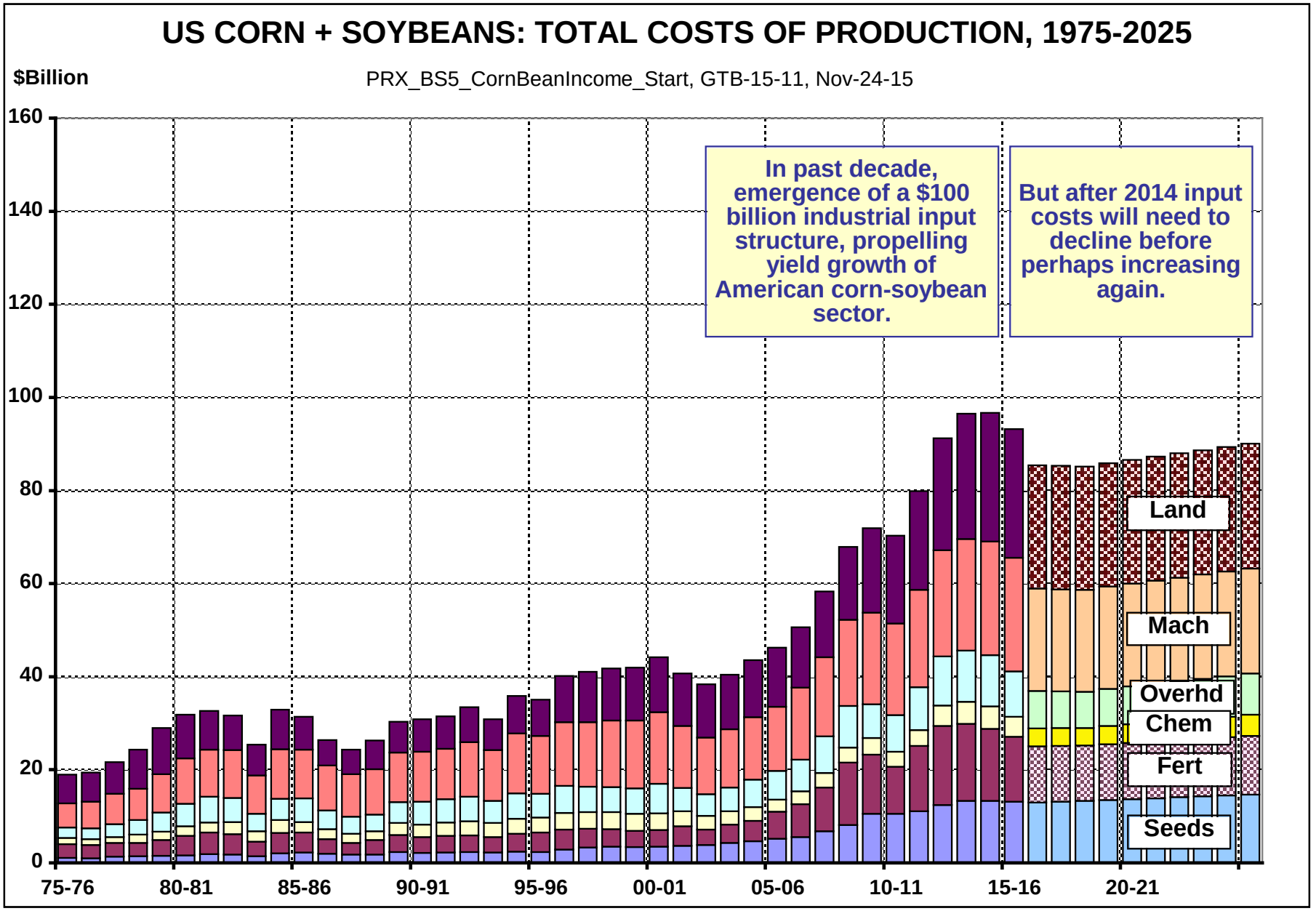
Climate Sensitivity per UN IPCC (AR4, 2007), Change in Global Mean Temp (°C) with doubling of CO-2 equiv						
	1.5	2.0	2.5	3.0	4.5	6.0
Year	Temperature reduction from GHG reduction due to RFS2 increased Renewable Fuels in 2022, per EPA* (°C)					
2050	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002
	Resulting Change in Global Mean Temperature (°C), per UN IPCC & EPA*					
2050	1.499	1.999	2.498	2.998	4.498	5.988
*From Table V.E-1, EPA Preamble to Final Rule, "Changes to Renewable Fuel Standard Program," February 3, 2010						

EPA says that the RFS can thus be seen as "directionally beneficial."

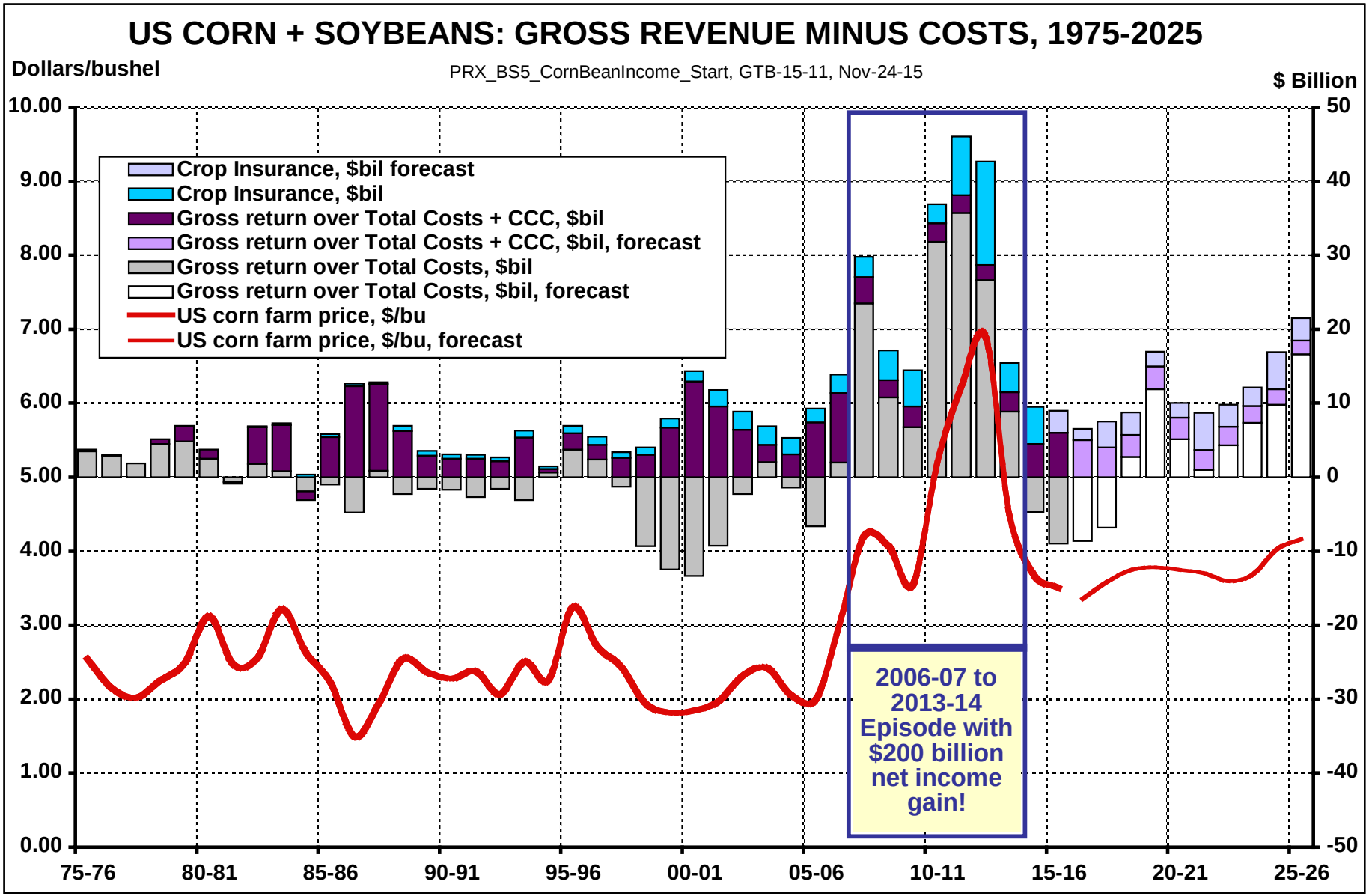
WEALTH BUILD EPISODE. ERS Cost of Production Survey of US Corn & Soybeans Used to Estimate Sector's Gross Revenue, Costs, & Returns in $Bil



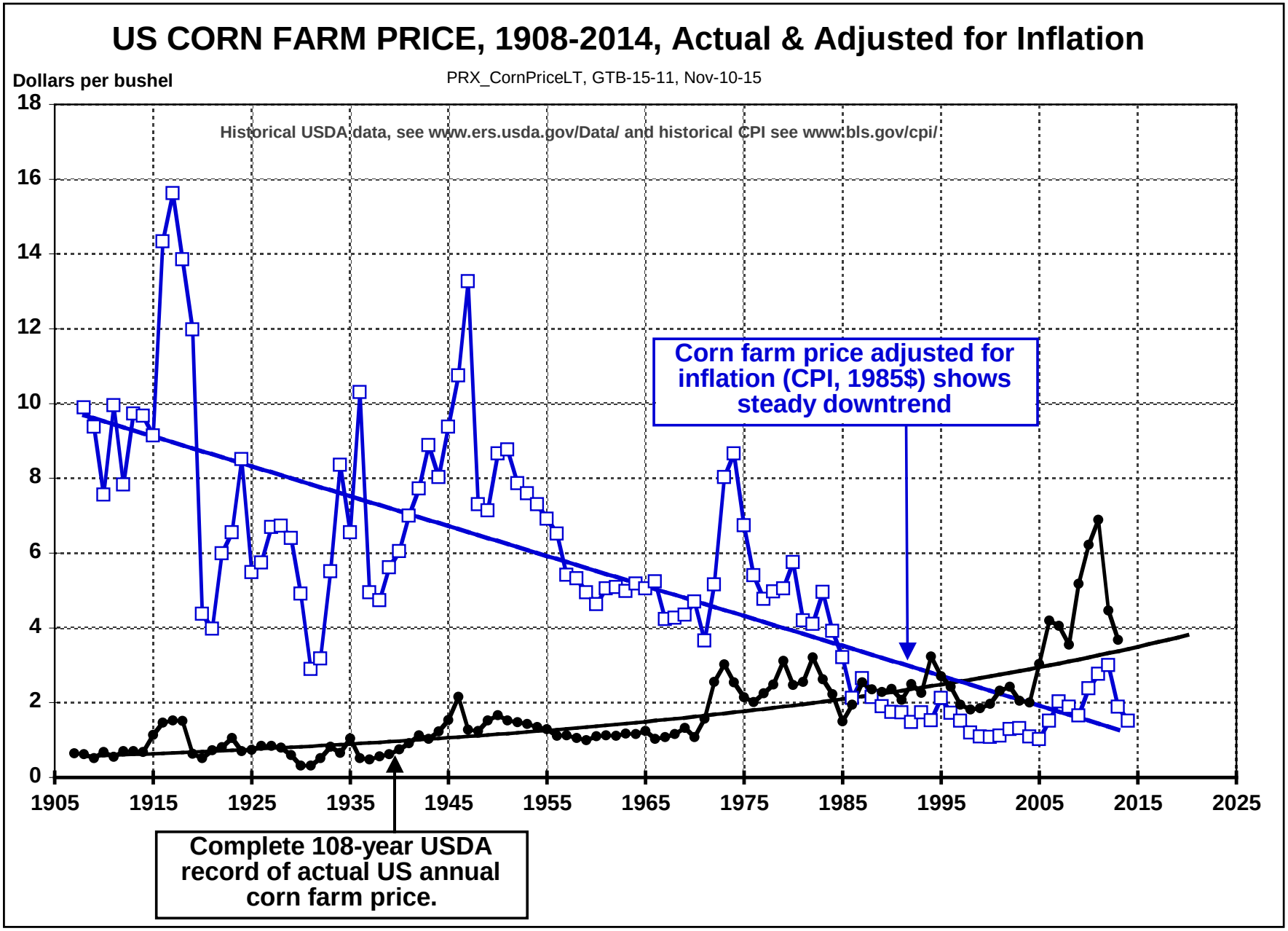
Latest ERA Actual is 2014-15, ERS Projected 2015-16, with Future Projections by PRX Blue Sky Model



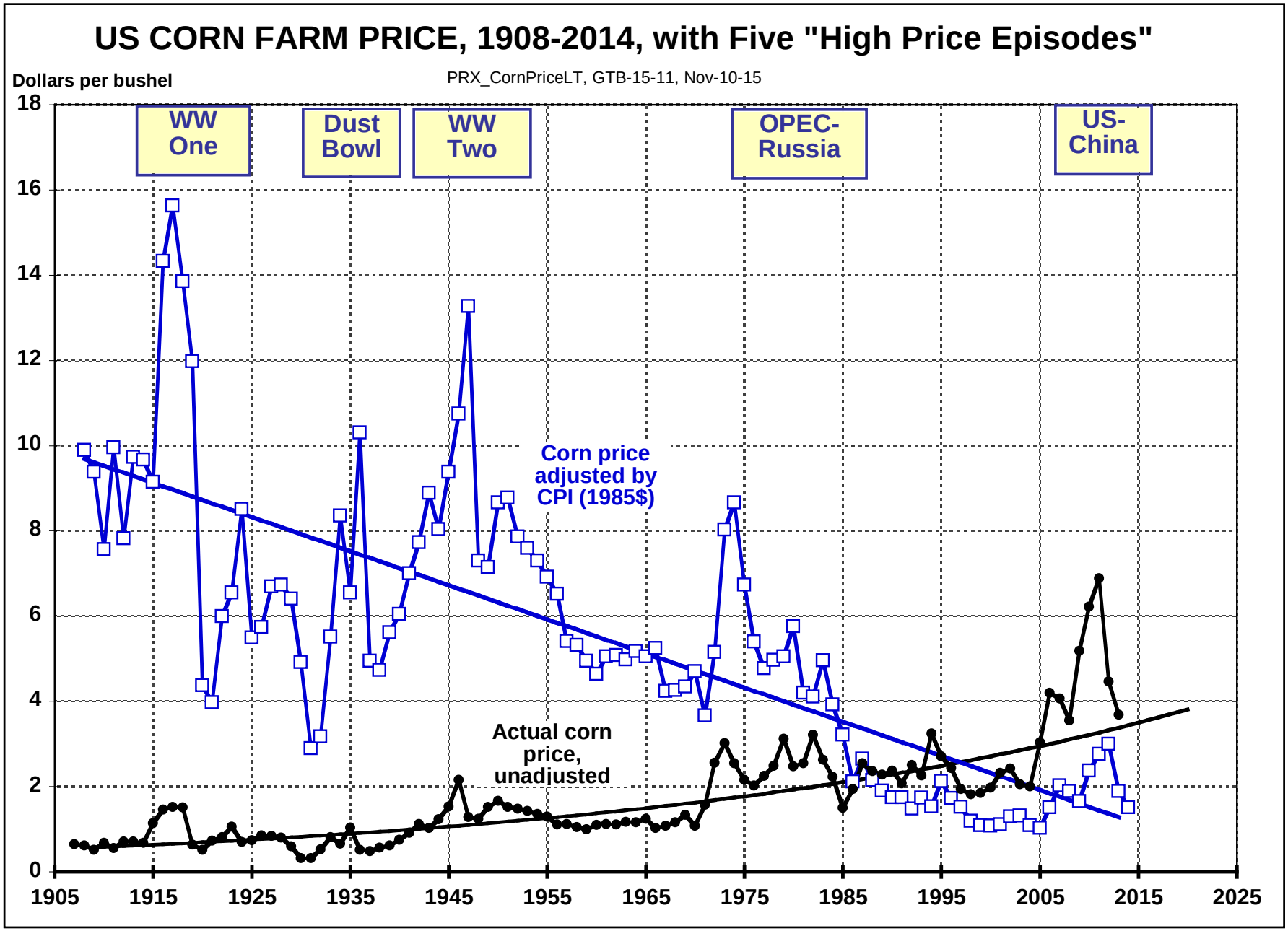
Was the astonishing seven-year wealth gain due mainly to the RFS? Are many farmers now holding their grain awaiting return of high prices?



Or Will the Aftermath of 2007-2013 be a steady decline in corn real price?

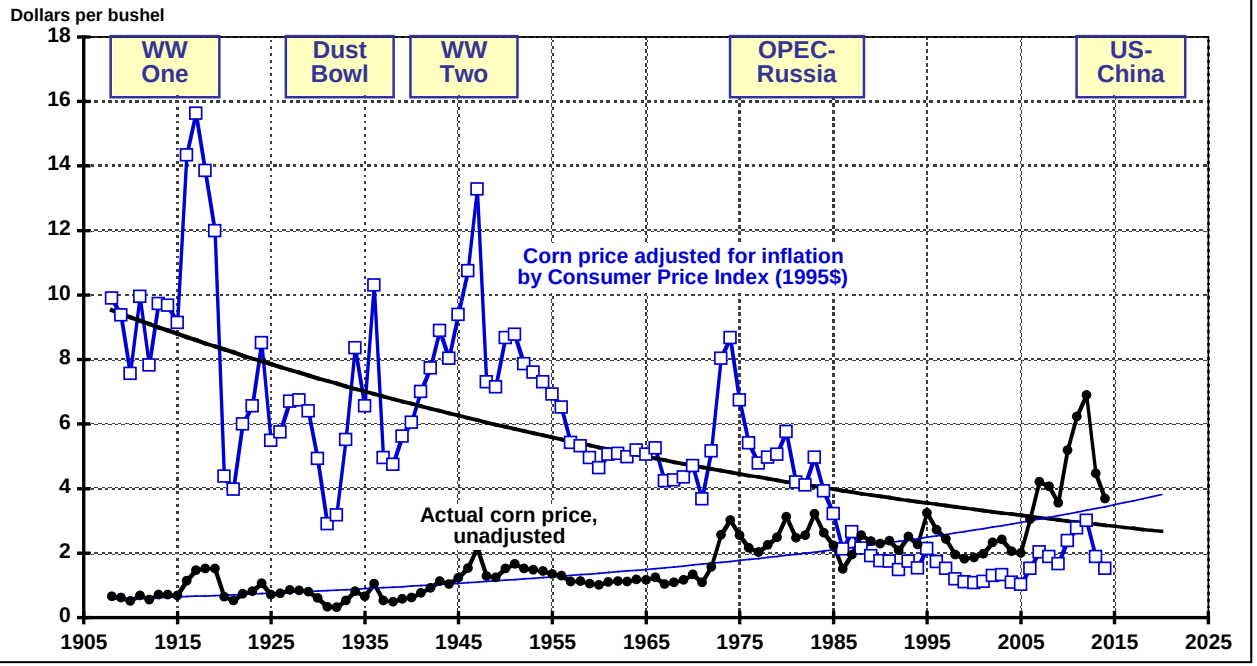


Or can some Episodes have lasting effects?



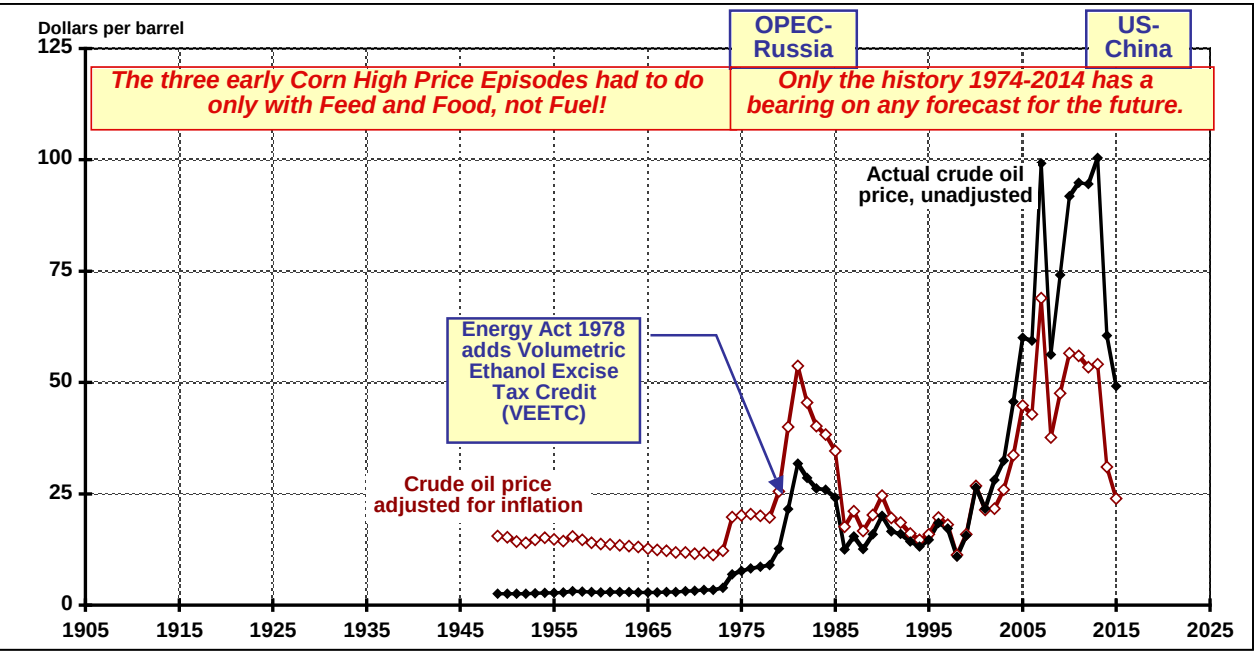
US CORN FARM PRICE, 1908-2014, with Five "High Price Episodes"

PRX_CornPriceLT, GTB-15-11, Nov-10-15



US CRUDE OIL PRICE, 1949-2014, Actual & Adjusted for Inflation

PRX_CornPriceLT, GTB-15-11, Nov-10-15



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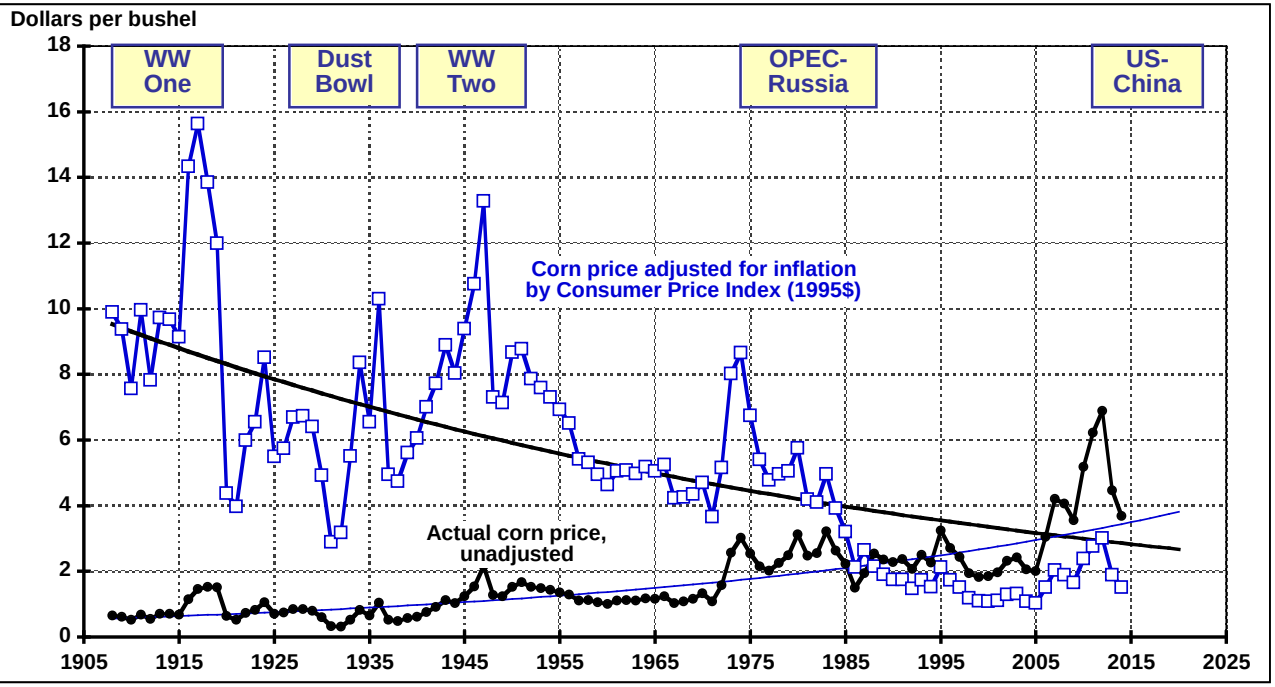
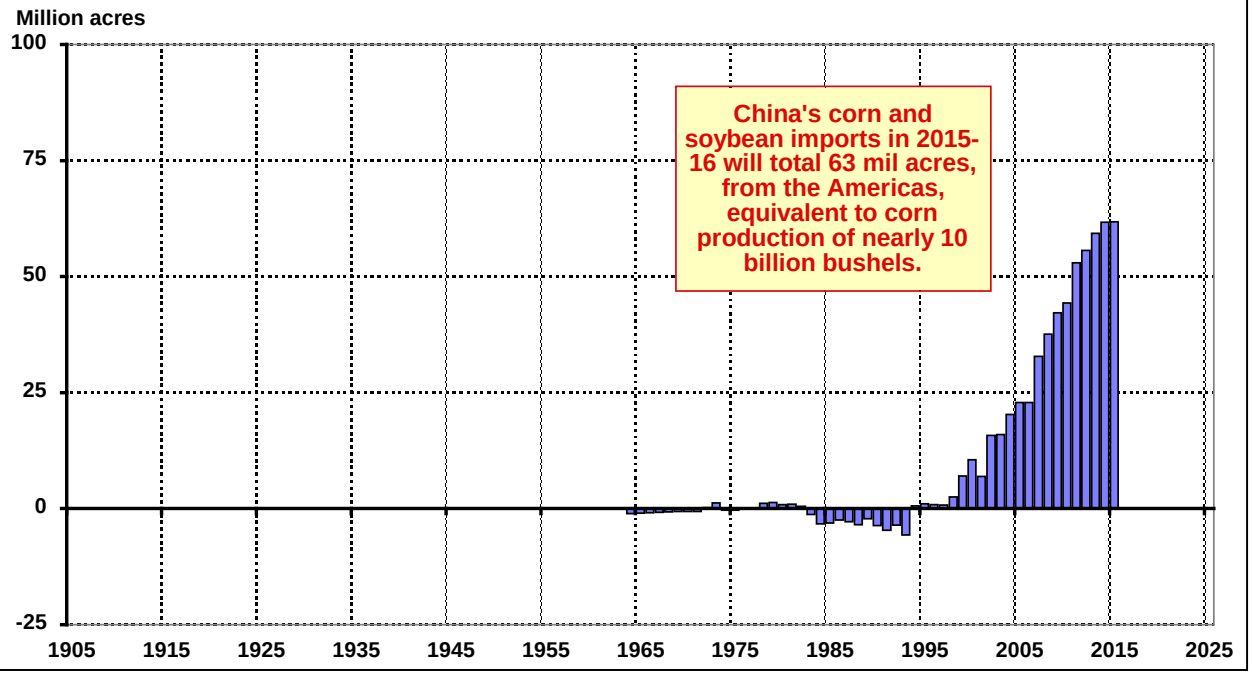
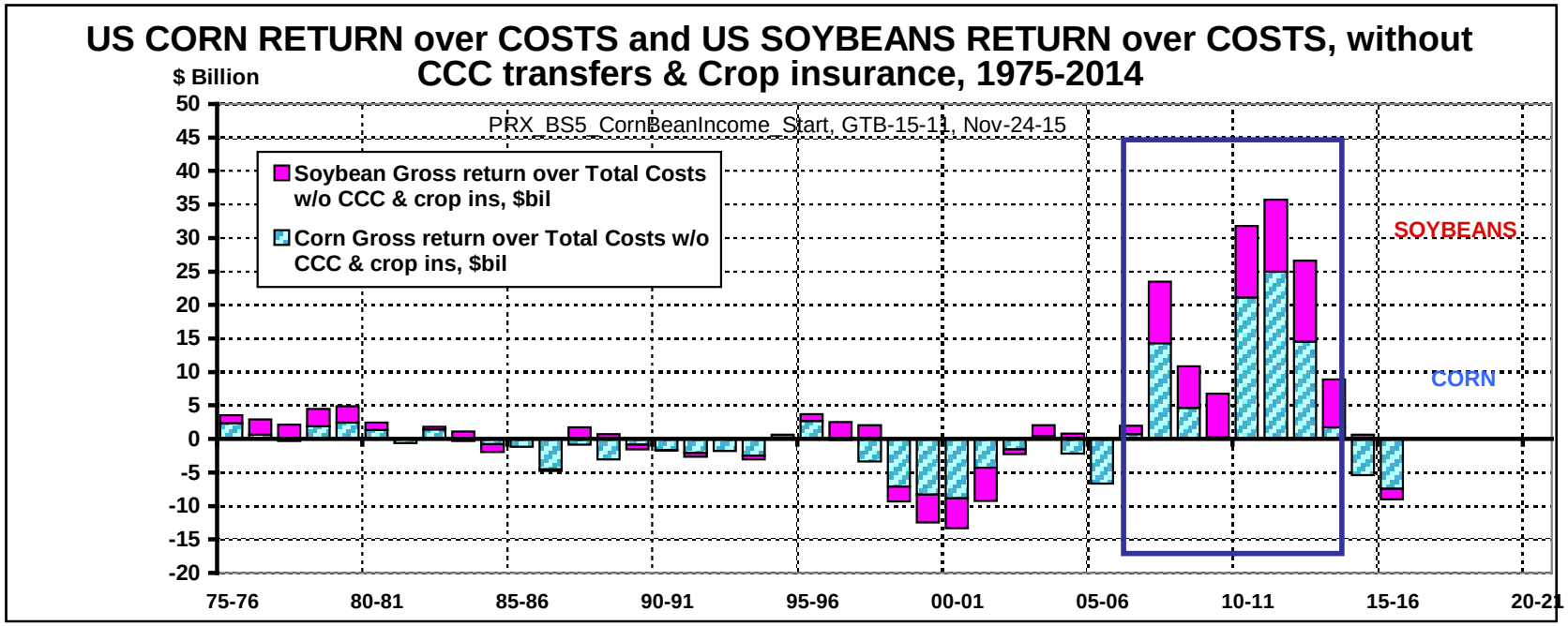
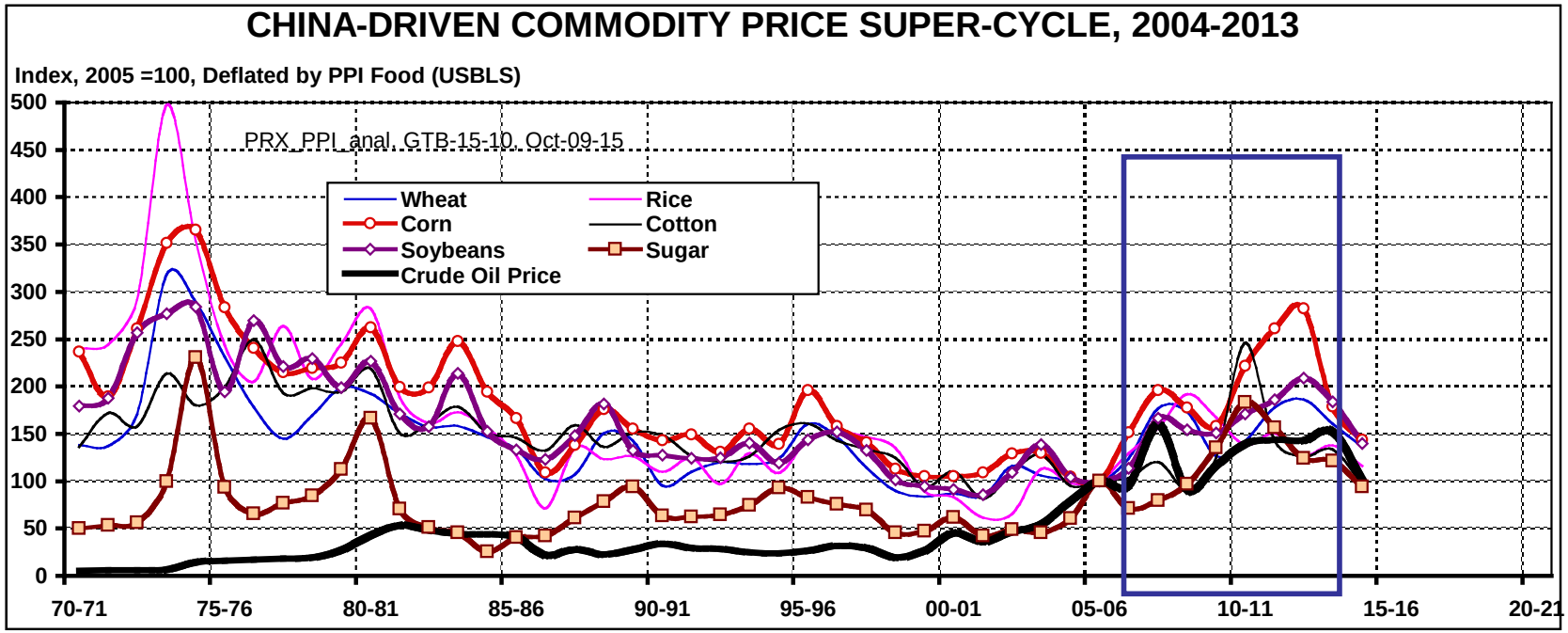
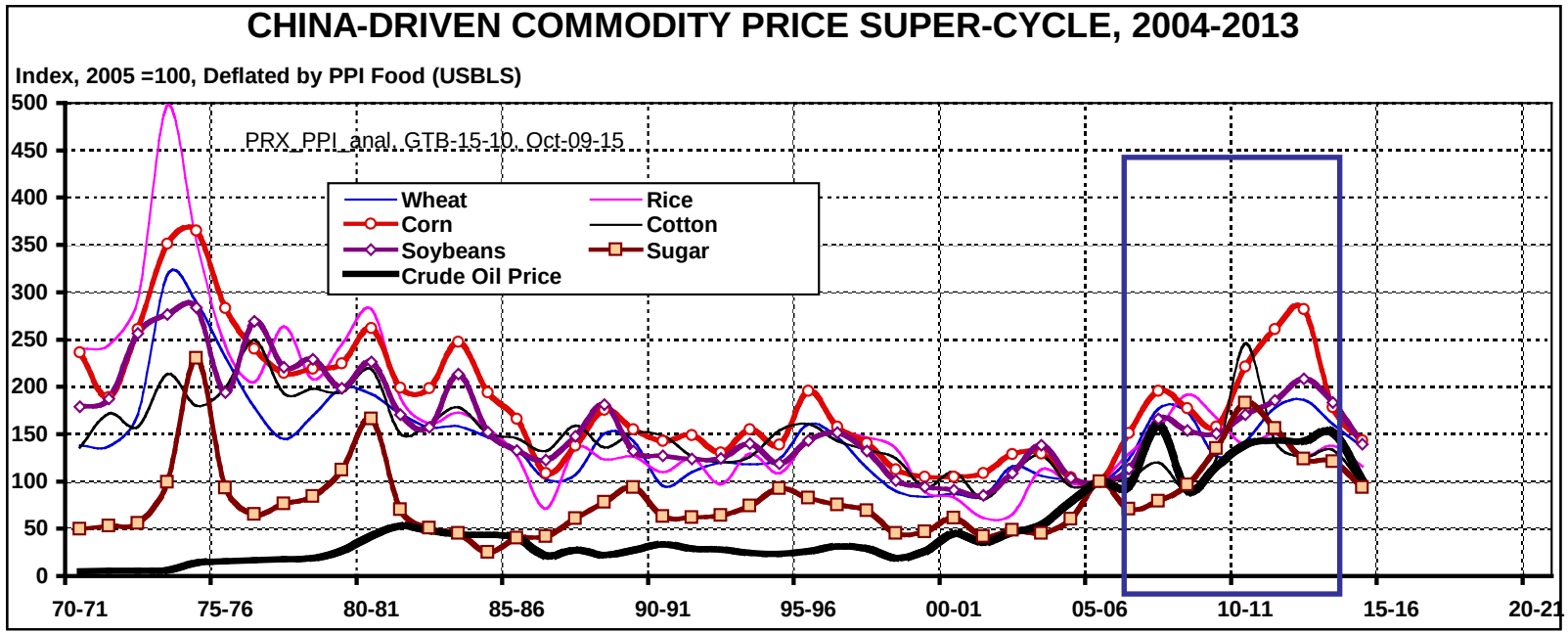


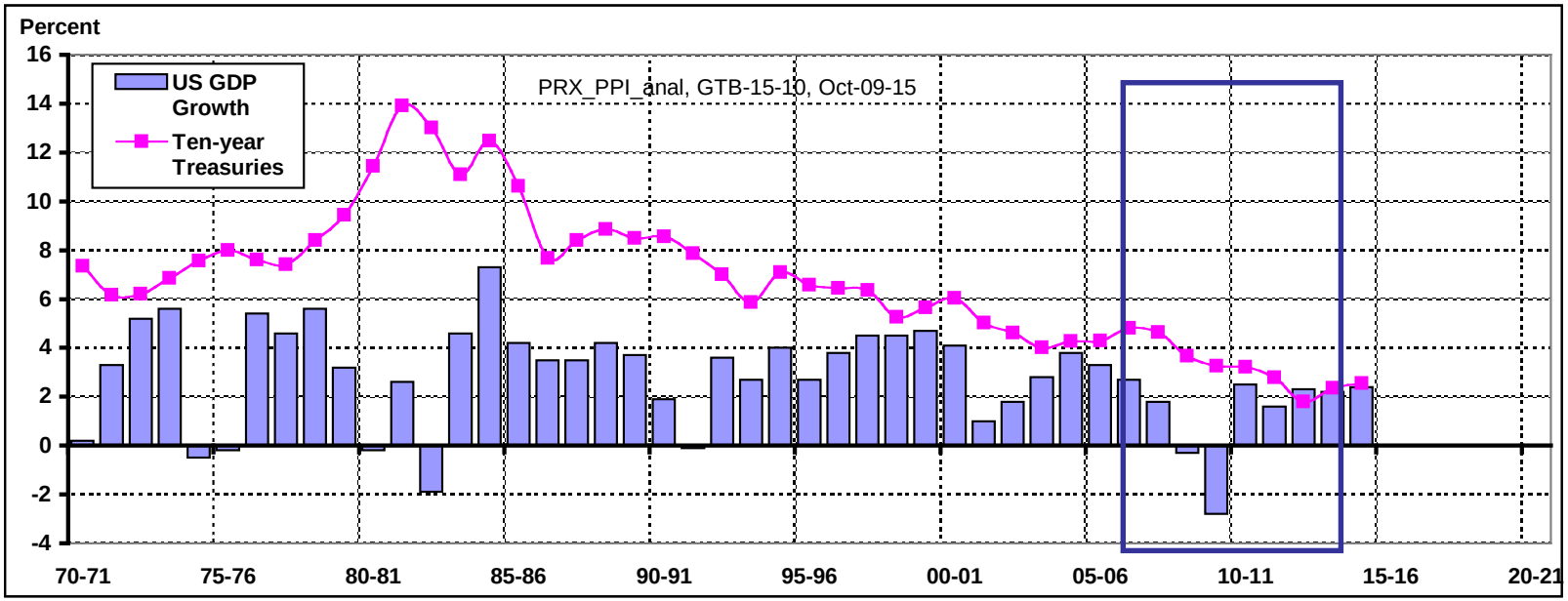
CHINA NET IMPORTS of CORN & SOYBEANS, US ACREAGE EQUIVALENT









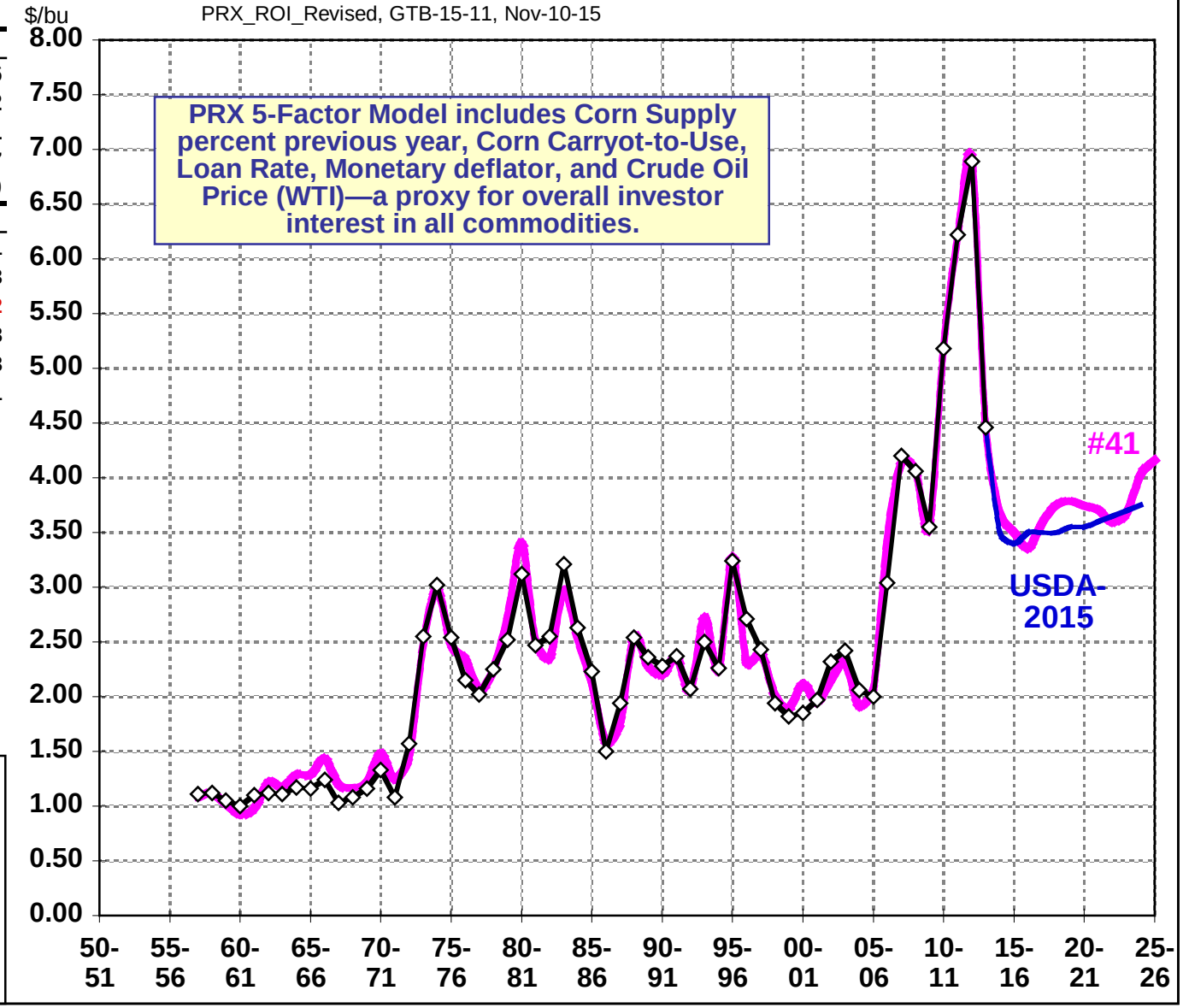


PRX Corn Price Theory in Regression Model Form

US CORN FARM PRICE, 1957-2025, ACTUAL AND MODELS

Regression Statistics	
Multiple R	0.96
R Square	0.92
Adjusted R Square	0.91
Standard Error	0.37
Observations	56.00
Coefficients	
Intercept	2.31
Spply % Prv Yr Use	-1.23
Crude Oil Price	0.02
Carry Out to Use	-1.08
Loan rate	0.48
Monetary Deflator	0.21

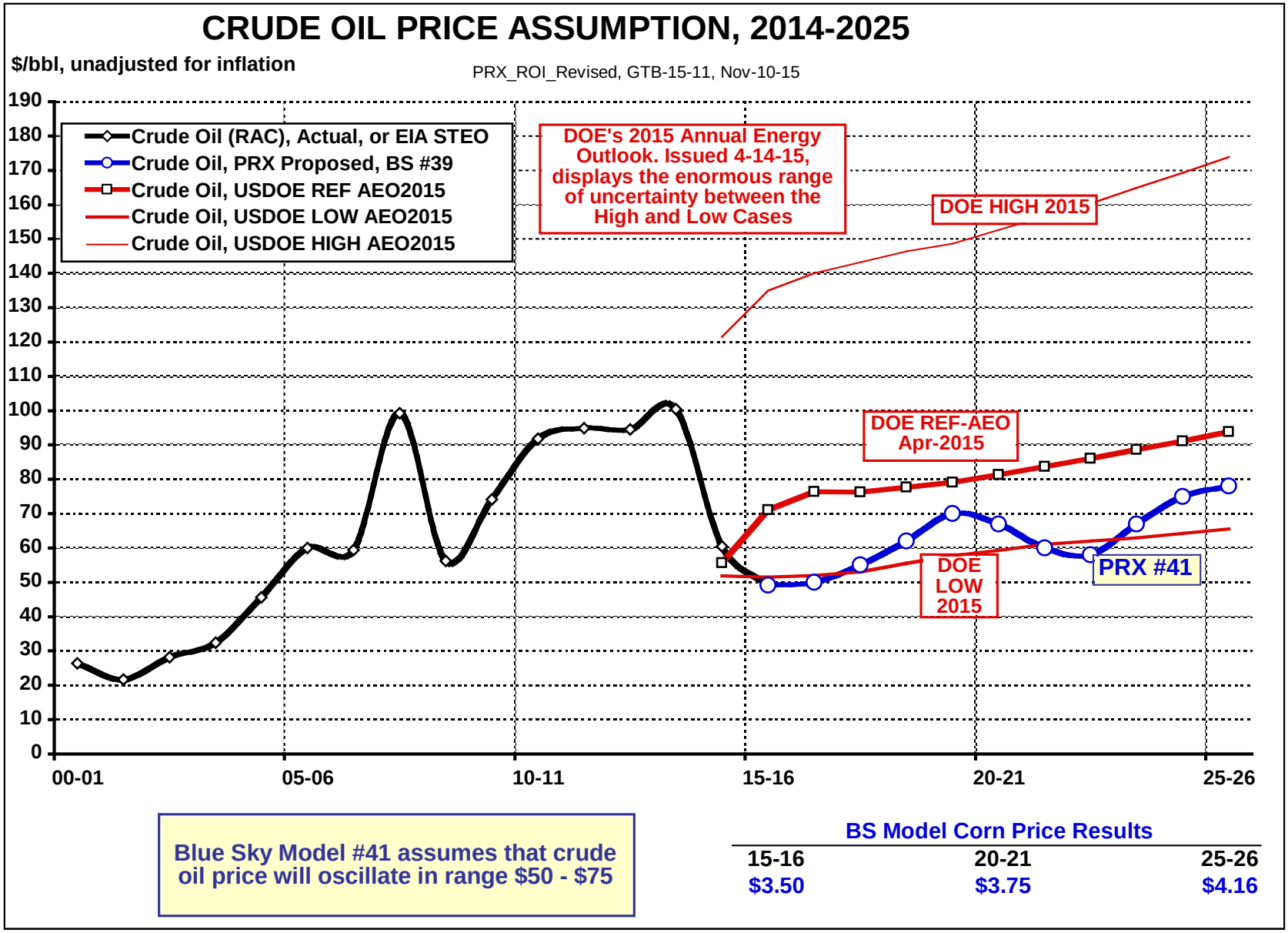
Model matches the ups and downs of the pre-1973 price pattern. Nonetheless, starting with the 1950s is necessary for the model to capture the "plateau shift" of the 1970s.

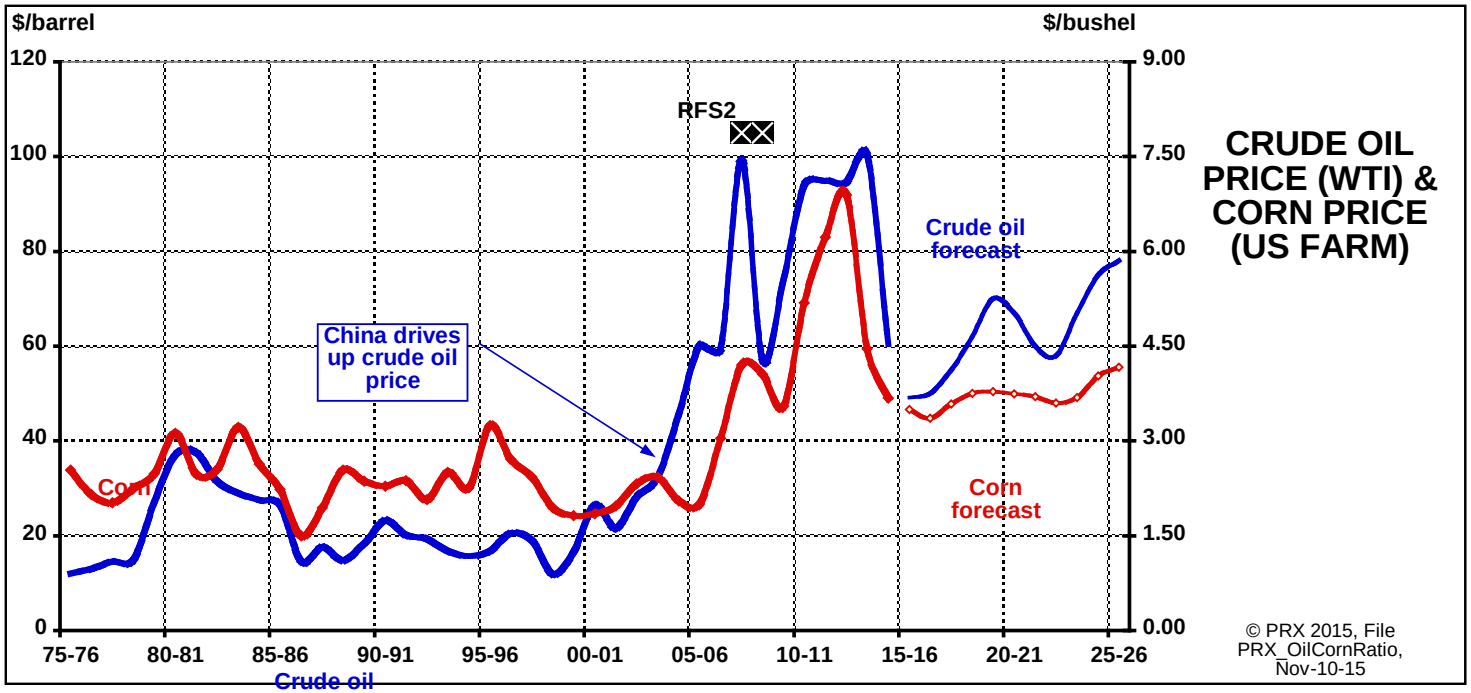


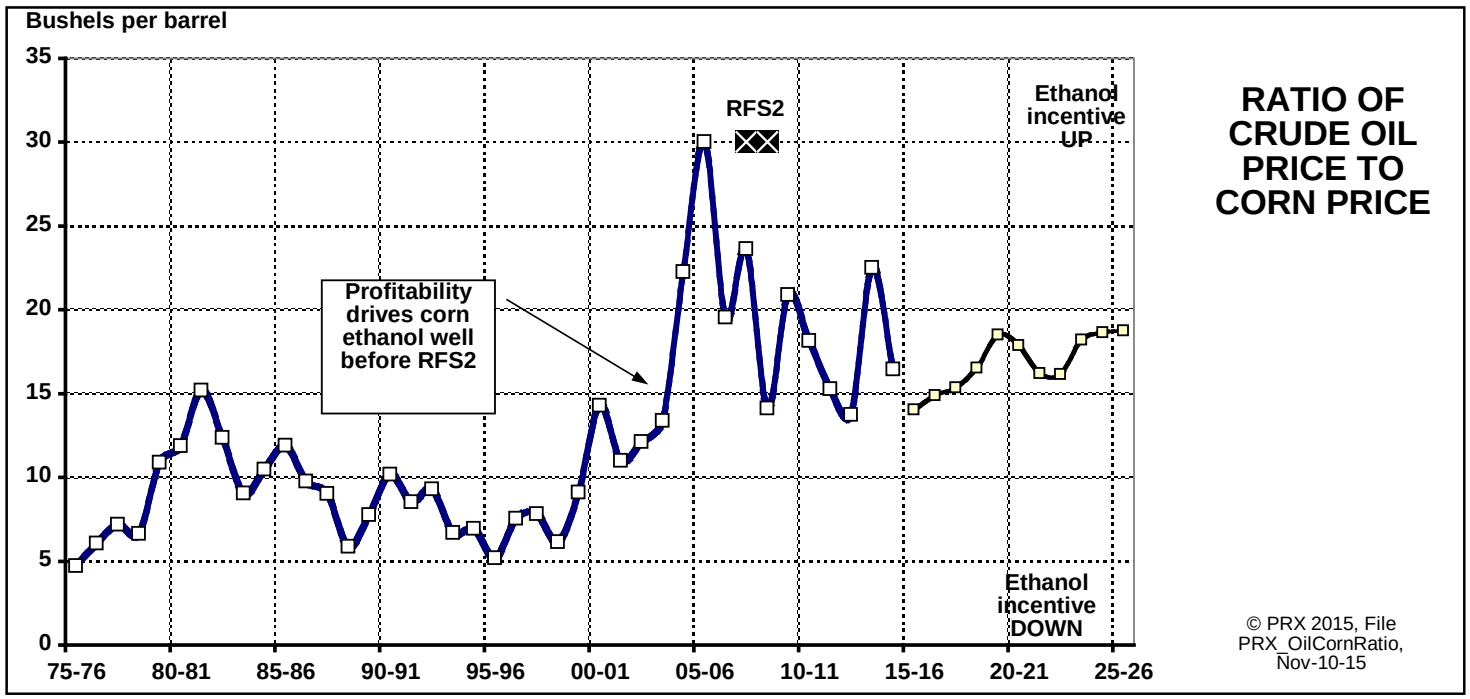
PRX Corn Price Theory in Words of a Long Time Grain Trader (John Stewart)

- **Cash corn prices are very strongly influenced by corn futures prices, which are primarily influenced by speculators whose trading volume dwarfs that of producers.**
- **This can be a good thing or a bad thing for producers. The high prices we have experienced for several years [2007-2013] were attributable to large speculative long positions.**
- **Crude oil is one of the key commodities that influence and fund large speculators. They see this as an indicator of inflationary expectations, and, rightly or wrongly, these traders, who control very large amounts of money, will buy a basket of commodities.**
- **Grains, including corn, were part of this basket, and this is why we have used the crude oil price in our regression model—and, up to now (!), it has greatly improved the fit.**

Let's look ahead to the Aftermath of the Wealth Build Episode







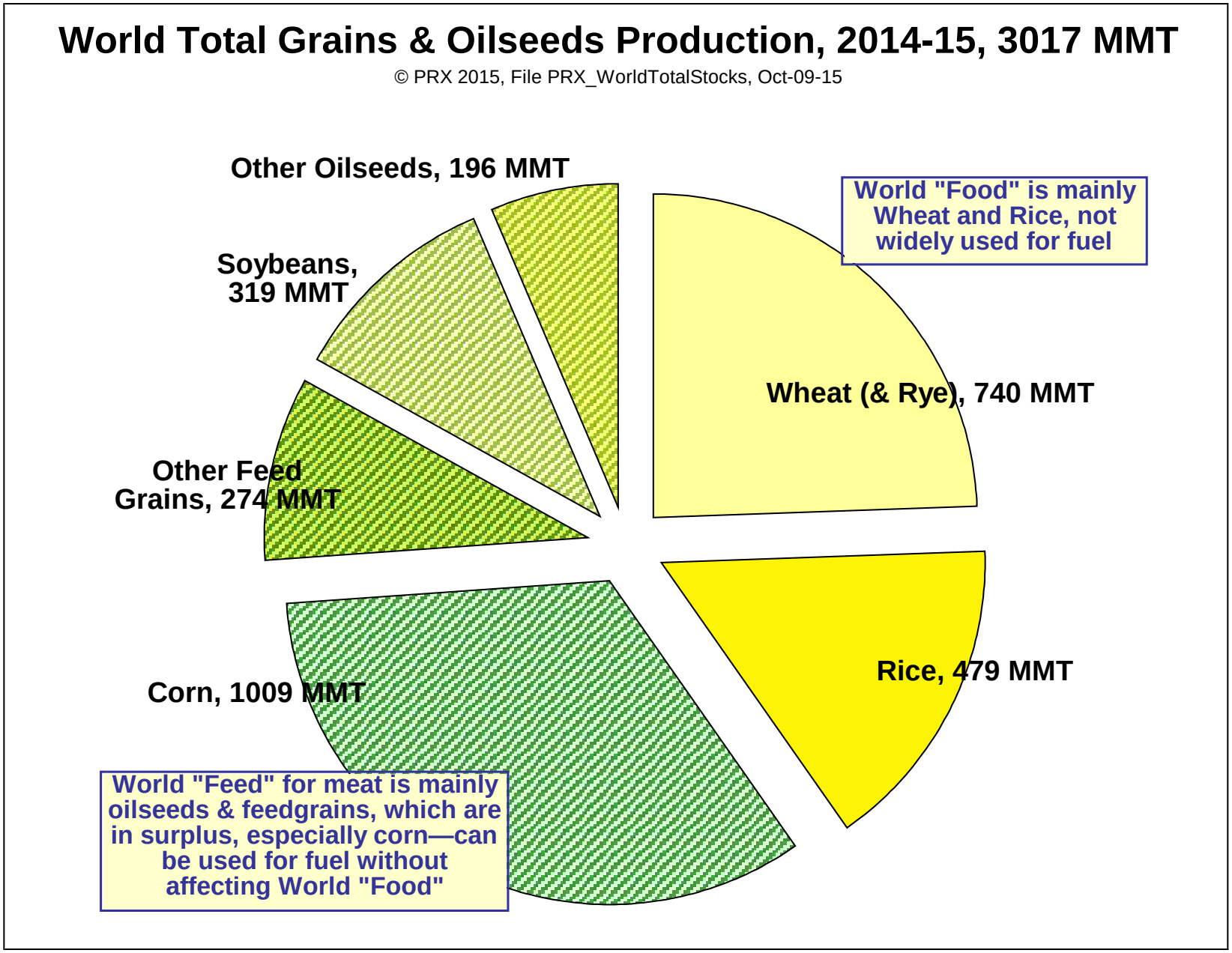
One OUTSIDE CHANCE in 5+ years is E-25

MID-LEVEL ETHANOL BLENDS
Can we produce enough fuel feedstocks?

Yes, due to Surplus Feedgrain Capacity of Three Main World Exporters

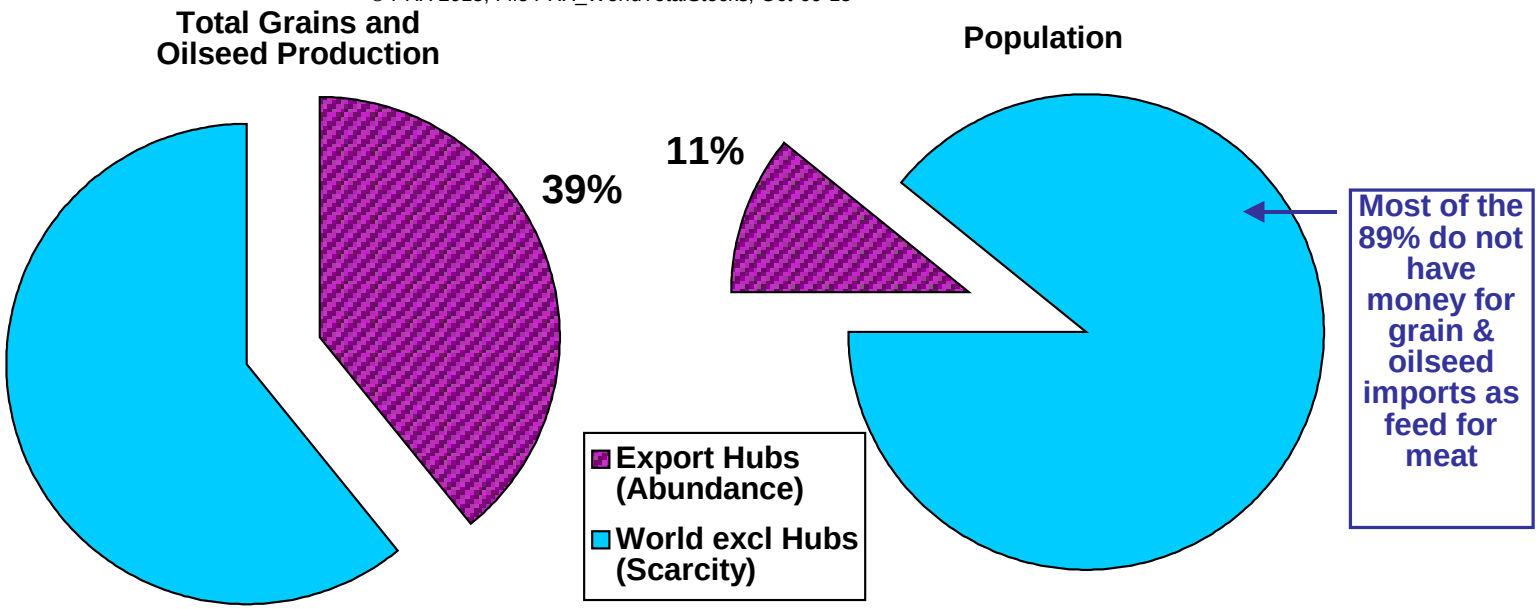
PRX Simplified US Corn Surplus Calculation, 2015-2030
for
AG-Auto-Ethanol Working Group
October 22, 2015 • PRX • Bill Hudson

From Current Official USDA Data



World Total Grains & Total Oilseeds by Origin: Geography Causes Surplus

WORLD GRAIN & OILSEED PRODUCTION STRUCTURE, 2014-15



Total Grains and Oilseed Production

Crop Yr	World	Export Hubs	Rest of World
	mmt	mmt	mmt
14-15	3017	1182	1834
		pct	pct
		39%	61%

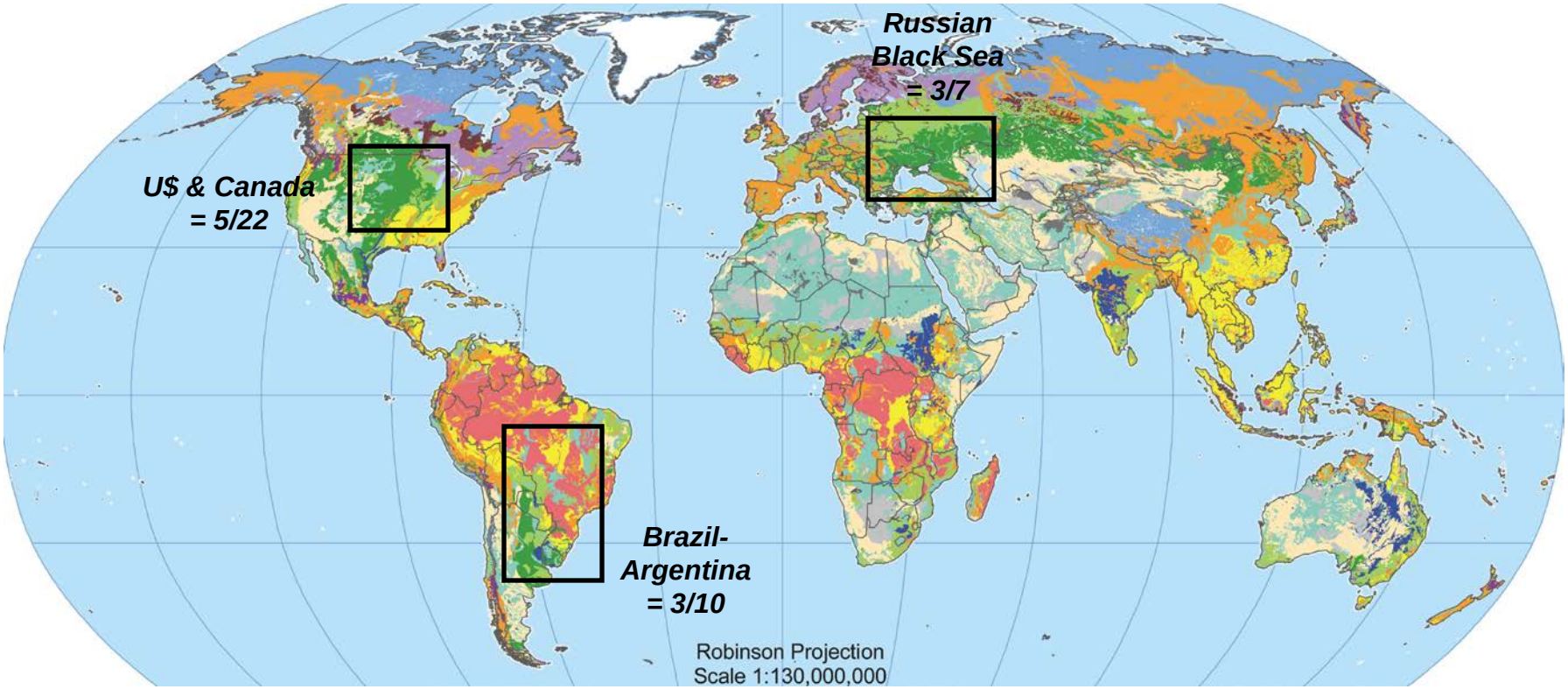
Population

Crop Yr	World	Export Hubs	Rest of World
	mil	mil	mil
14-15	7244	789	6454
		pct	pct
		11%	89%

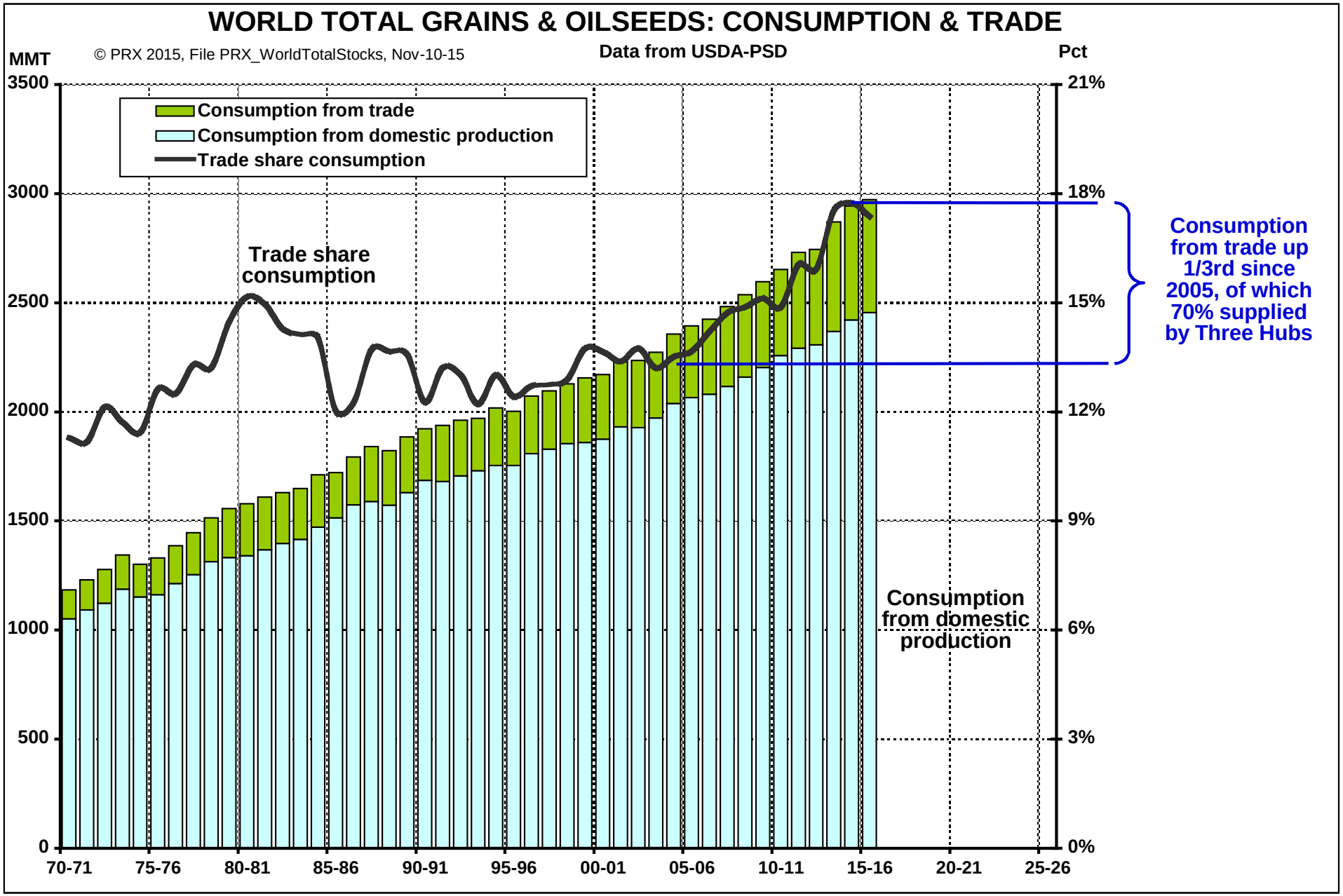
The Three Major Export Hubs are (1) US/CN, (2) Brazl/Arg, & (3) Black Sea

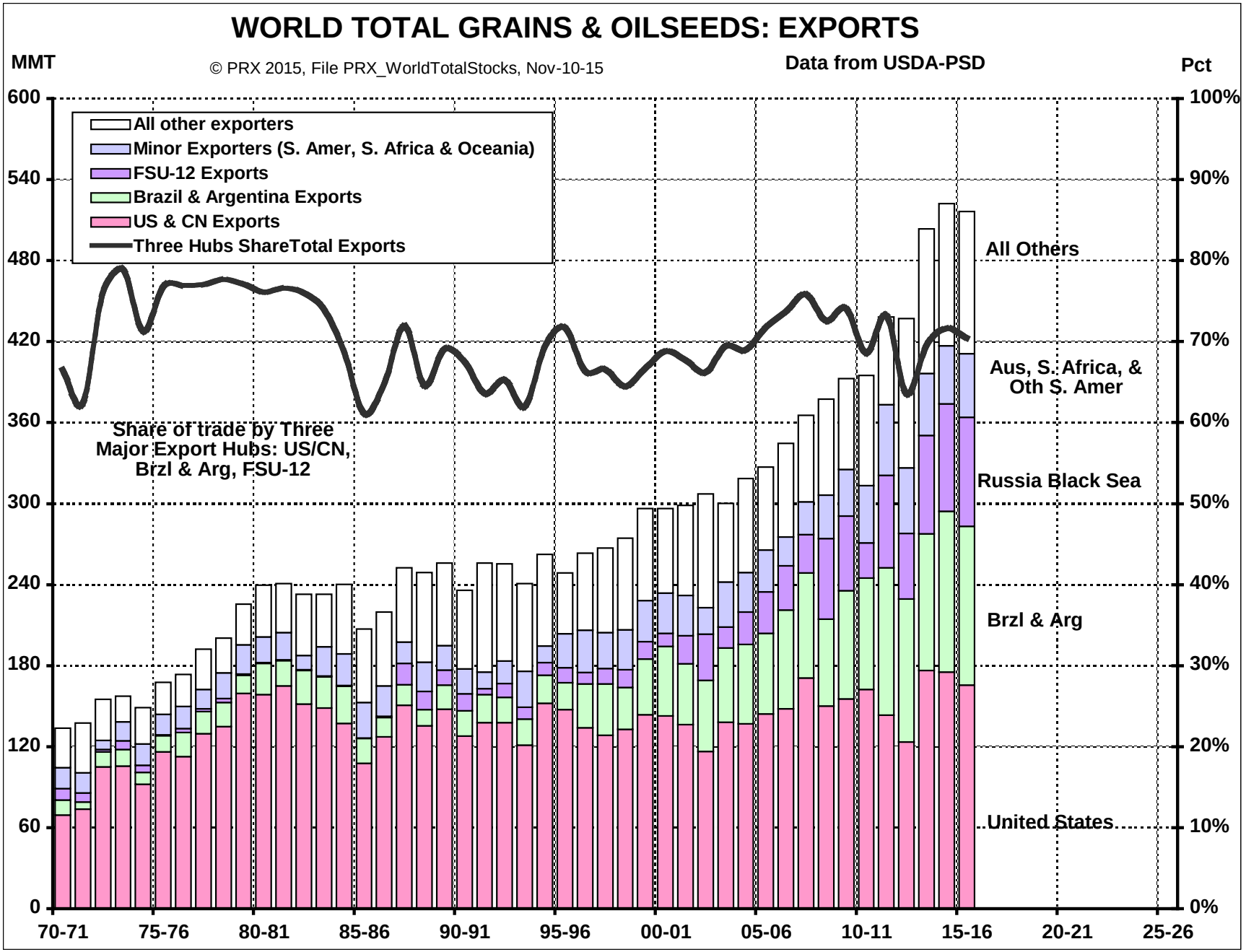
World Grains & Oilseeds by Surplus Export Hubs

Three Export Hubs = 11% World Population,
but 39% World Grain/Oilseed Production =“11/39”
= Perennial Regional Feedgrains/Oilseed Surpluses

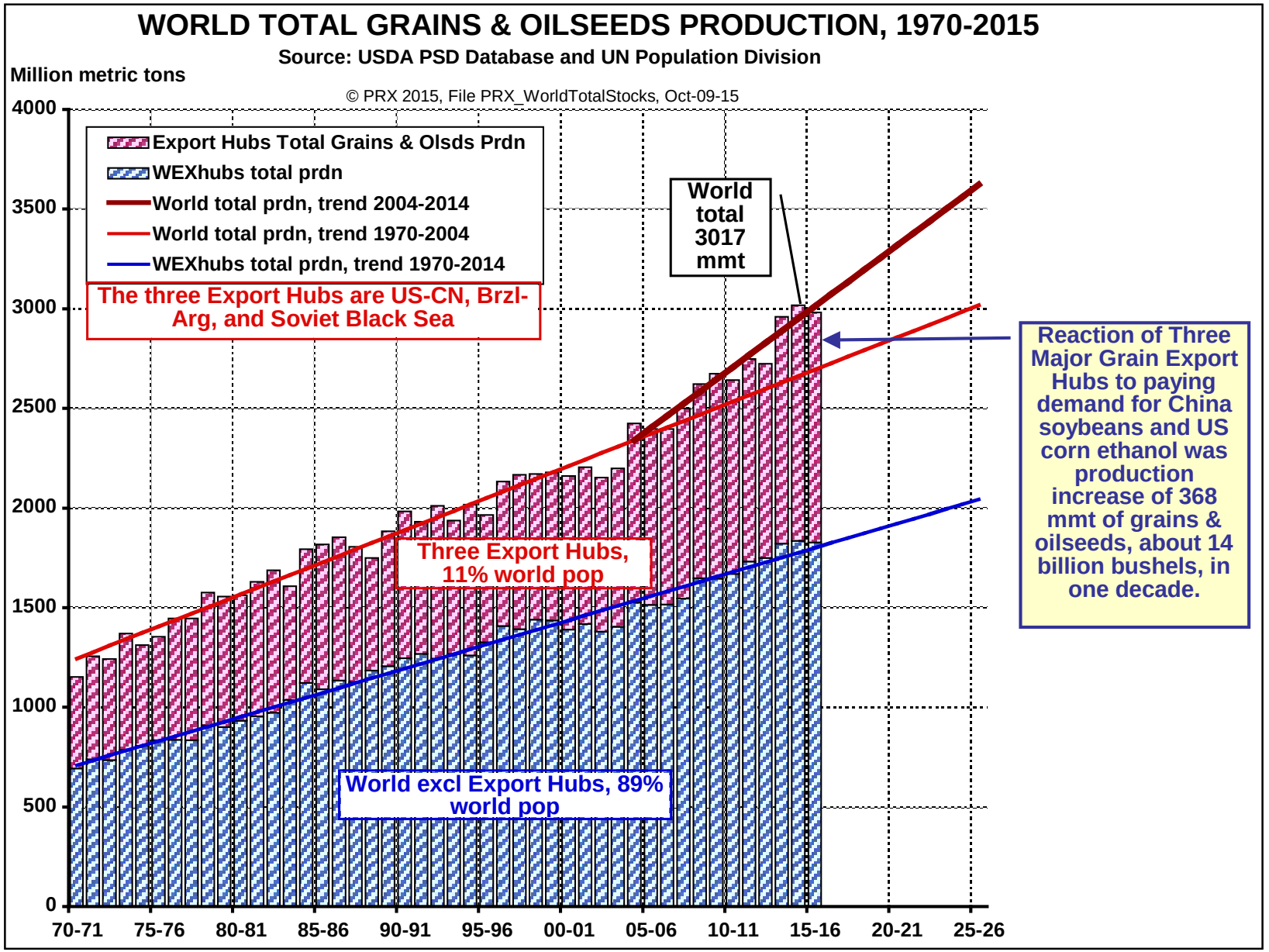


. . . Unless rest of World (89/61) has money to buy meat, or unless surpluses used for fuel.





World Grains & Oilseeds INCREASE is by Export Hubs



Question from AAE-WG audience: "What is increase in corn planted acres since the 2007 Energy Act?" The subtotal of corn + soybean acres has increased as a share of principal crops + CRP, but the overall total of all major crops + CRP acres has declined—and is well within the EPA 402 rule.

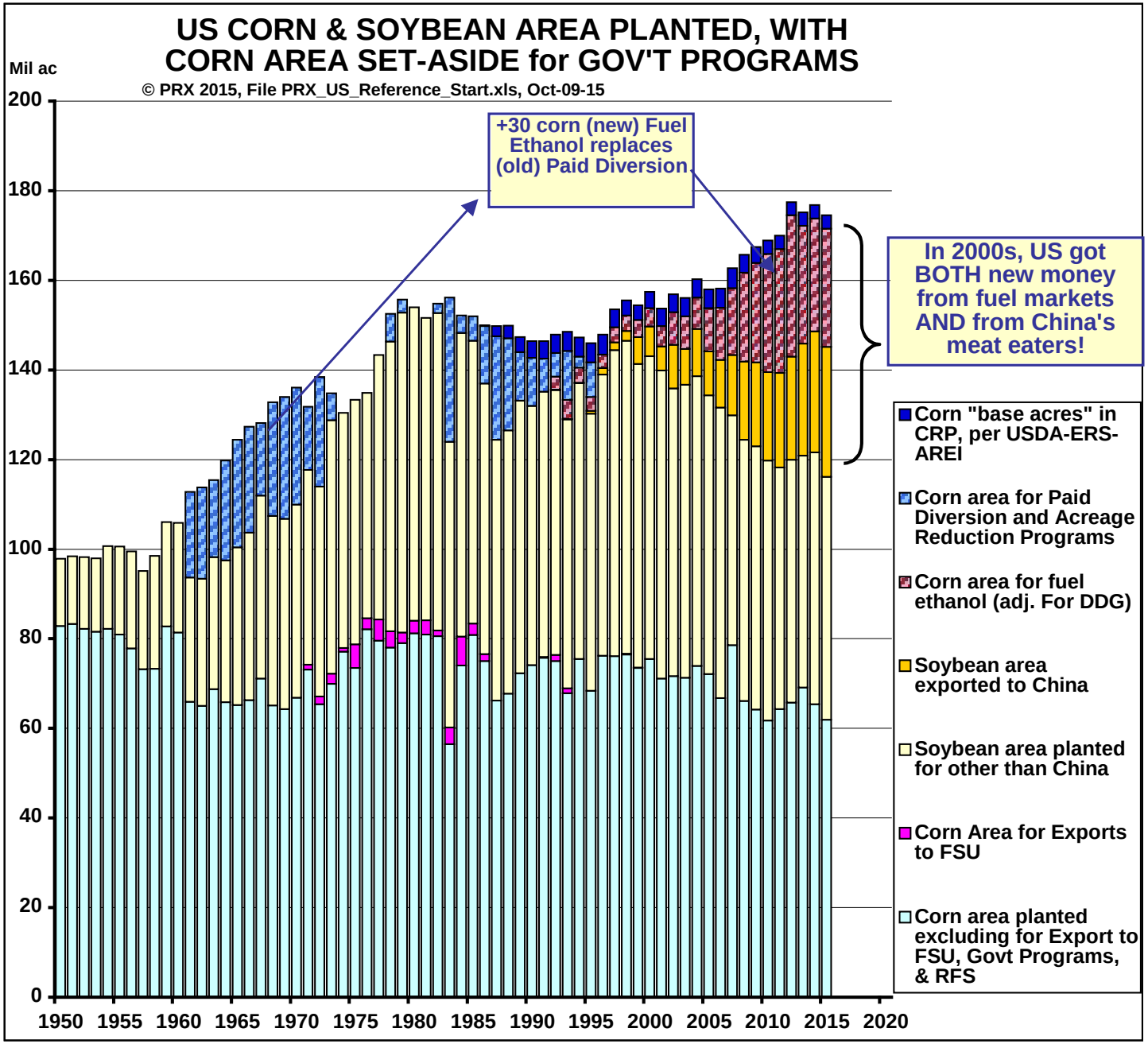
US MAJOR FIELD CROPS AREA PLANTED, 94-95 to 15-16 CROP YEARS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Crop	All	Feedgrains					Oilseeds				Corn +		Total	All Hay	Other	Principal		Subtotal	Total	Other
year	Wheat	Corn	Sorghum	Barley	Oats	Total	Soy	Sunseed	Canola	Total	Soy	Cotton	Major		Major	Crops*	CRP	w/CRP	EPA*	(19-18)
	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac
95-96	69.0	71.5	9.4	6.7	6.2	93.8	62.5	3.5	0.4	66.4	134.0	16.9	246.2	59.8	12.3	318.3	35.0	353.3		cropland
96-97	75.1	79.2	13.1	7.1	4.6	104.1	64.2	2.5	0.4	67.1	143.4	14.7	260.9	61.2	11.6	333.7	34.5	368.2		pasture
97-98	70.4	79.5	10.1	6.7	5.1	101.4	70.0	2.9	0.7	73.6	149.5	13.9	259.2	61.1	11.8	332.1	32.8	364.9		& fallow
98-99	65.8	80.2	9.6	6.3	4.9	101.0	72.0	3.6	1.1	76.7	152.2	13.4	256.9	60.0	13.0	330.0	30.1	360.1		
99-00	62.7	77.4	9.3	5.2	4.7	96.5	73.7	3.6	1.1	78.4	151.1	14.9	252.5	63.2	13.6	329.3	29.8	359.1		
00-01	62.5	79.6	9.2	5.9	4.5	99.1	74.3	2.8	1.6	78.7	153.8	15.5	255.8	60.4	12.5	328.7	31.4	360.1		
01-02	59.4	75.7	10.3	5.0	4.4	95.3	74.1	2.6	1.5	78.2	149.8	15.8	248.7	63.5	12.3	324.6	33.6	358.2		
02-03	60.3	78.9	9.6	5.0	5.0	98.5	74.0	2.6	1.5	78.0	152.9	14.0	250.8	63.9	12.6	327.3	34.0	361.2		
03-04	62.1	78.6	9.4	5.4	4.6	98.0	73.4	2.3	1.1	76.8	152.0	13.5	250.4	63.4	11.9	325.7	34.1	359.8		
04-05	59.6	80.9	7.5	4.5	4.1	97.0	75.2	1.9	0.9	77.9	156.1	13.7	248.3	61.9	12.1	322.3	34.7	357.0		
05-06	57.2	81.8	6.5	3.9	4.2	96.3	72.0	2.7	1.2	75.9	153.8	14.2	243.6	61.6	12.4	317.6	34.9	352.5		
06-07	57.3	78.3	6.5	3.5	4.2	92.5	75.5	2.2	0.9	78.6	153.8	15.3	243.7	60.6	11.3	315.6	36.0	351.6		
07-08	60.5	93.5	7.7	4.0	3.8	109.1	64.7	2.1	1.2	68.0	158.3	10.8	248.3	61.0	11.0	320.4	36.8	357.1	401.6	44.4
08-09	63.2	86.0	8.3	4.2	3.2	101.7	75.7	2.5	1.0	79.2	161.7	9.5	253.6	60.2	11.2	325.0	34.6	359.6	408.3	48.7
09-10	59.2	86.4	6.6	3.6	3.4	100.0	77.5	2.0	0.8	80.3	163.8	9.1	248.6	59.8	10.9	319.3	33.7	353.0	401.2	48.3
10-11	53.6	88.2	5.4	2.9	3.1	99.6	77.4	2.0	1.4	80.8	165.6	11.0	244.9	59.9	11.9	316.7	31.3	348.0	398.2	50.2
11-12	54.4	91.9	5.5	2.6	2.5	102.5	75.0	1.5	1.1	77.7	167.0	14.7	249.3	55.6	10.2	315.1	31.1	346.3	392.0	45.7
12-13	55.3	97.3	6.2	3.7	3.0	110.2	77.2	1.9	1.8	80.9	174.5	12.3	258.6	54.7	11.0	324.3	29.5	353.8	384.0	30.2
13-14	56.2	95.4	8.1	3.5	3.0	109.9	76.8	1.6	1.3	79.8	172.2	10.4	256.4	57.9	10.6	324.9	26.8	351.7	380.0	28.3
14-15	56.8	90.6	7.1	3.0	2.7	103.4	83.3	1.6	1.7	86.6	173.9	11.0	257.8	57.1	11.8	326.8	25.4	352.2	378.0	25.8
15-16	54.6	88.4	8.7	3.4	3.1	103.5	83.2	1.6	1.7	86.5	171.6	9.0	253.7	57.1	14.9	325.7	25.0	350.7	379.0	28.3
Change from previous year, based on Jun-30-2015 USDA Acreage Report																				
	-2.2	-2.2	1.5	0.4	0.3	0.1	-0.1	0.0	0.0	0.0	-2.3	-2.0	-4.2	0.0	3.1	-1.1	-0.4	-1.5		

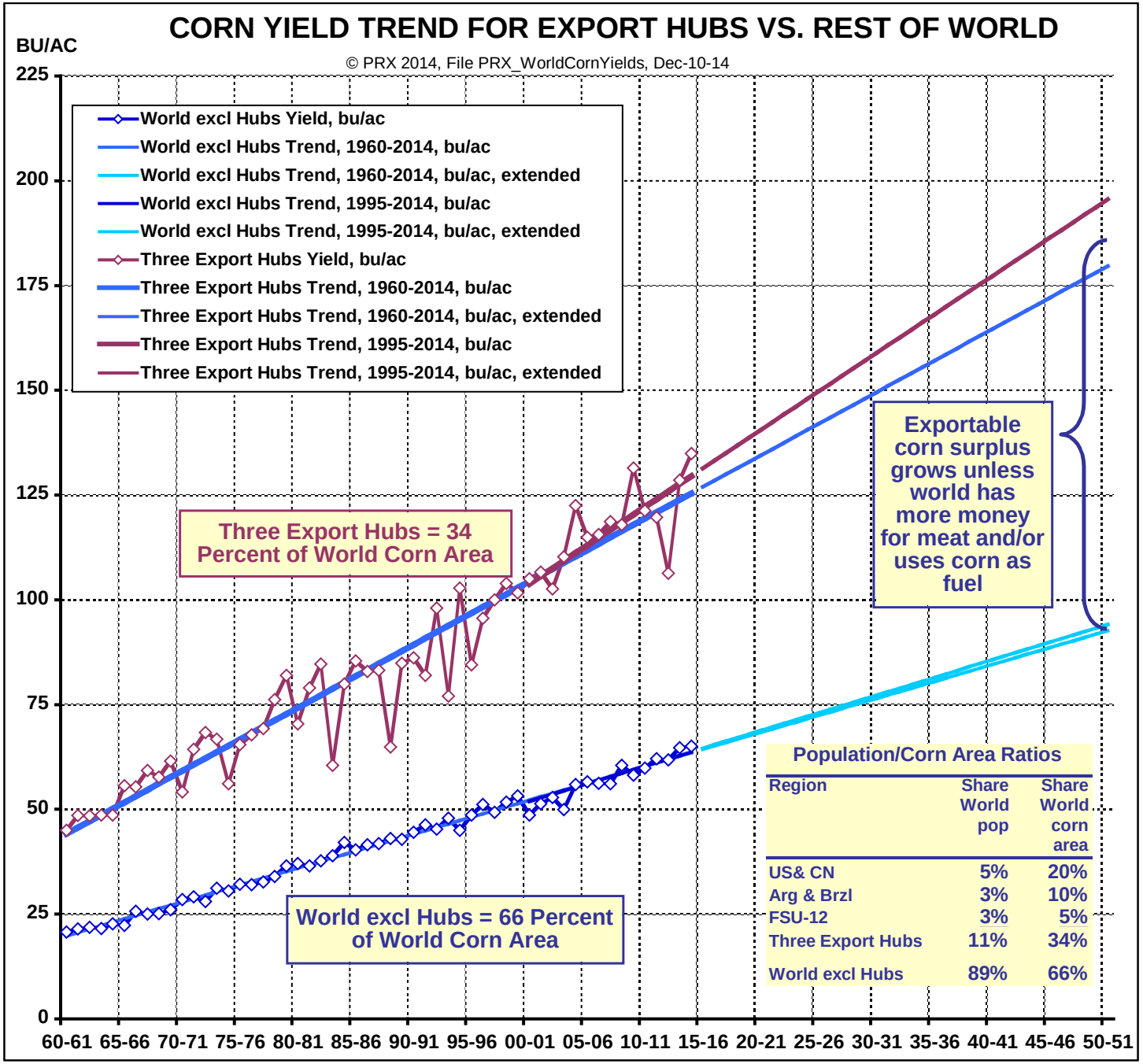
*Principal Crops 2014 reported by NASS in Jun-2015. EPA black numbers are officially reported. EPA compliance uses USDA-FSA in November, not to exceed the 402 of 2007. Red estimates by PRX, today's date.

Corn + soybean acreage has grown as a share of other crops (see previous page).

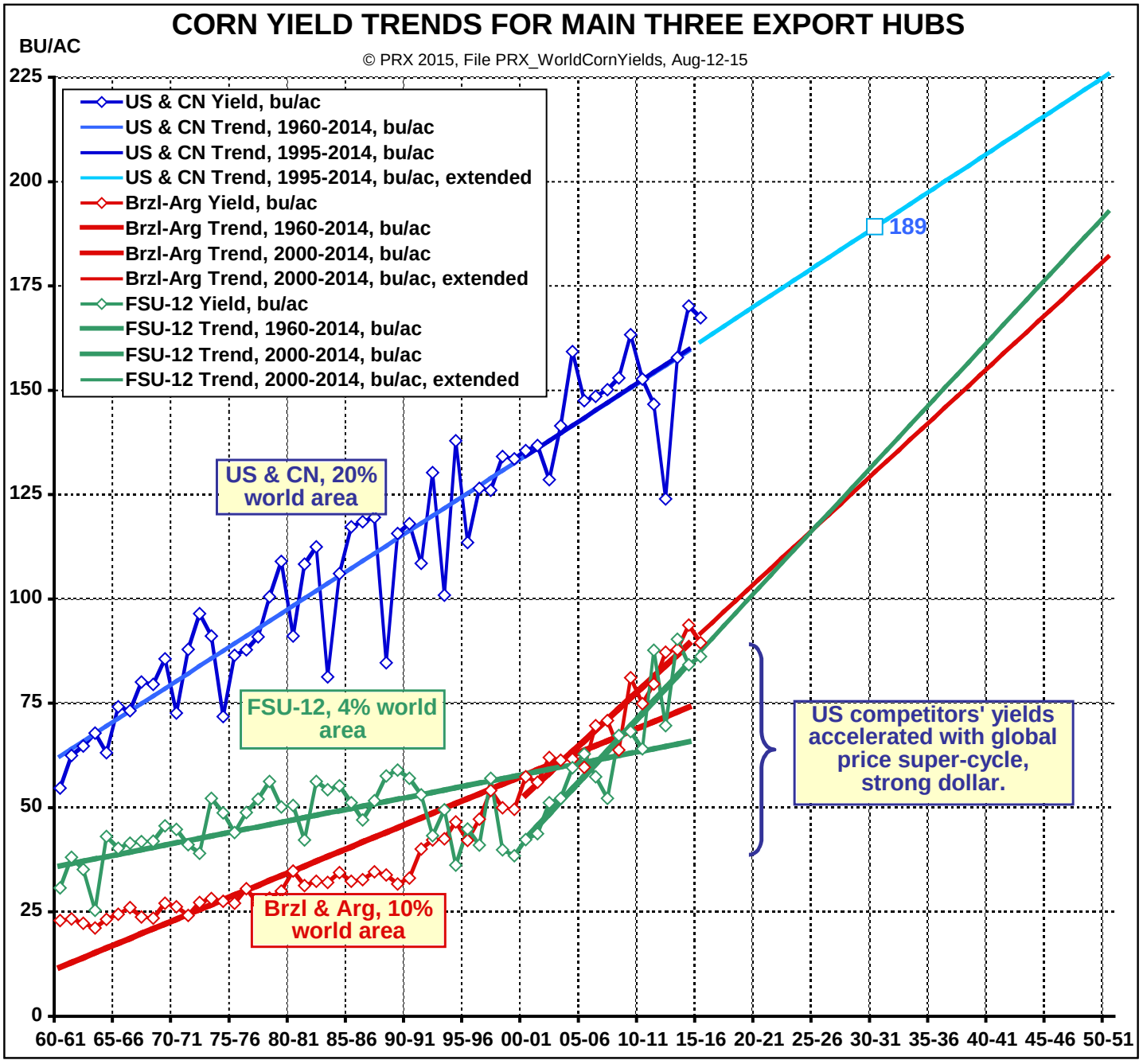
Chart shows paid diversion of CCC corn programs, but not of other feedgrains, wheat, and CRP (beginning in mid-1980s).



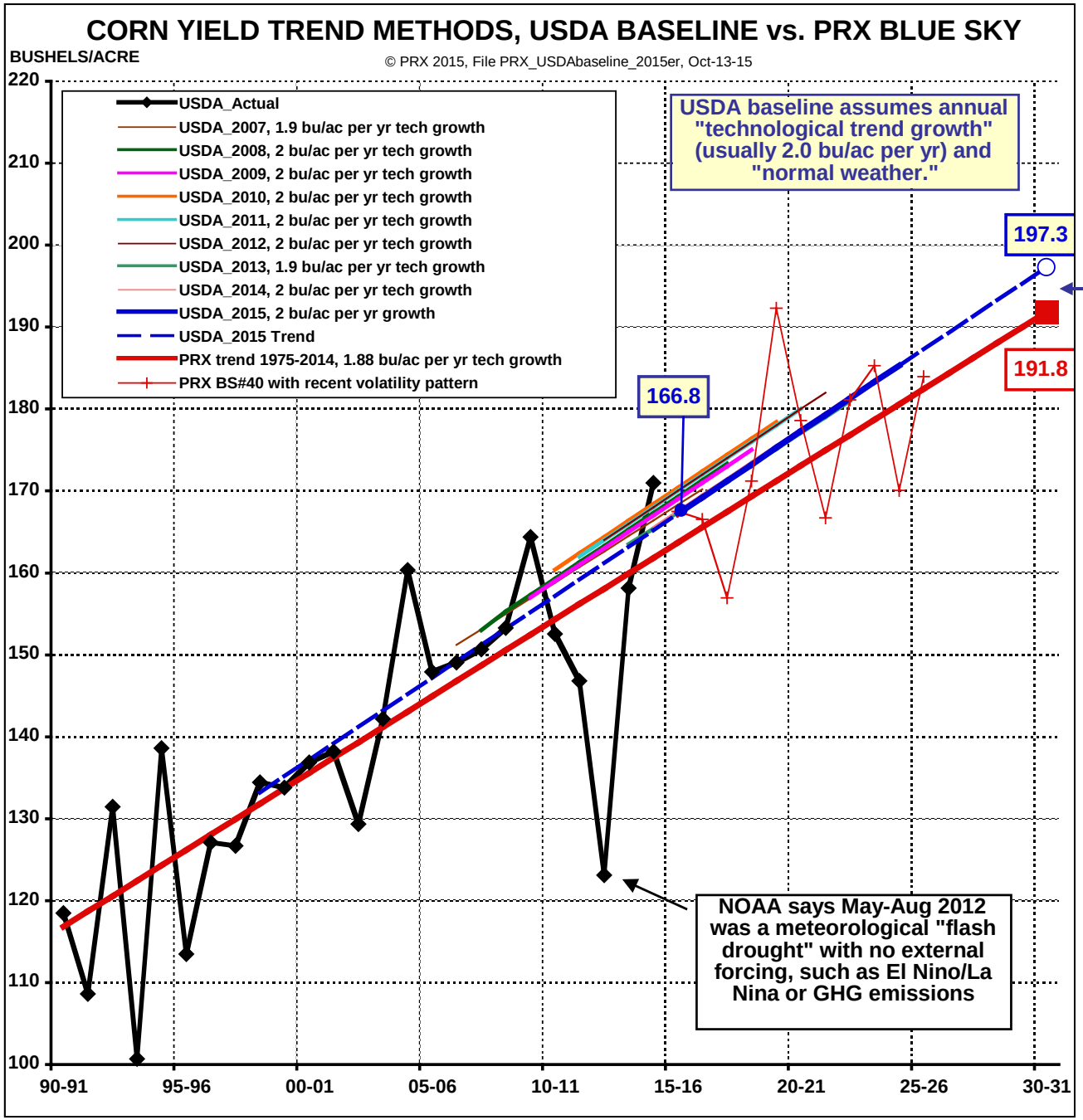
World Corn, per official USDA data



US & CN Corn, Long-term



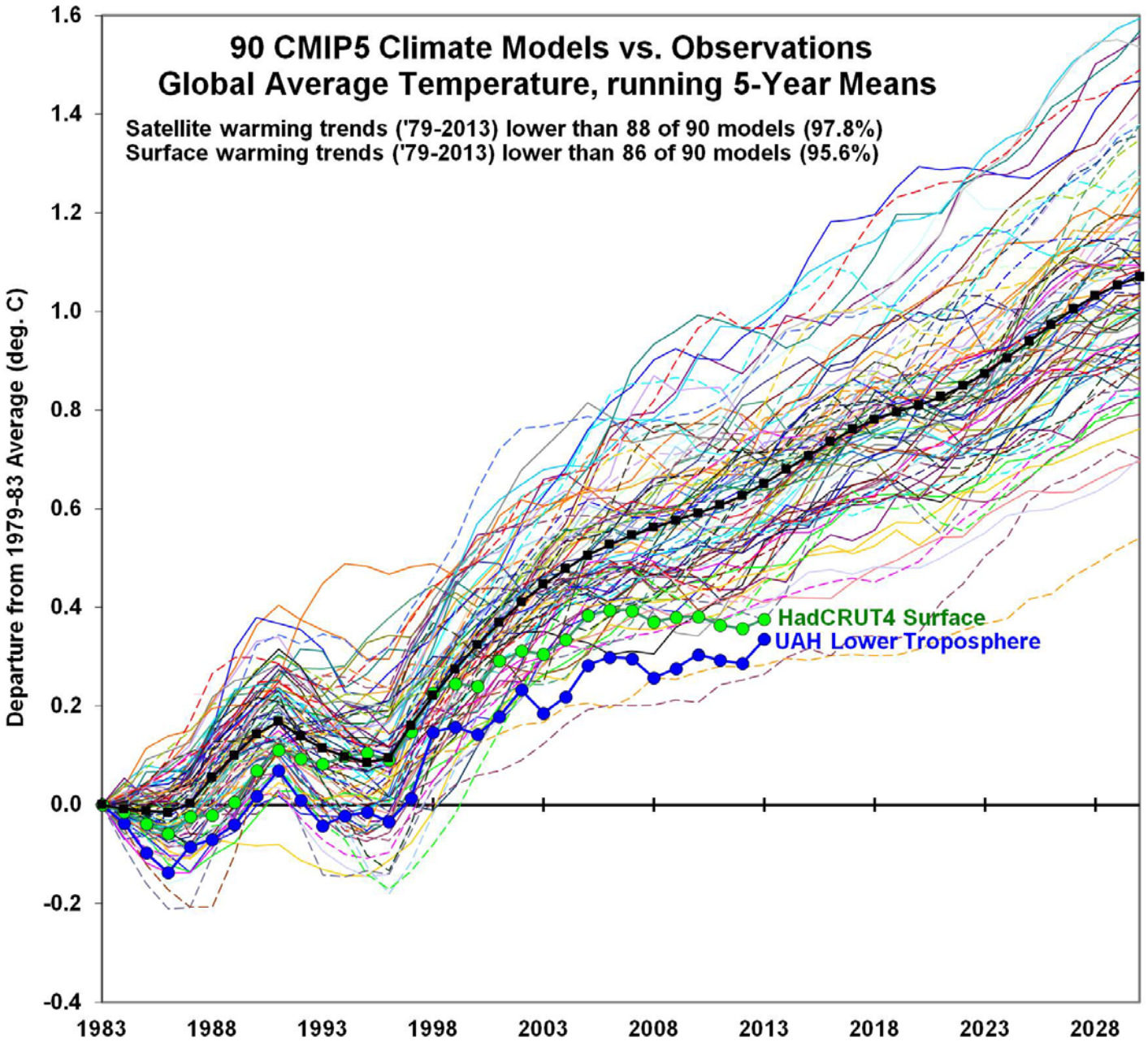
US Corn, 2030



Use 195 for PRX 2030 calculation.

The "genetic potential" yield is more than double this figure, as shown by NCGA corn contest winners.

BTW, what about Climate Change?

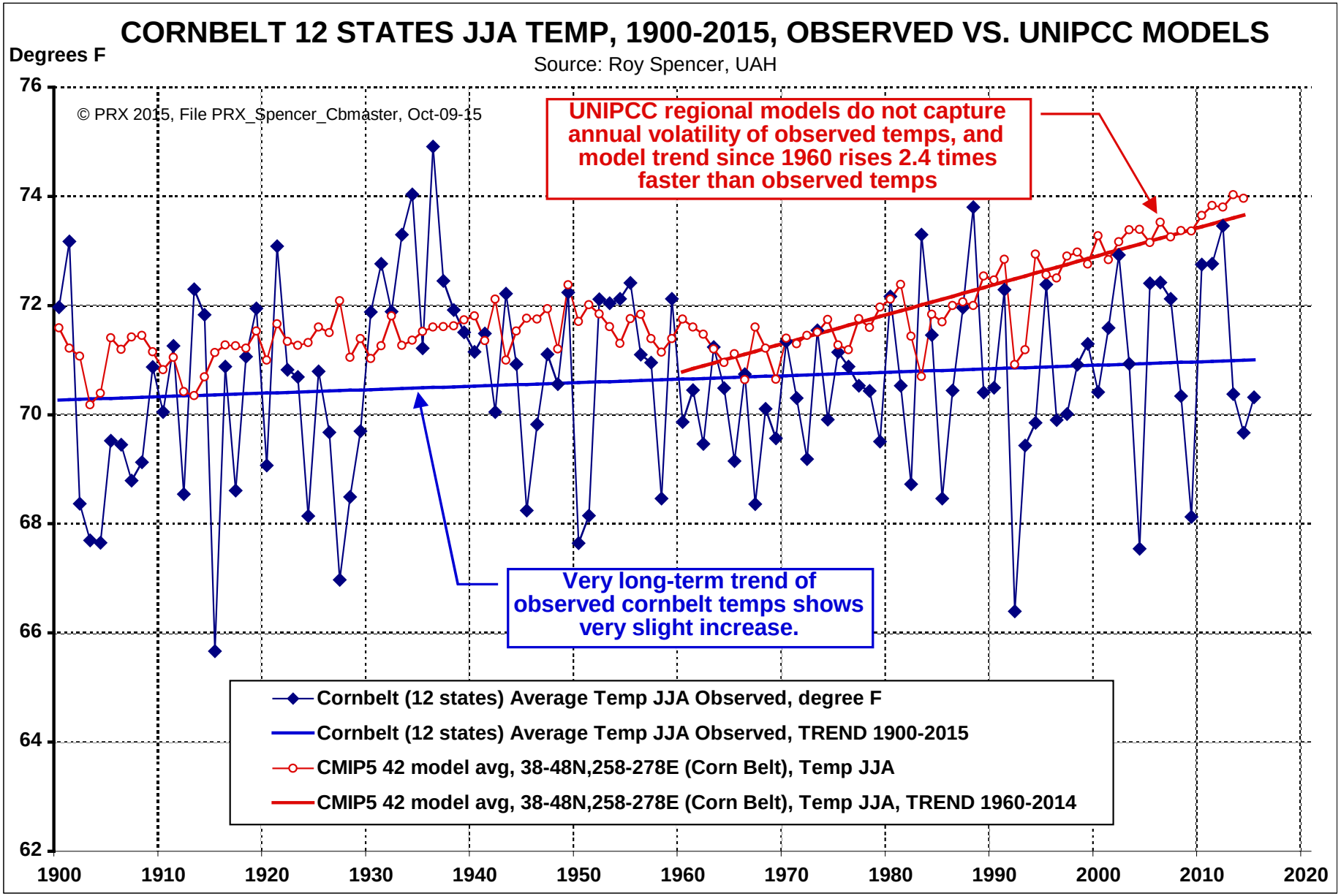


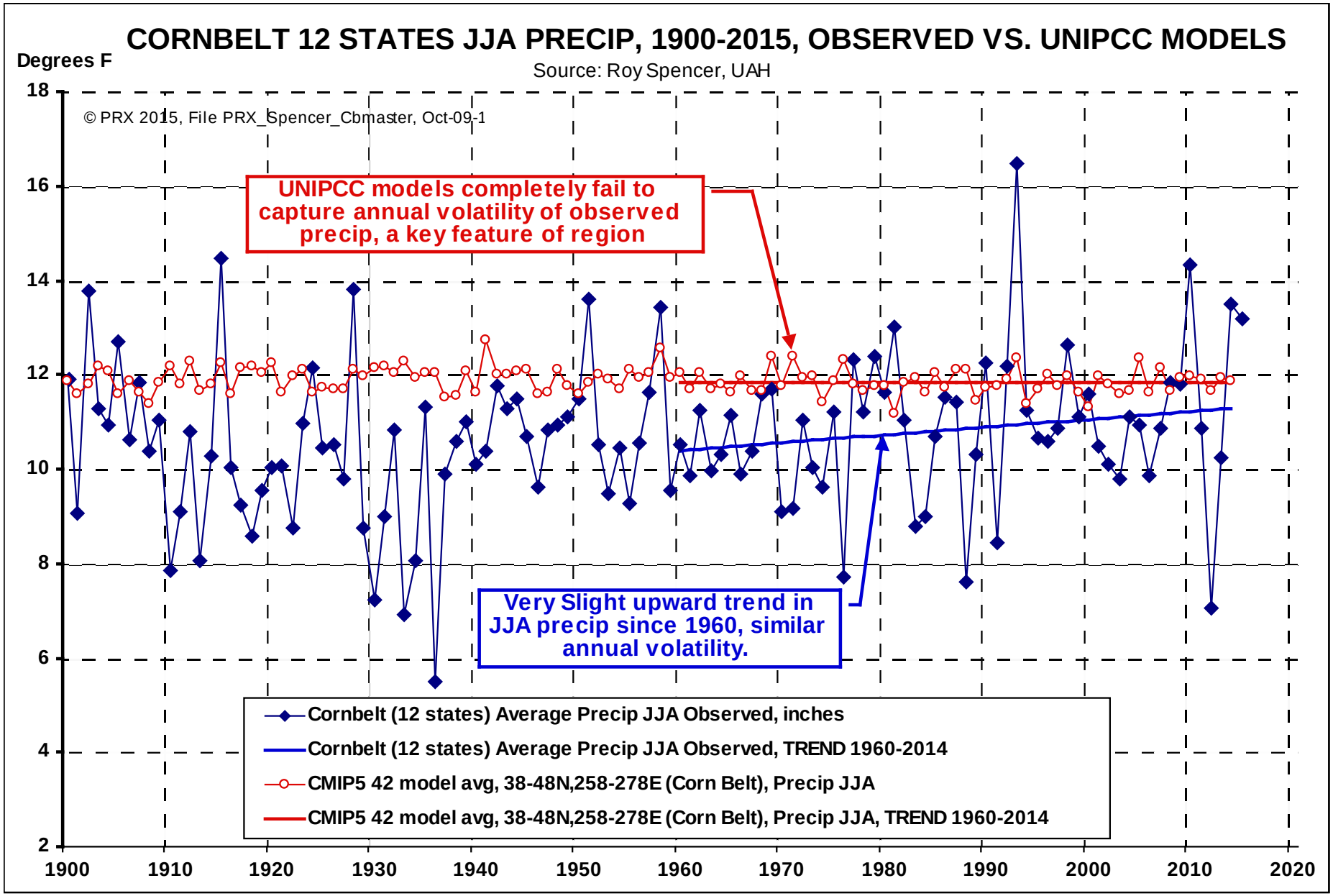
Dan Glickman, Secretary of Ag 1995-2001, who established the Climate Change Office in 1997 under Chief Economist Keith Collins, said in early 2015: "We could be doing much more to educate producers and establish tools like longer term weather and climate forecasting."

(Dan: Take your pick from these 42!)

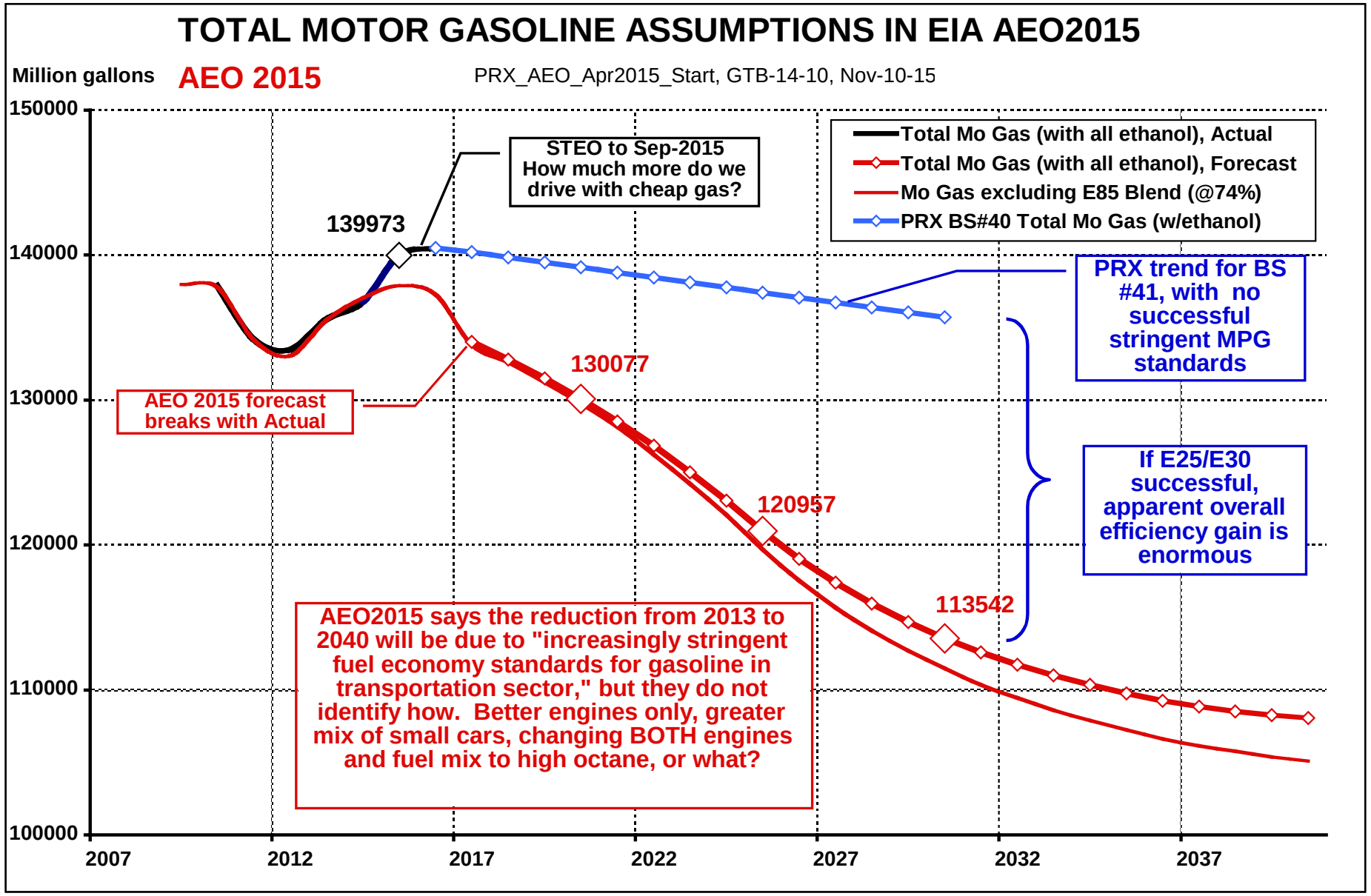
(Note: USDA-ERS published a Climate Change Impact Study on US Crop Yields Nov-30-2015, using some of the UN models shown here.)

Speculation: USDA Baseline Team not willing to adopt AVERAGE of UNIPCC regional temp-precip models





Latest USDOE-AEO, Dec-2014, misses impact of cheap gasoline on volume of usage.



WITH GASOLINE USAGE IN AEO 2015, ESTIMATED ETHANOL VOLUME & BUSHELS OF CORN DEMAND WITH E25 @ 70% ACCEPTANCE

			Eventual E25					
			GASOLINE USE					2030-2015
			2010	2015	2020	2025	2030	Change
			STEO		AEO 2015			
1	Domestic gas use	mil gals	137857	139973	130077	120957	113542	
2	used as E0	pct			2.0%	2.0%	2.0%	
3	used as E10	pct			93.0%	60.5%	28.0%	
4	used as E25 (or E15 above)	pct			5.0%	37.5%	70.0%	
5	Ethanol domestic volume used							
6	used as E10, conventional	mil gal			12097	7318	3179	
7	used as E25, conventional	mil gal			1626	11340	19870	
8	Total used, conventional	mil gal	12858	13432	13723	18658	23049	
9	used as cellulosic	mil gal	0	75	100	100	350	
10	Ethanol domestic volume used	mil gal	12858	13507	13823	18758	23399	
11	Ethanol domestic volume used	pct	9.3%	9.6%	10.6%	15.5%	20.6%	
12	Total conventional ethanol used	mil gal	12858	13357	13623	18558	22699	
13	Conventional ethanol net exports	mil gal	439	1092	1264	1464	1664	
14	Conventional ethanol production	mil gal	13298	14448	14887	20021	24363	9915

Approx additional ethanol needed for 70% E25 in 2030

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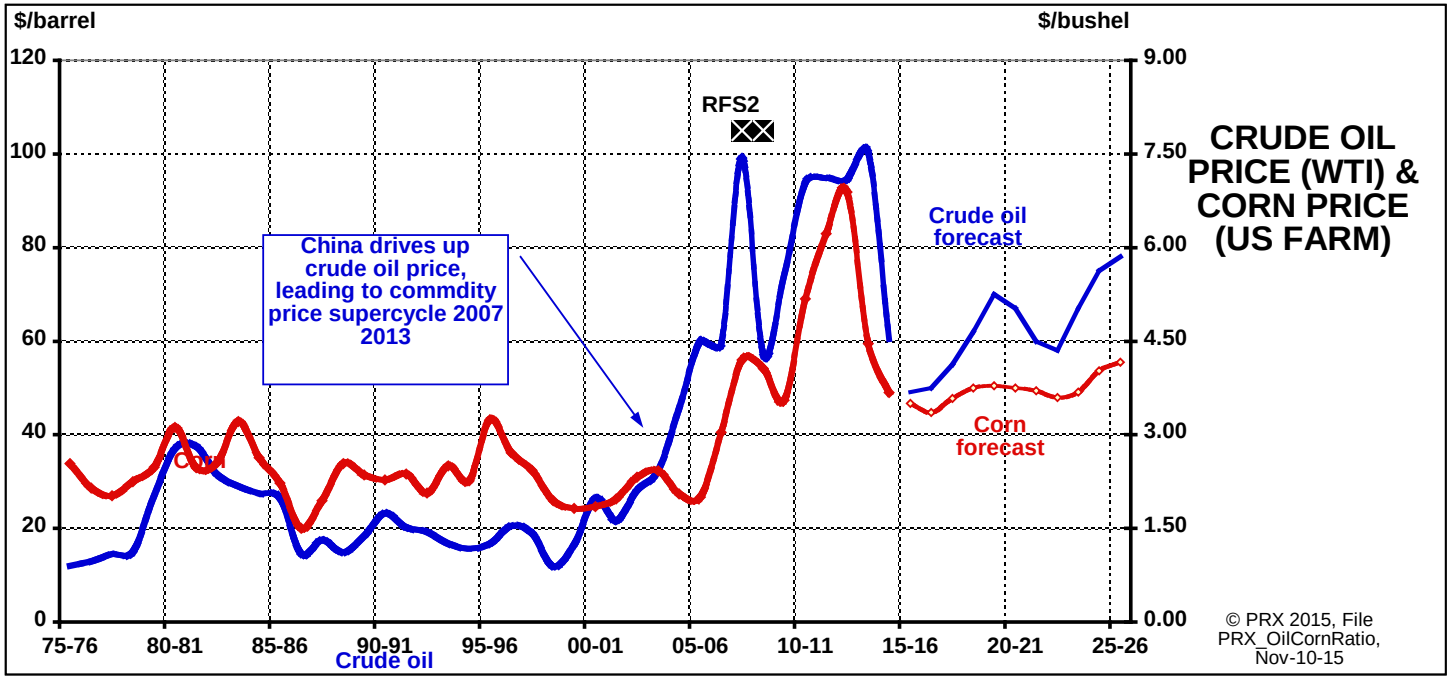
15								
16	PRX Ethanol yield	gals/bu	2.75	2.80	2.85	2.89	2.94	
17	PRX calc corn/milo ethanol prdn	mil bu	4840	5166	5232	6917	8277	
18								
19	PRX DDG prdn estimate	mt/bu	0.0068	0.0068	0.0068	0.0068	0.0068	
20	PRX DDG prdn estimate	mmt	33	35	36	47	57	
21	PRX DDG domestic fed	pct	74.2%	67.8%	63.1%	58.1%	53.1%	
22	PRX DDG domestic fed	mmt	25	24	23	28	30	
23	PRX DDG domestic fed corn displ	bu/mt	38	38	38	38	38	
24	PRX DDG domestic fed corn displ	mil bu	924	901	849	1034	1131	
25								Total
26	PRX calc corn/milo excl DDG fed displ	mil bu	3916	4265	4382	5883	7146	2881
27								
28	PRX DDG export estimate	pct	25.8%	32.2%	36.9%	41.9%	46.9%	
29	PRX DDG export estimate	mmt	9	11	13	20	27	
30	PRX DDG export estimate	mil bu	321	427	496	745	997	
31								
32	PRX Area Planted & Trend	mil ac	88.2	88.9	92.0	92.0	94.0	
33	PRX Area Harvested & Trend	mil ac	81.4	81.1	83.9	83.9	85.7	
34	PRX Yield and Trend	bu/ac	153	168	175	185	195	
35	PRX Corn Production trend	mil bu	12447	13585	14687	15526	16721	3136
36	Surplus (-), Deficit (+)	mil bu						-255

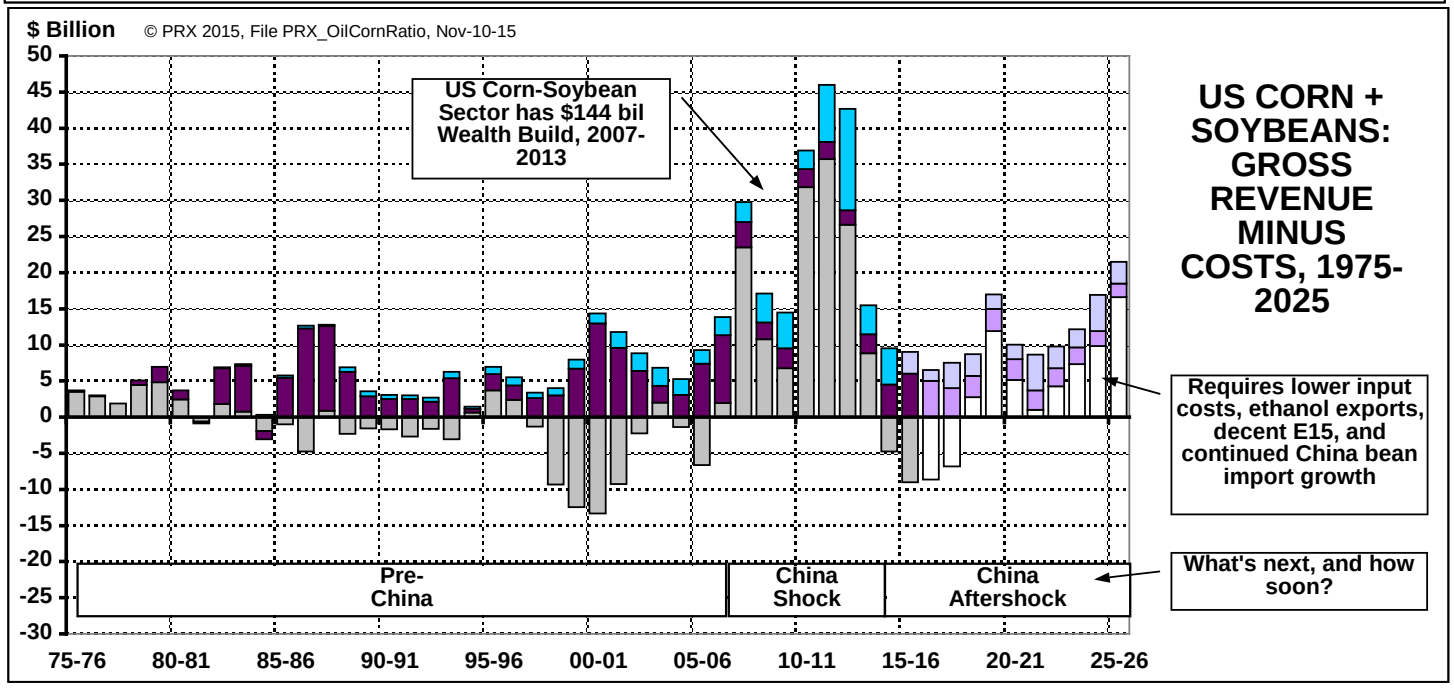
Annual corn surplus 2030

US CORN & SOYBEAN DEMAND SUMMARY, Blue Sky #41

PRX_BS1_OverviewDeck_Start, GTB-15-11, Nov-10-15, #41

	Item	Unit	Crop Year 12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	25-26 minus 15-16
	Corn Ethanol Use																
1	Eth Prdn	*mil bu*	4558	5018	5242	5149	5225	5301	5386	5470	5553	5636	5718	5799	5880	5960	811
2	Eth Prdn	*bil gal*	*12.9*	*14.1*	*14.5*	*14.5*	*14.6*	*14.9*	*15.2*	*15.5*	*15.8*	*16.1*	*16.4*	*16.7*	*17.0*	*17.3*	*2.8*
3	Eth Exp	*bil gal*	*0.6*	*0.8*	*0.9*	*0.9*	*1.0*	*1.0*	*1.1*	*1.2*	*1.3*	*1.4*	*1.5*	*1.6*	*1.7*	*1.8*	*0.9*
4	Eth Dmstc	*bil gal*	*13.0*	*13.4*	*13.6*	*13.8*	*14.0*	*14.2*	*14.4*	*14.6*	*14.8*	*15.0*	*15.2*	*15.4*	*15.6*	*15.8*	*2.0*
5	Mo Gas	*bil gal*	*133.5*	*135.6*	*136.8*	*139.7*	*140.3*	*140.0*	*139.6*	*139.3*	*138.9*	*138.6*	*138.2*	*137.9*	*137.6*	*137.2*	*-2.4*
6	Eth E10	*bil gal*	*12.9*	*13.2*	*13.5*	*13.7*	*13.9*	*13.9*	*14.1*	*14.2*	*14.3*	*14.3*	*14.3*	*14.3*	*14.2*	*14.2*	*0.5*
7	Eth E15+	*bil gal*	*0.1*	*0.2*	*0.2*	*0.2*	*0.3*	*0.4*	*0.4*	*0.5*	*0.7*	*0.8*	*1.0*	*1.3*	*1.5*	*1.8*	*1.6*
	Corn Exports by Type Summary																
8	Whole Corn	*mil bu*	766	1839	1864	1800	1788	1837	1885	1933	1980	2026	2072	2117	2000	2000	200
9	Ethanol Eqv	*mil bu*	202	290	296	322	374	391	425	458	492	525	558	591	624	656	335
10	DDG/CGF Eq	*mil bu*	270	350	324	333	346	351	365	368	376	385	386	400	408	416	82
11	Meat Eqv	*mil bu*	612	653	656	605	679	694	709	724	739	754	769	784	799	814	209
12	Subtotal	*mil bu*	1850	3131	3140	3061	3187	3272	3384	3483	3587	3690	3785	3893	3831	3886	826
13	Feed & Other	*mil bu*	4675	5305	5366	5358	5406	5182	5356	5566	5296	5127	5214	5239	4895	5077	-281
14	Corn Ttl Use	*mil bu*	11083	13454	13748	13567	13818	13755	14125	14519	14436	14452	14717	14930	14606	14923	1356
	Soybean Export & Biodiesel Use																
15	Exports	*mil bu*	1317	1638	1843	1675	1652	1687	1602	1809	1870	1932	1994	2056	2119	2182	*507*
16	Soyoil Bio	*mil gals*	*577*	*690*	*630*	*646*	*667*	*688*	*709*	*730*	*751*	*771*	*792*	*813*	*834*	*855*	*209*
17	Shr Crush	*pct*	*22.7%*	*26.4%*	*23.0%*	*23.0%*	*23.9%*	*26.1%*	*27.7%*	*25.5%*	*26.2%*	*27.0%*	*28.4%*	*31.3%*	*29.1%*	*29.9%*	*6.9%*
18	Corn oil indst	*mil gals*	*244*	*254*	*283*	*299*	*294*	*300*	*305*	*312*	*318*	*325*	*331*	*338*	*344*	*350*	*52*
19	Ttl Use	*mil bu*	3111	3479	3861	3705	3652	3587	3402	3859	3920	3982	3994	3931	4169	4232	527





China's absolute food oil & protein meal dependence on the Americas.