



# **Biofuel Supply, Feedstock Availability & Infrastructure Issues**

## **Joint Lead Commissioner Workshop on Transportation Energy Demand Forecasts**

Hearing Room A

August 21, 2013

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*Fuels and Transportation Division*

*California Energy Commission*

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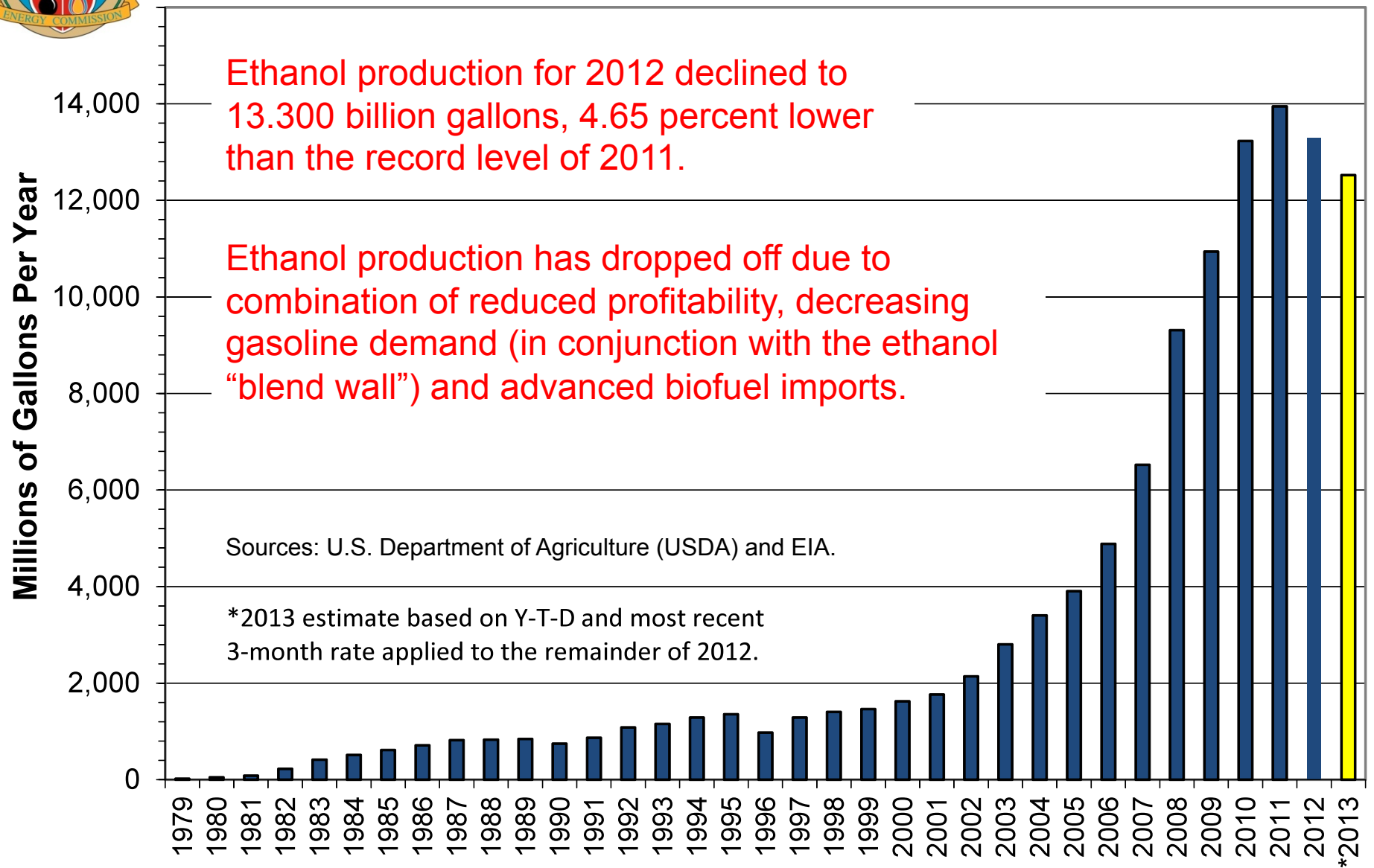


# Presentation Topics

- Ethanol fuel use and feedstocks
- Ethanol availability
- Ethanol issues
- Biodiesel use and feedstocks
- Biodiesel availability
- Biodiesel issues
- Advanced biofuel use
- Advanced biofuel availability
- Advanced biofuel issues

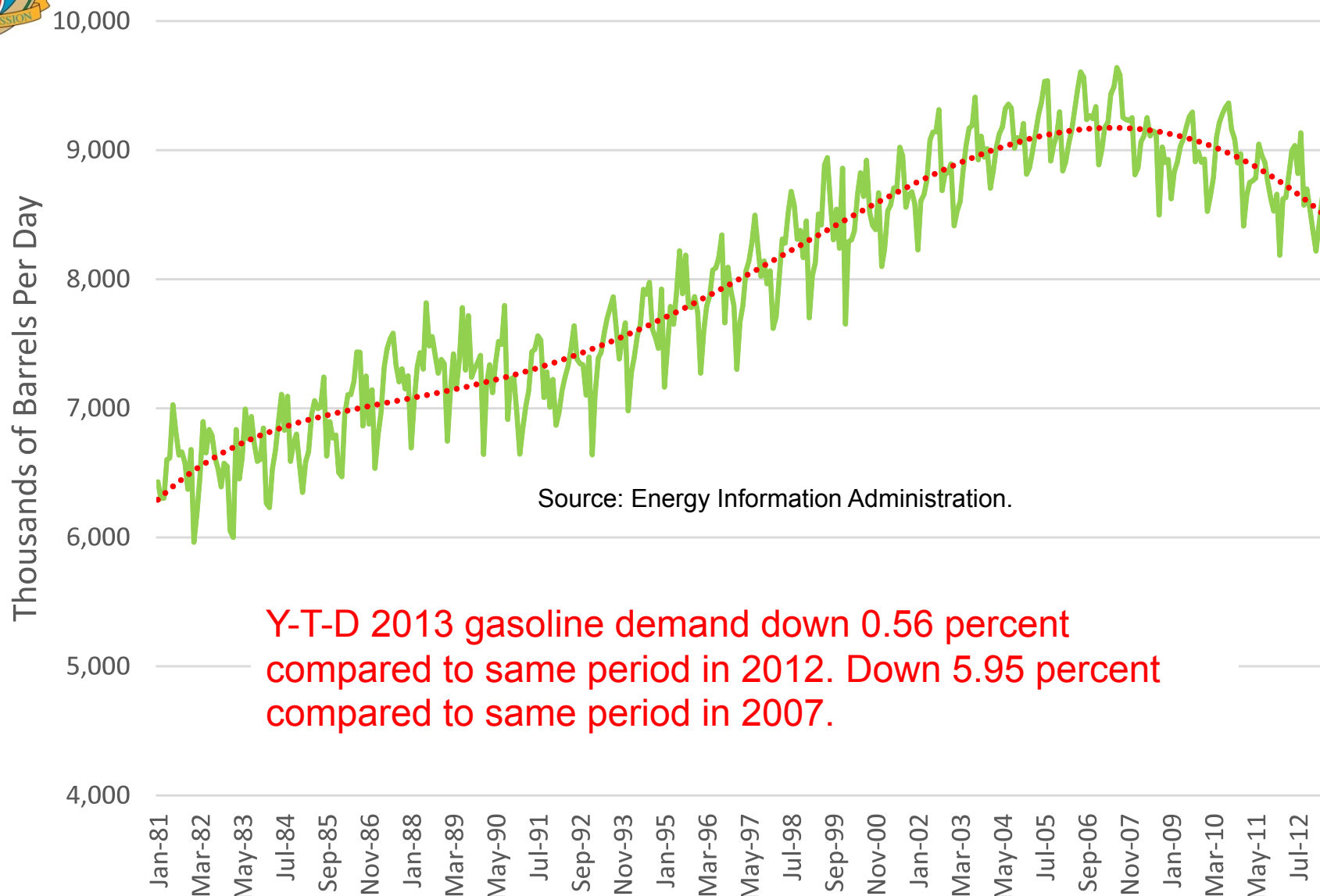


## U.S. Ethanol Production 1979 - 2013





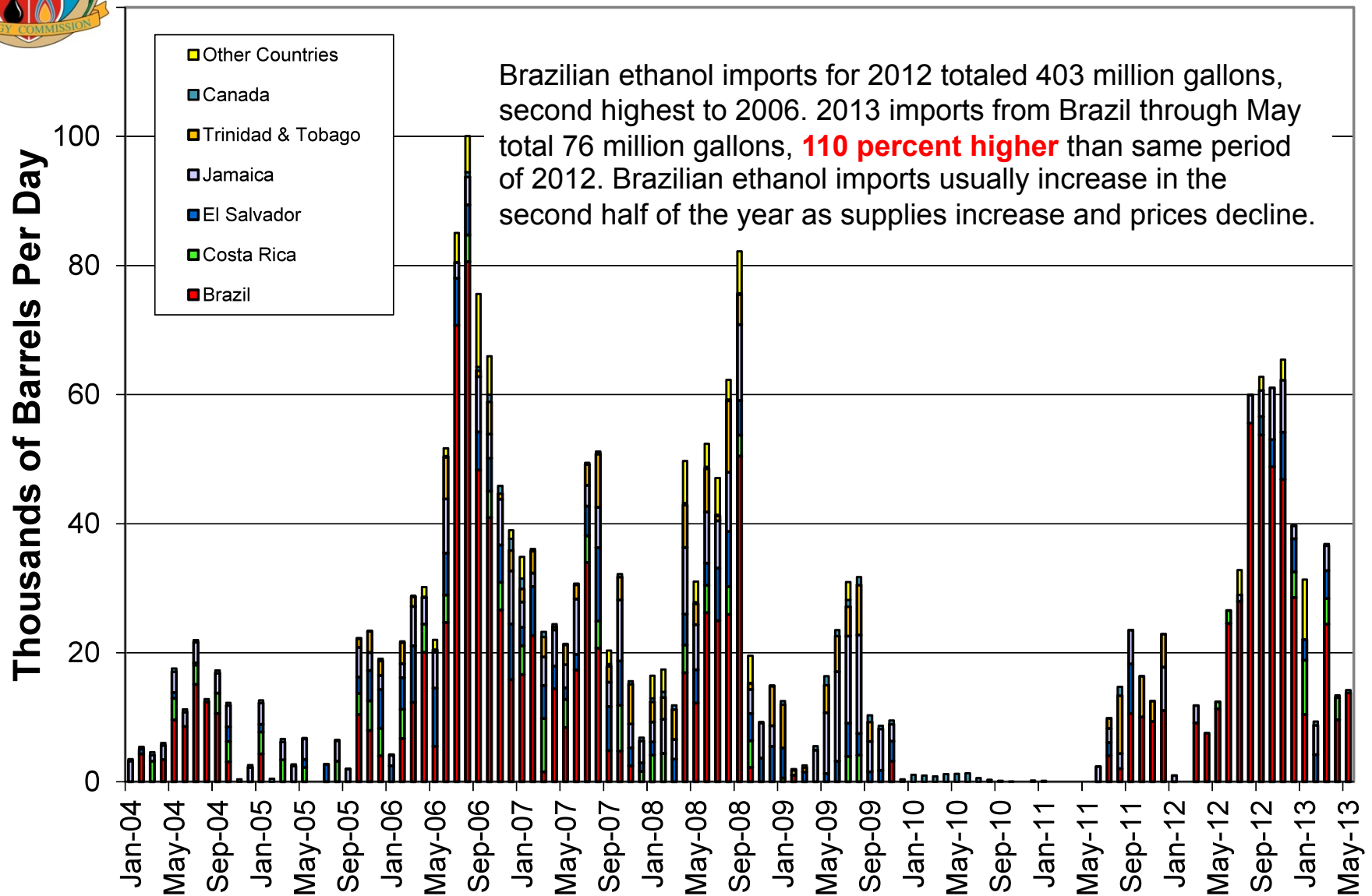
## U.S. Finished Gasoline Demand (1981 - May 2013)





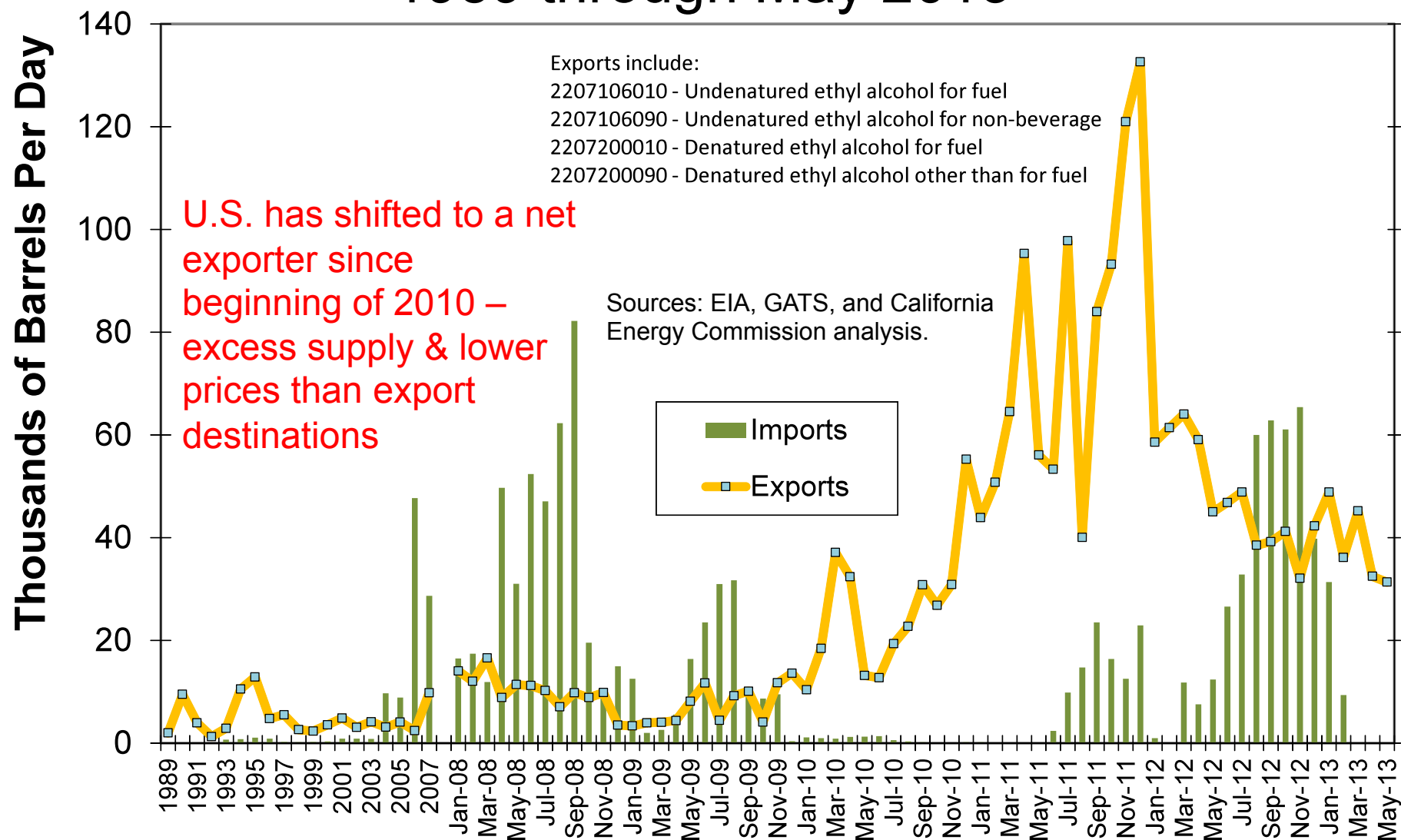


# U.S. Imports of Fuel Ethanol



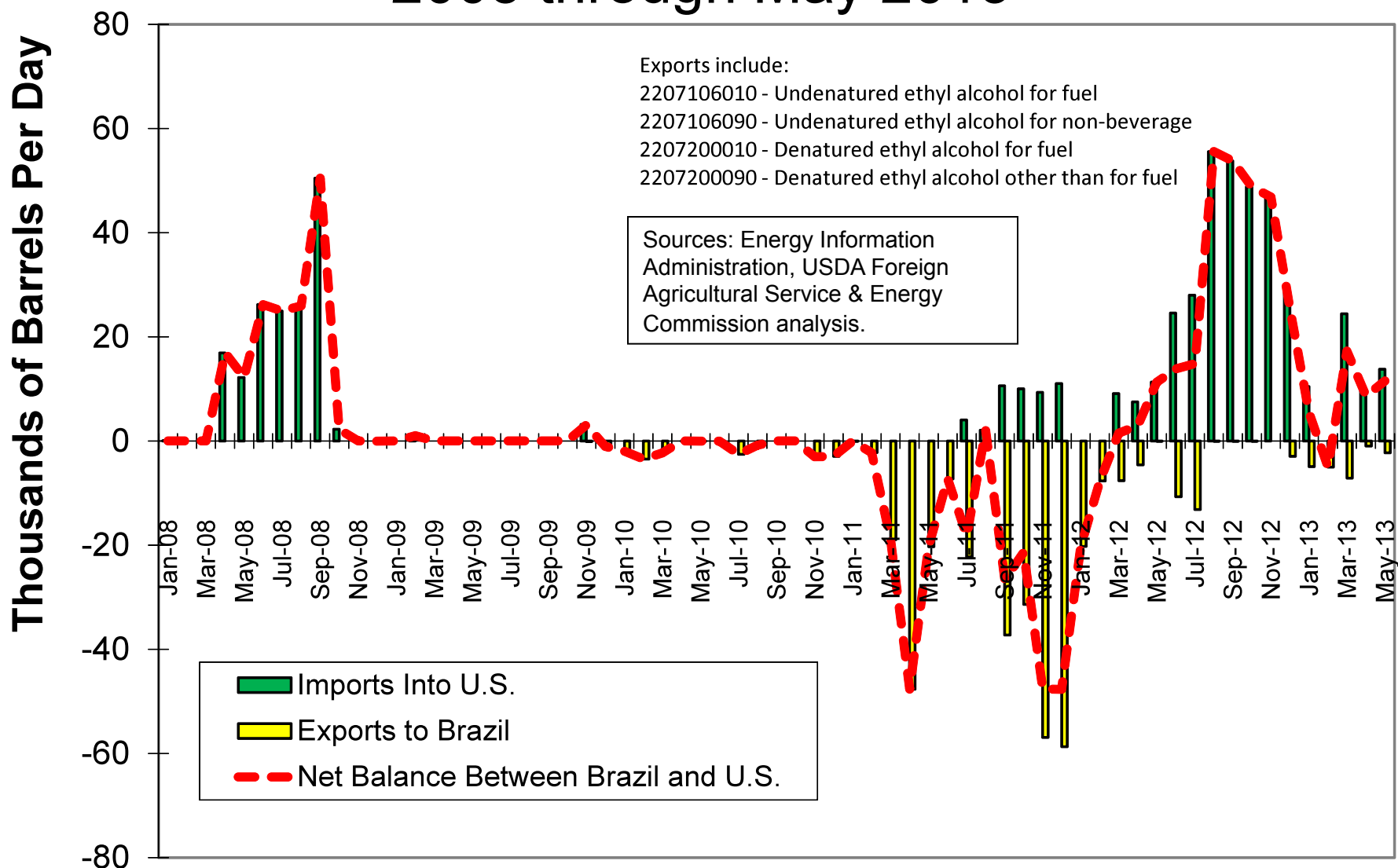


# U.S. Imports & Exports for Ethanol 1989 through May 2013



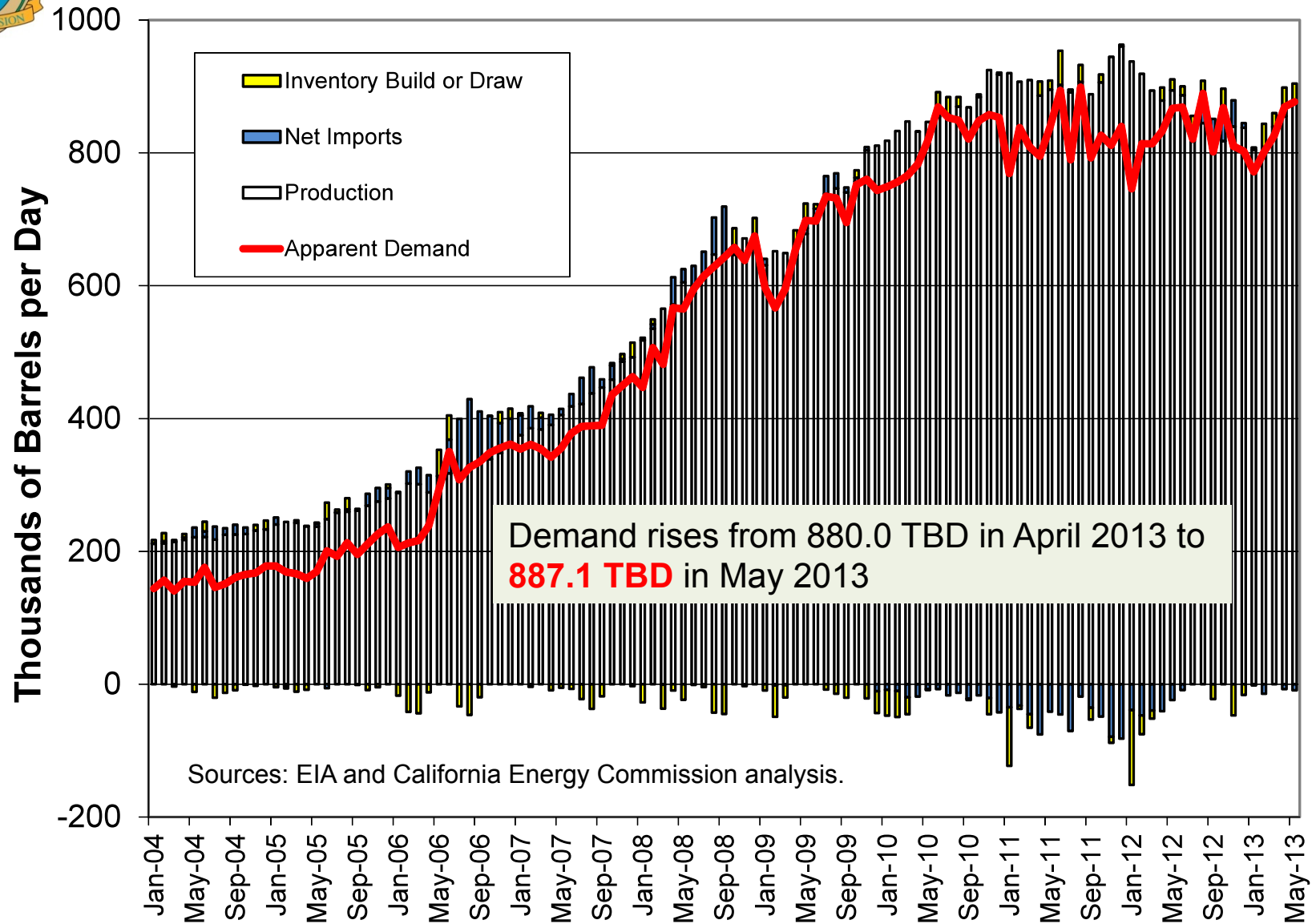


# Brazil & U.S. Imports & Exports for Ethanol 2008 through May 2013



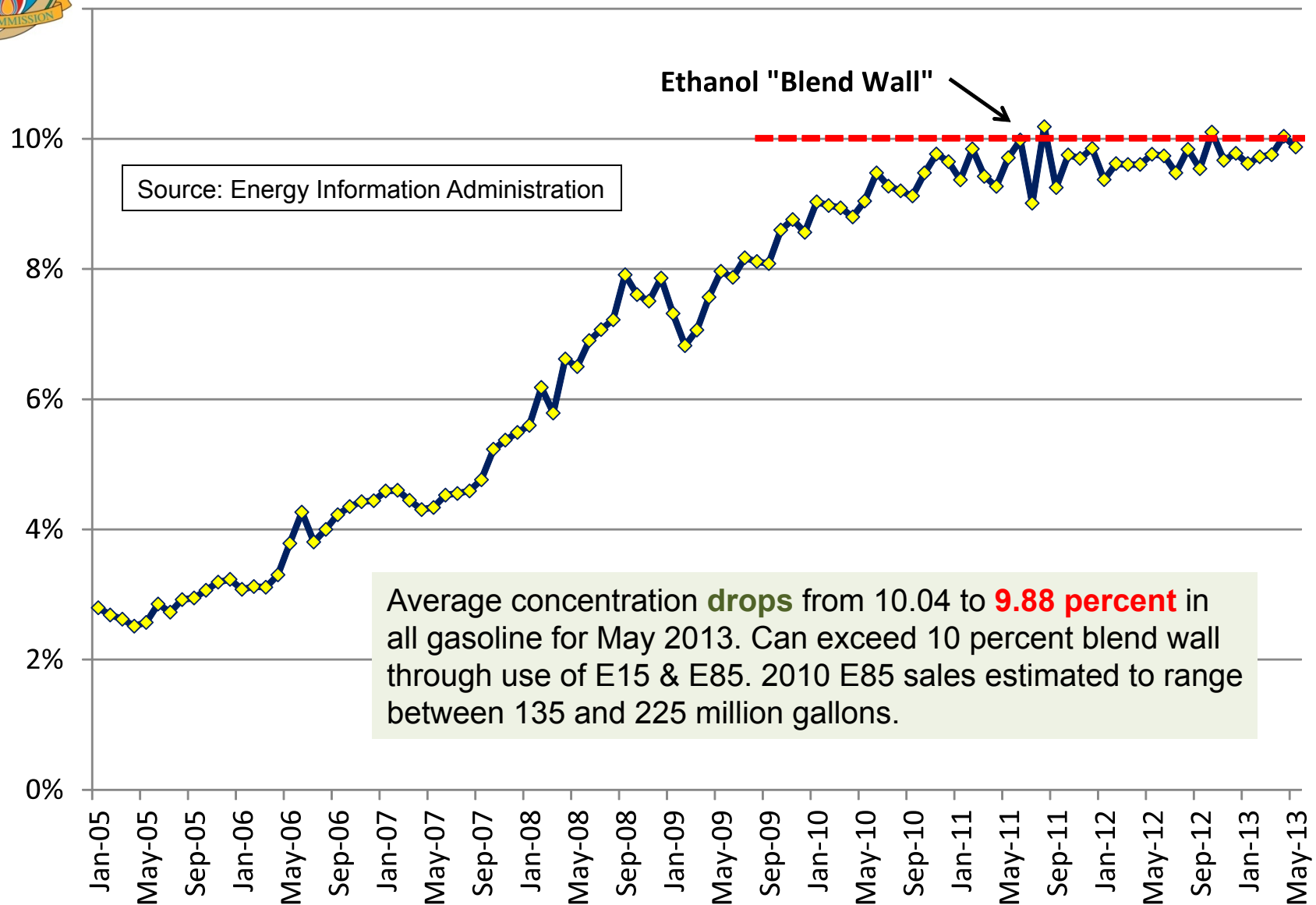


# U.S. Ethanol Supply and Demand



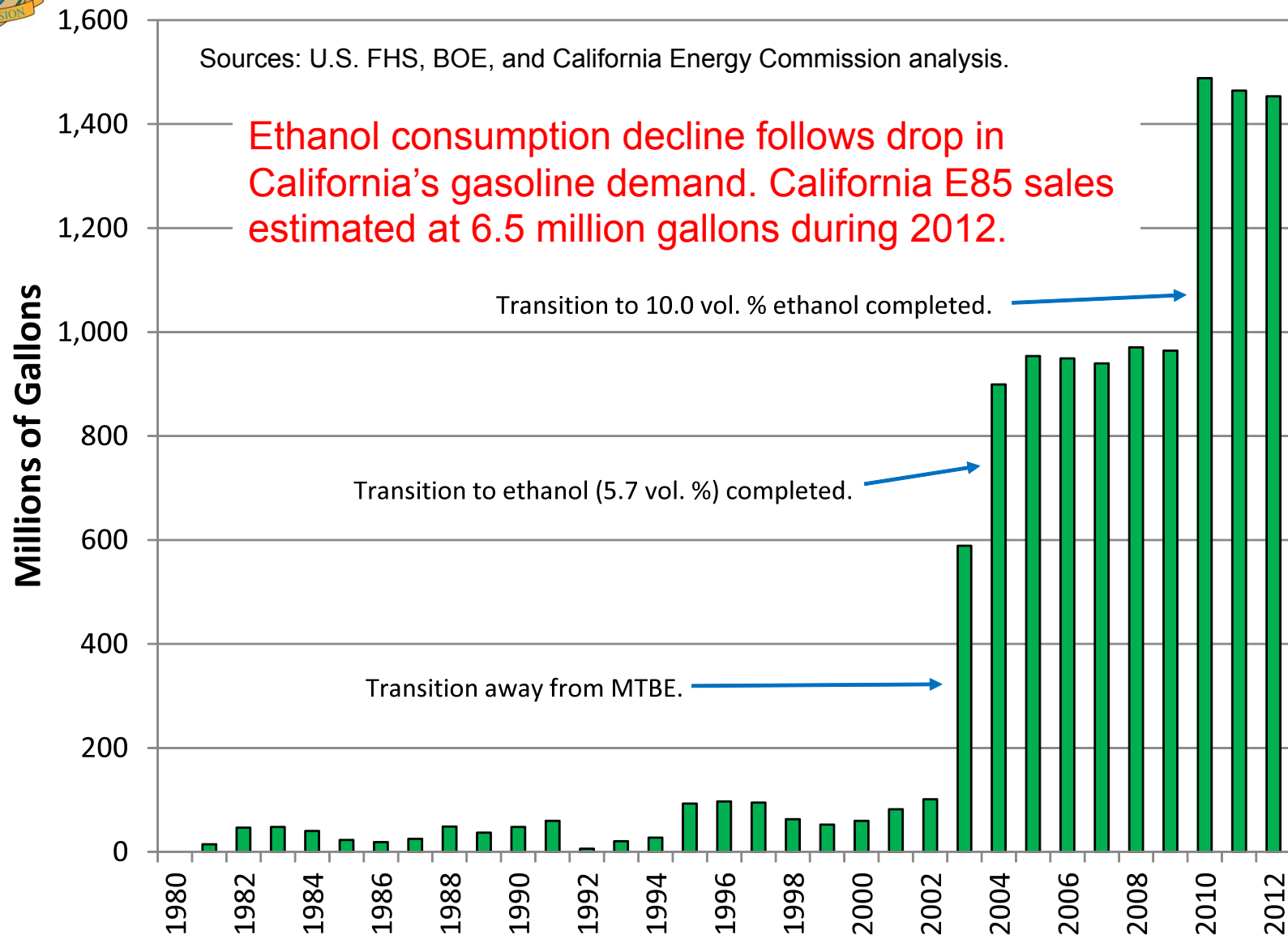


# U.S. Ethanol Concentration in Gasoline





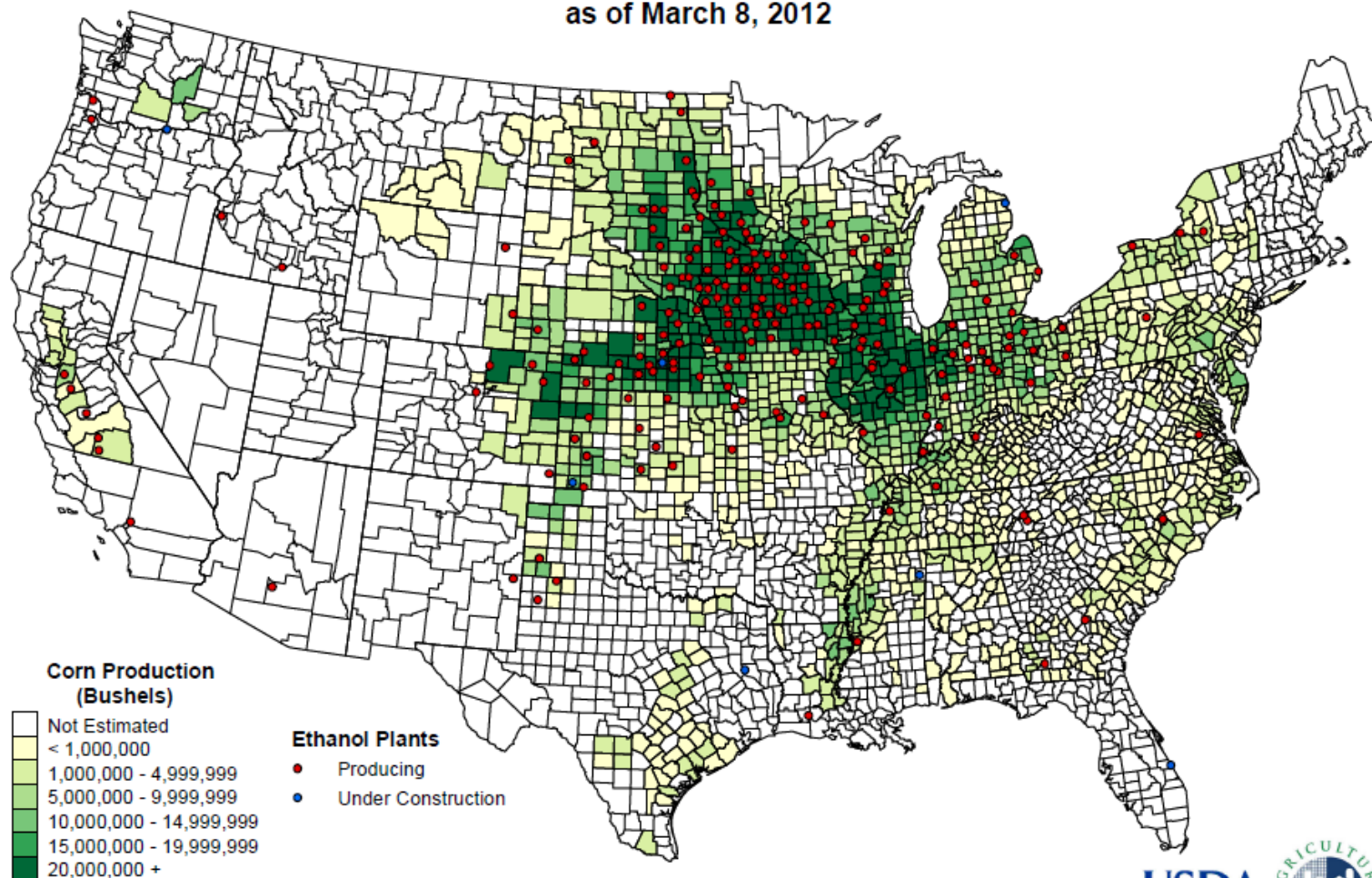
# California Fuel Ethanol Consumption





# Ethanol Plants & Corn Production

Corn for Grain 2011  
Production by County and Location of Ethanol Plants  
as of March 8, 2012



Note: The depicted ethanol plants use corn or other feedstock.

Data Sources: U.S. Department of Agriculture, National Agricultural Statistics Service.

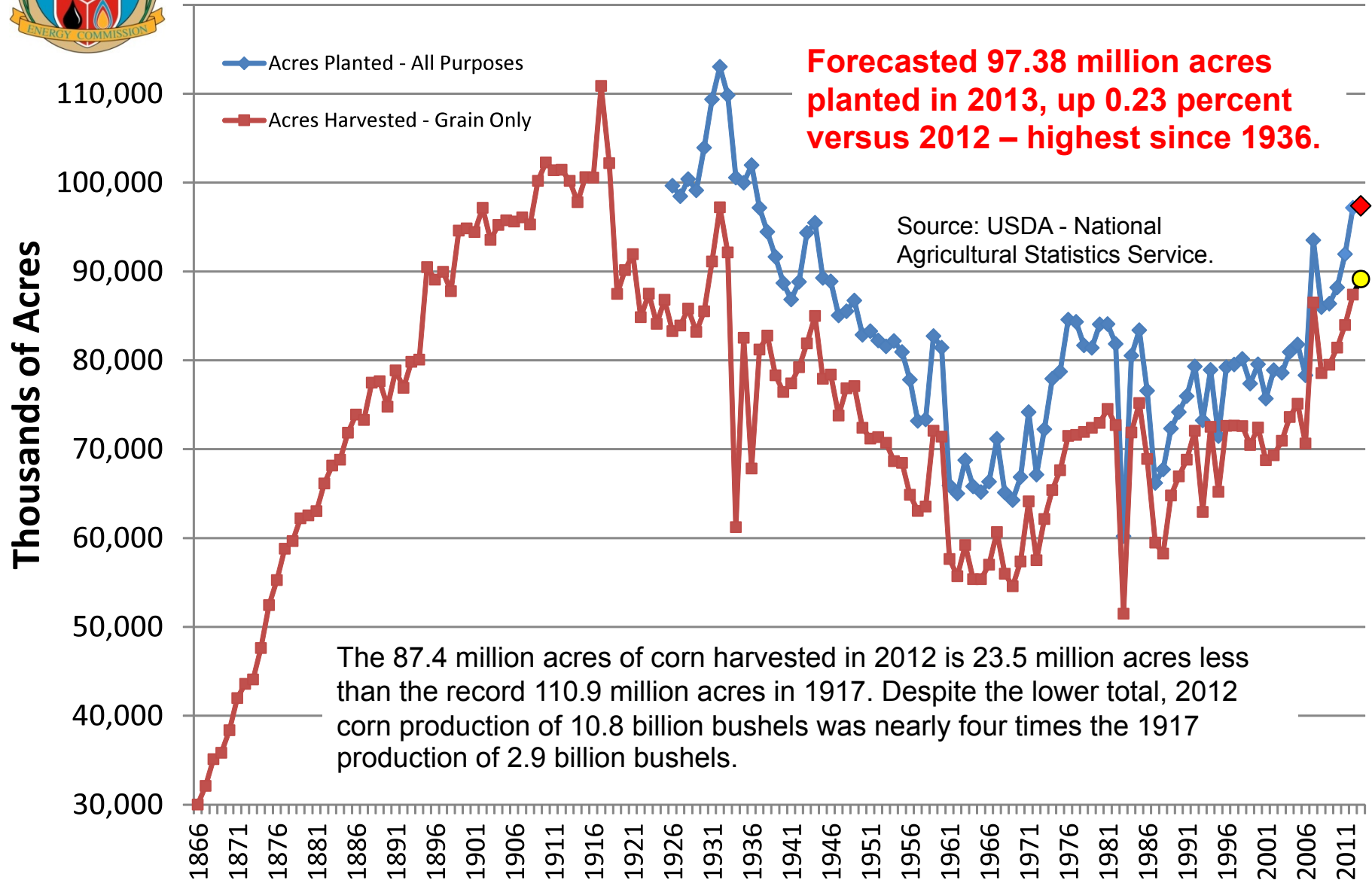
"USA Plants." *Ethanol Producer Magazine*, March, 2012. <http://www.ethanolproducer.com/plants/listplants/USA/>







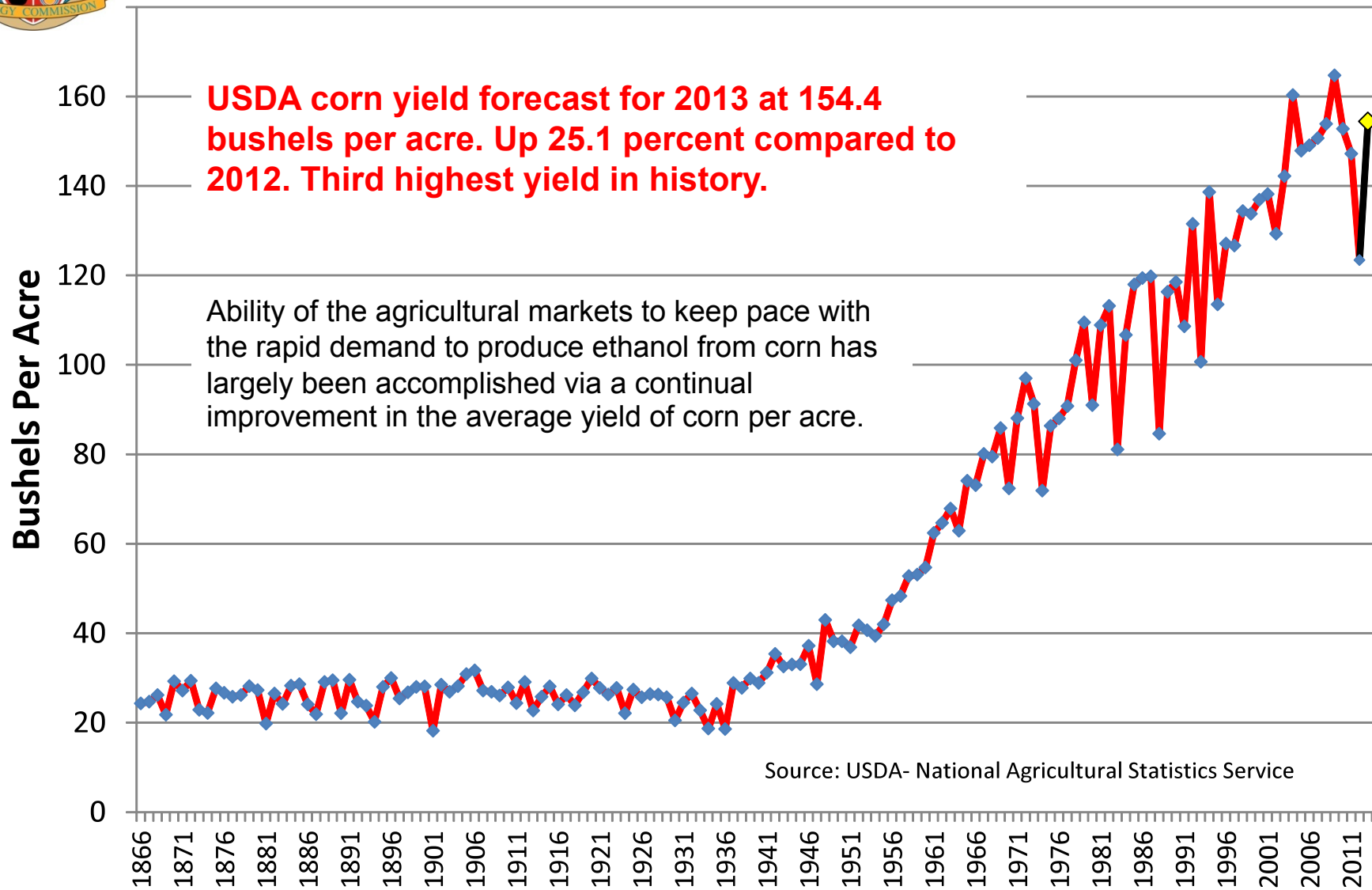
# Corn Acres Planted & Harvested (1866 - 2013)





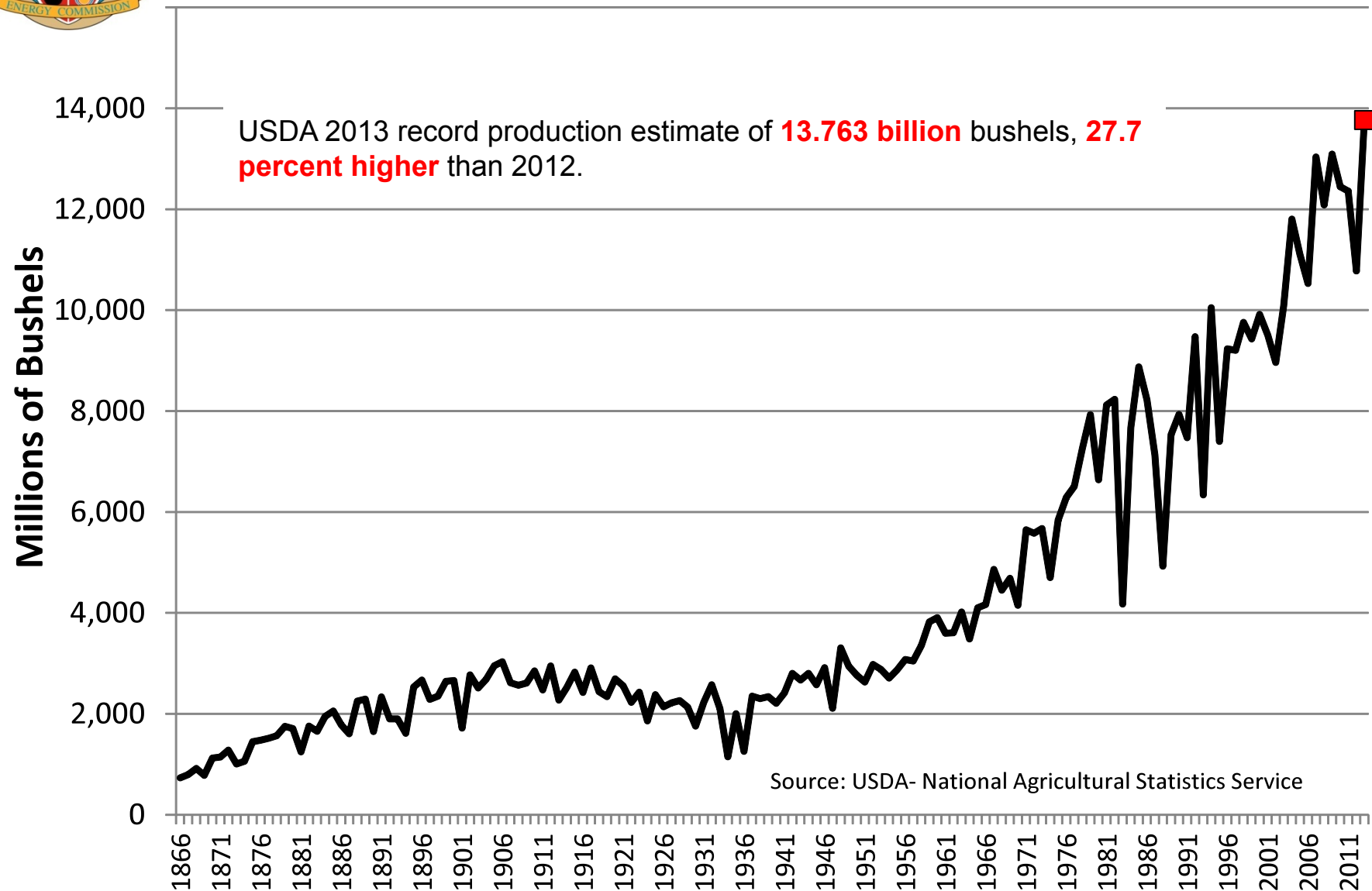


## U.S. Annual Corn Yield (1866 - 2013)



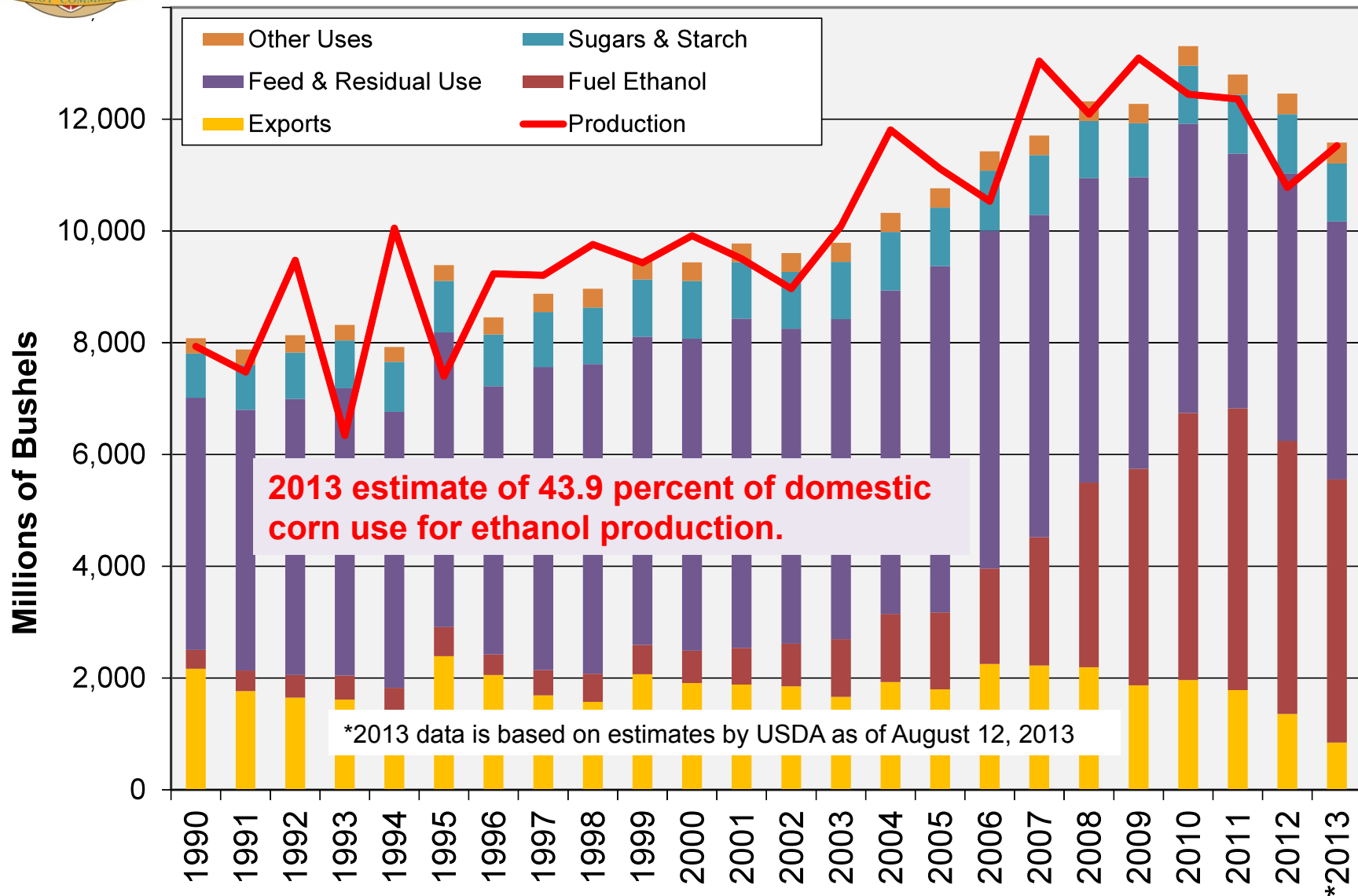


# U.S. Annual Corn Production (1866 - 2013)



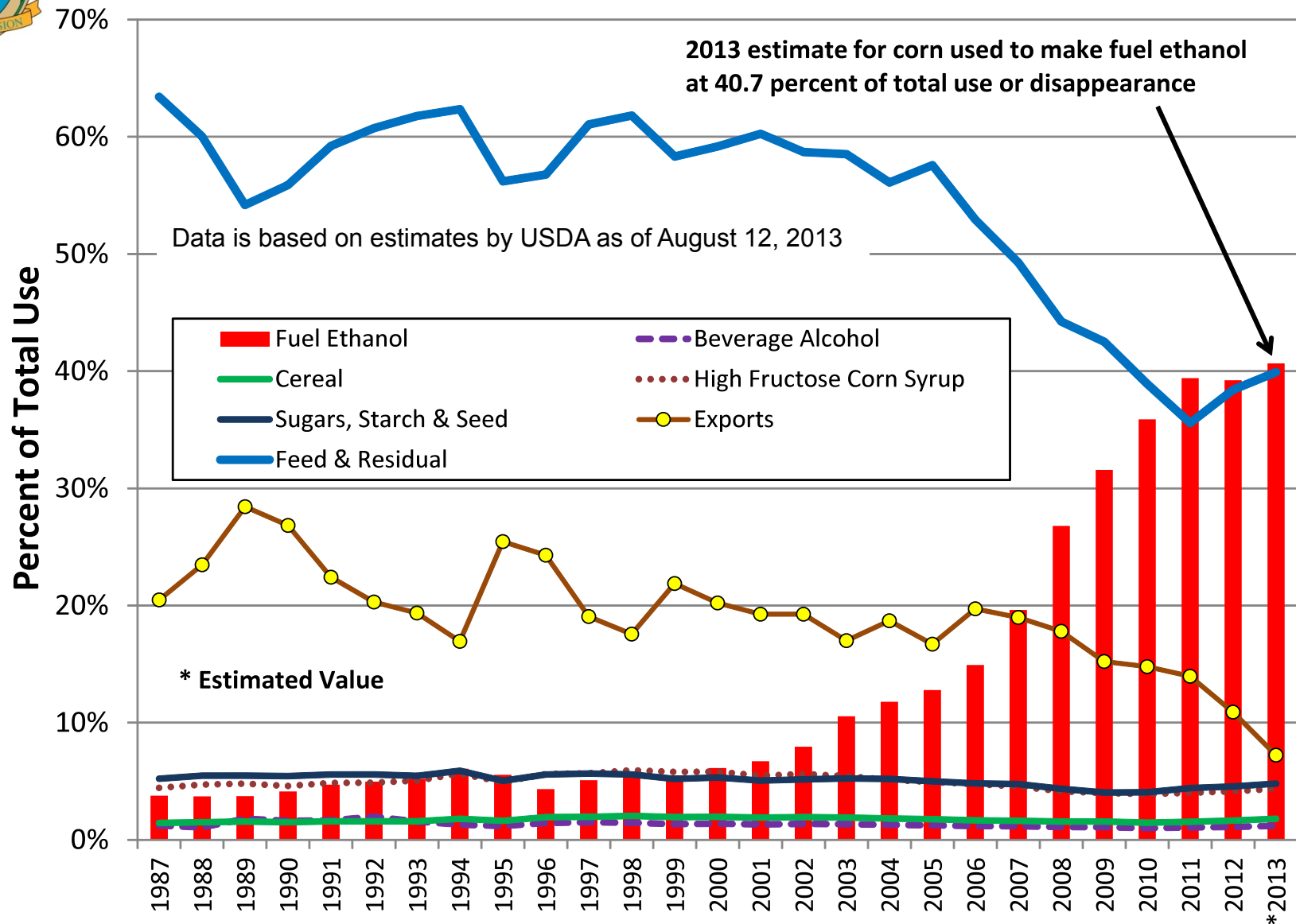


# U.S. Corn Disposition & Production



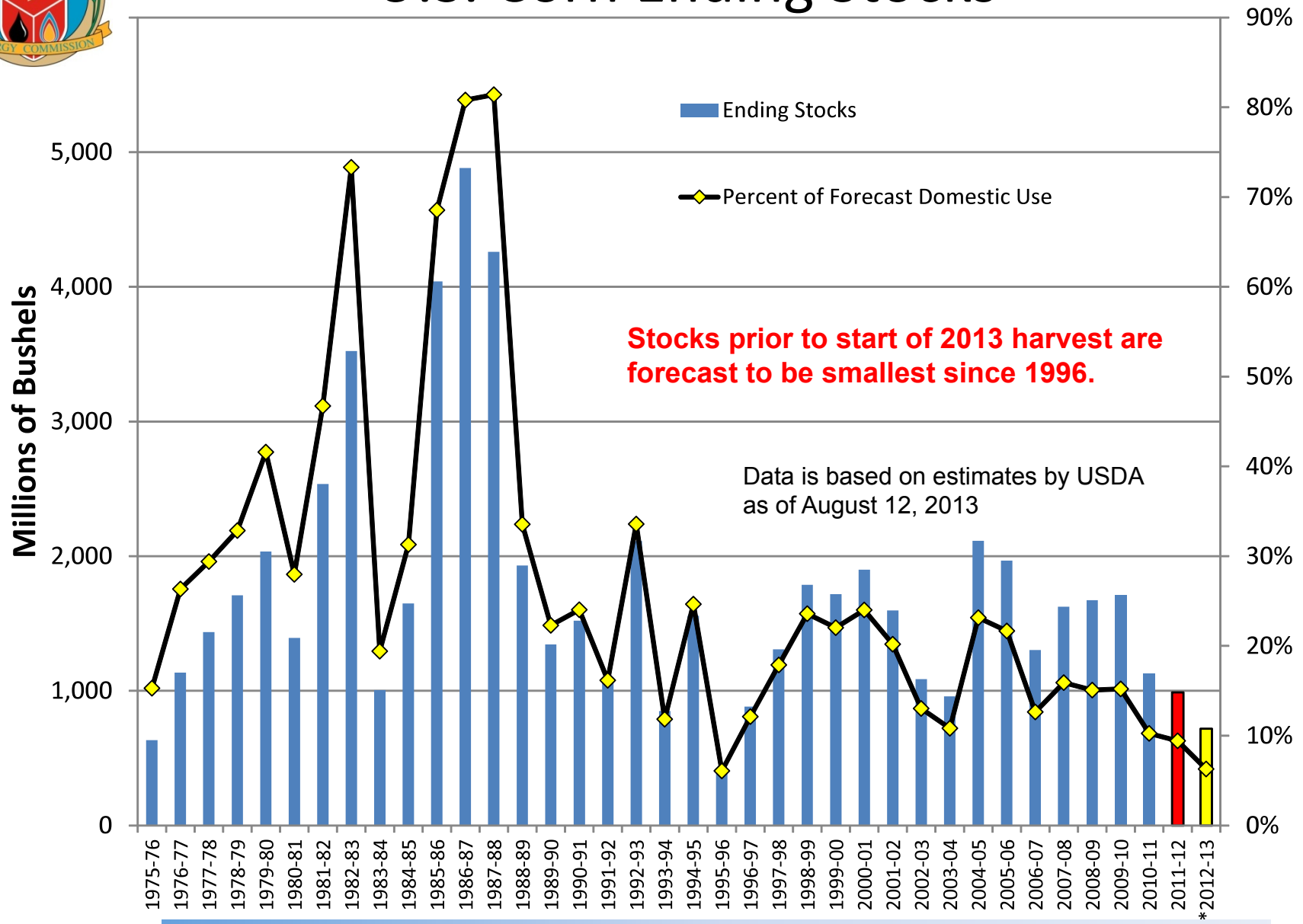


# U.S. Corn End Use – Percent of Supply



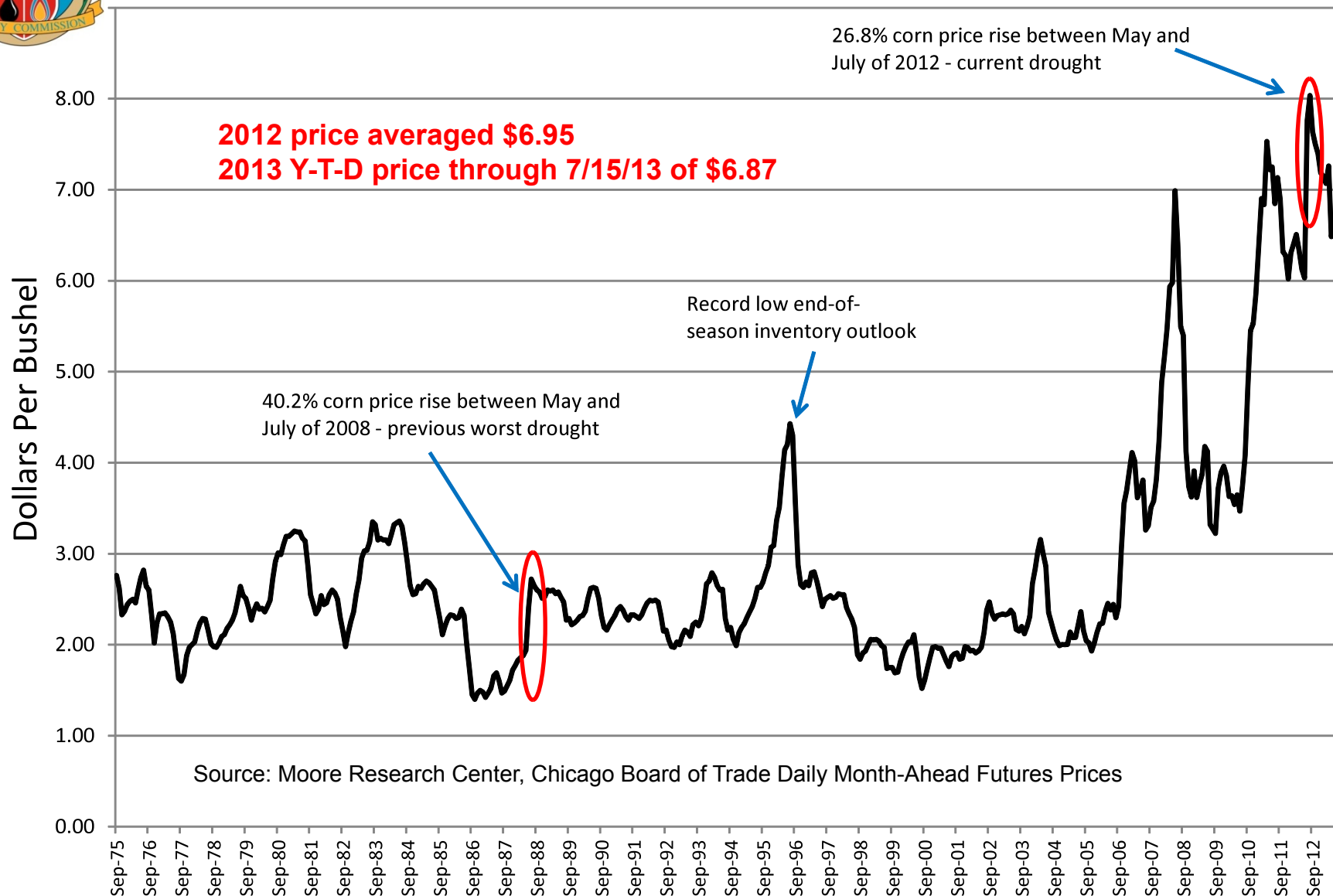


# U.S. Corn Ending Stocks



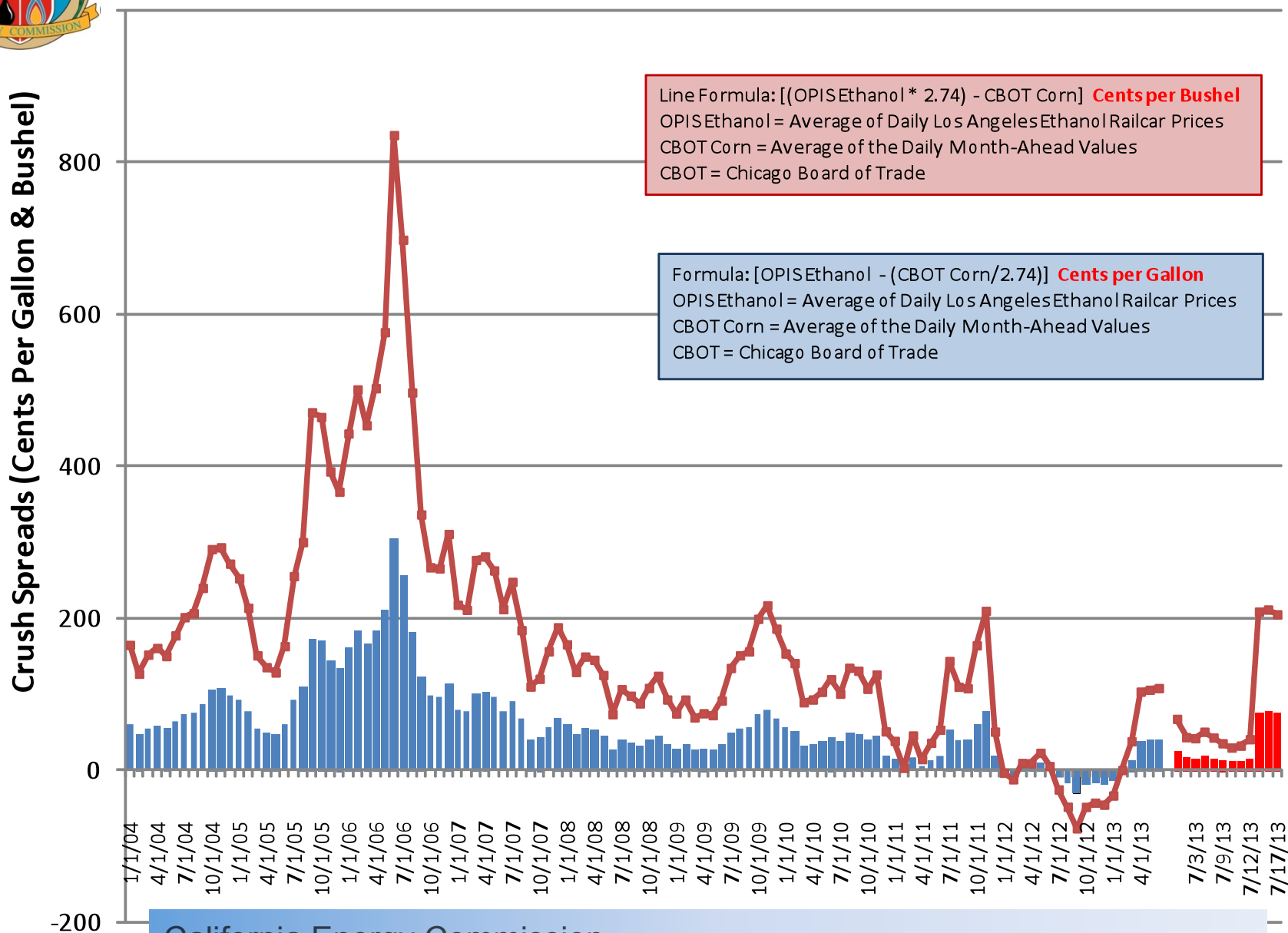


# U.S. Monthly Corn Prices





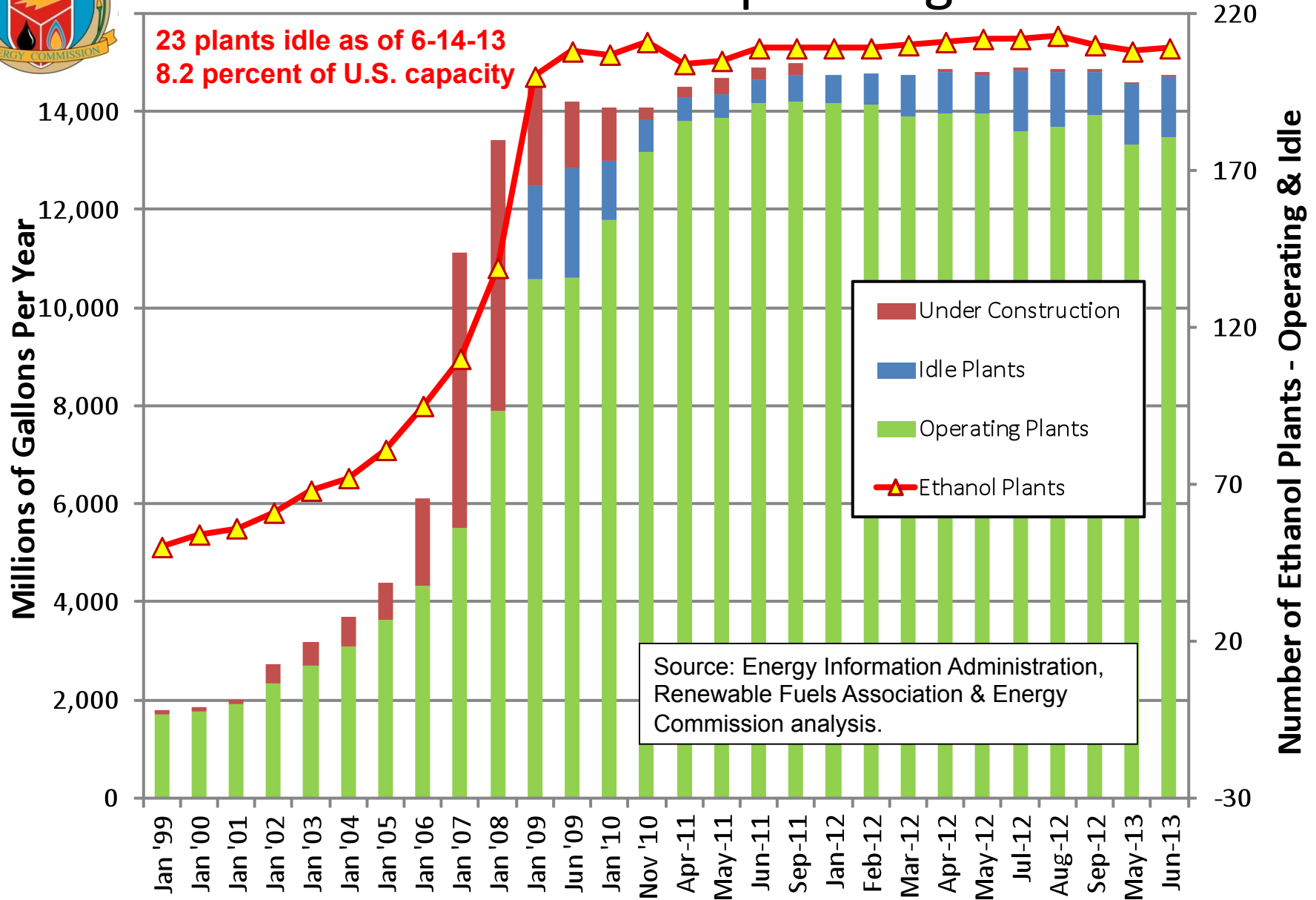
# Ethanol Crush Spread – Improving Margins



California Energy Commission



# U.S. Ethanol Plants Operating Status







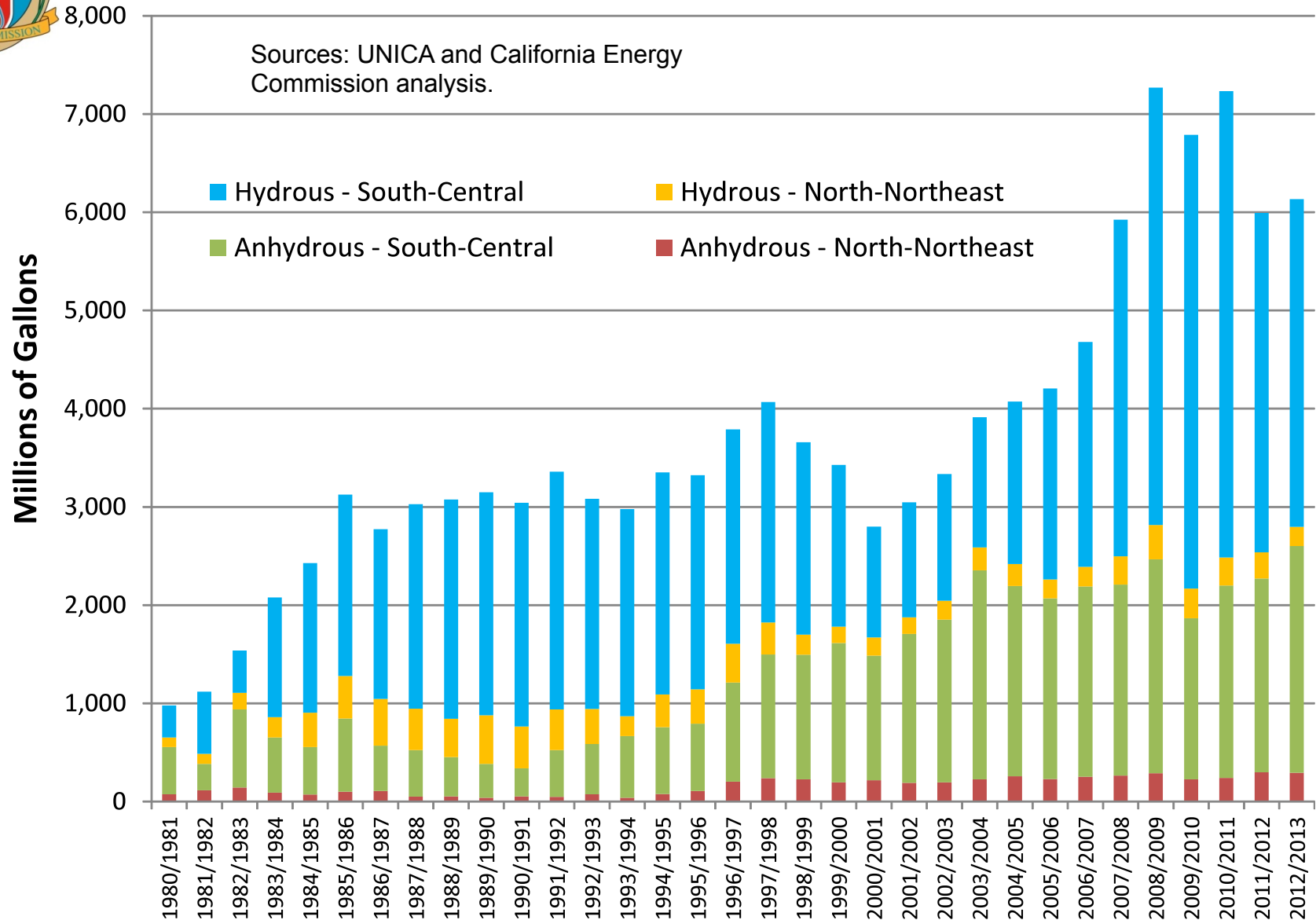
# Brazilian Ethanol

- The United States surpassed Brazil as the top ethanol producer during 2007 and doubled Brazil's output for 2012
- However, Brazilian ethanol will be a commodity in high demand as companies strive to source adequate quantities of biofuels to meet the Advanced Biofuel requirements under RFS2 and meet obligations under the LCFS

2012 Comparison	Brazil	United States
Number of Ethanol Plants	95	210
Combined Number of Ethanol & Sugar Mill Facilities	292	
Total Ethanol Plants	387	210
Total Ethanol Production (Billions of Gallons)	6.2	13.3
Average Plant Production (Millions of Gallons/Year)	15.9	<b>63.3</b>
Ethanol Production Per Acre of Feedstock (Gallons)	<b>556.4</b>	336.1
Ethanol Plant Operation	Seasonal	Year-round
Long-Term Feedstock Storage	No	Yes



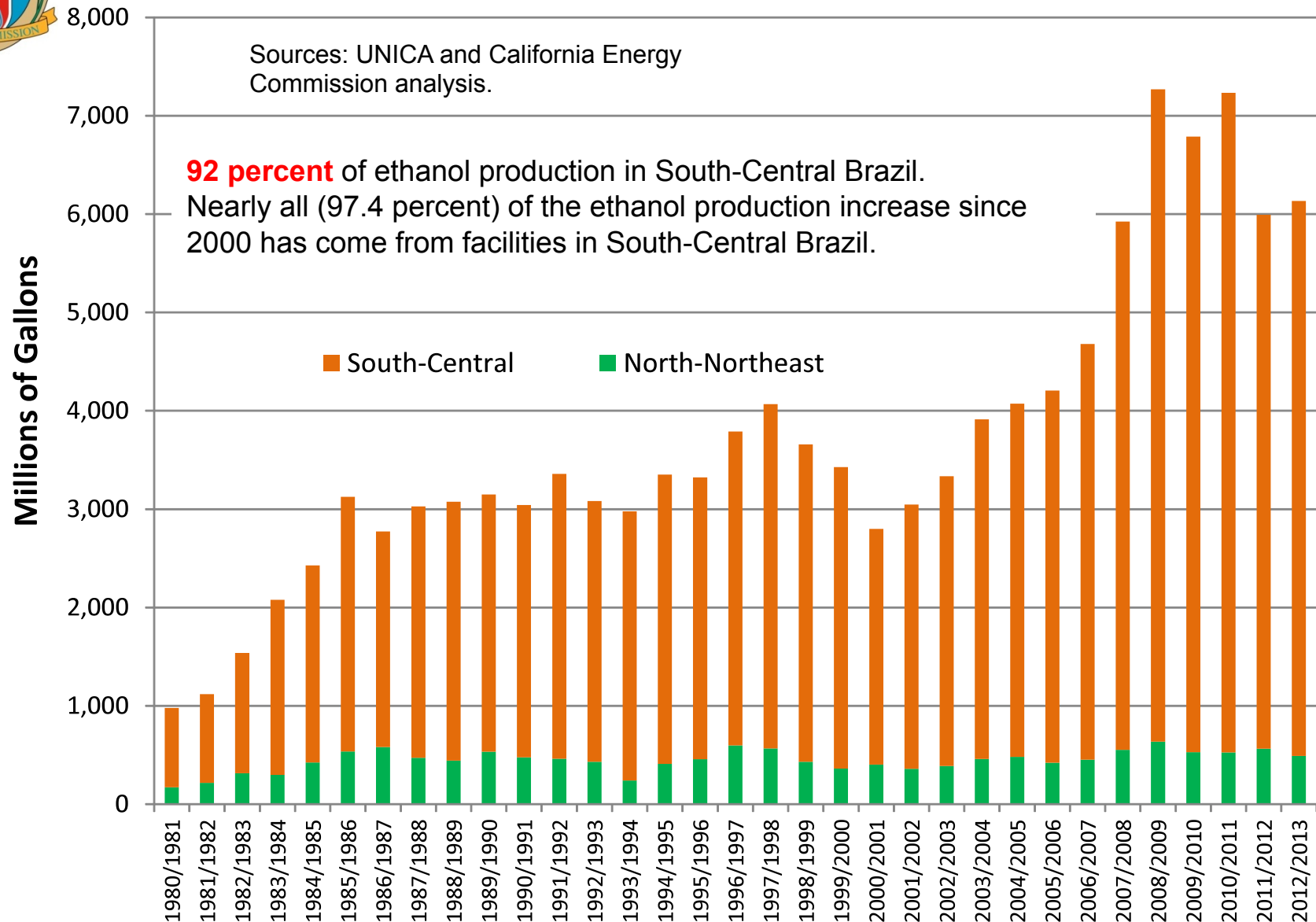
# Brazil Ethanol Production





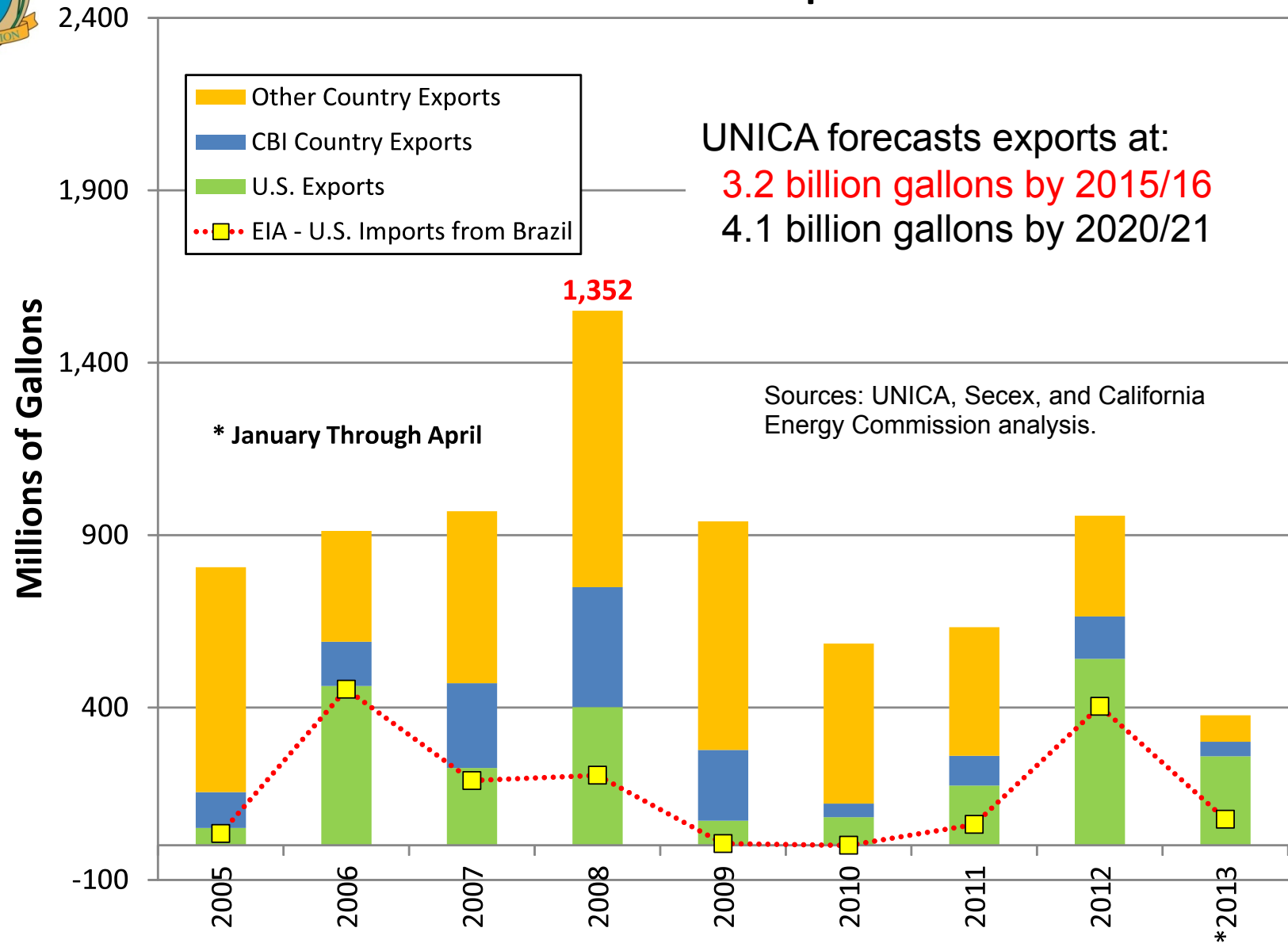
# Brazil Ethanol Production

Sources: UNICA and California Energy Commission analysis.





# Brazil Ethanol Exports





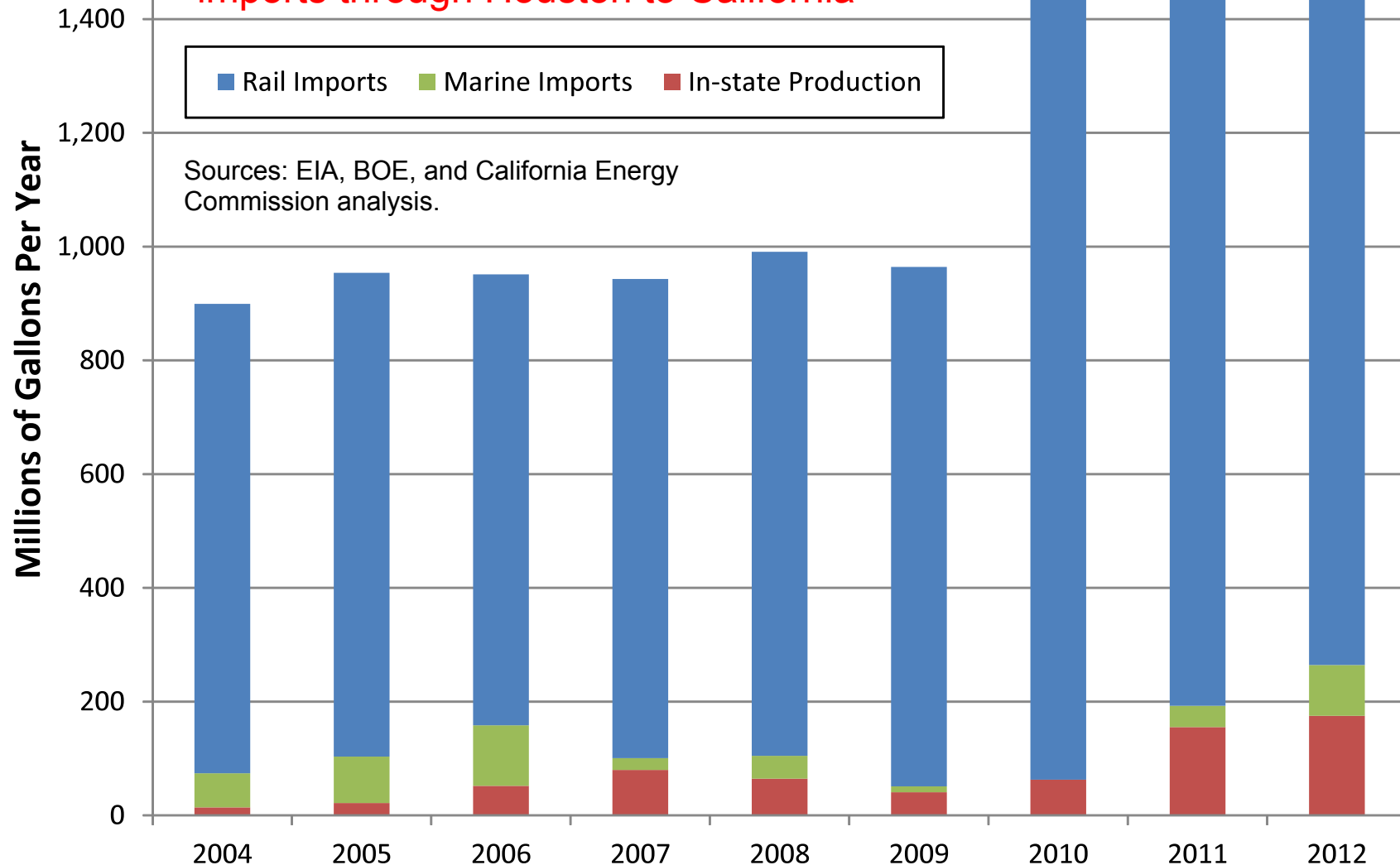
# Ethanol Availability

- California is expected to increase the variety of ethanol sources over the next several years as refiners strive to comply with federal RFS2 and California LCFS regulations
- Sugarcane ethanol from Brazil is expected to play an increasingly important role
- Even if Brazilian ethanol export forecasts are less robust than anticipated, significant quantities of ethanol from Brazil could still be obtained by shipping Midwest corn ethanol to that country in exchange for sugarcane ethanol



# California Ethanol Infrastructure

Rail infrastructure adequate to handle Brazil imports through Houston to California



Sources: EIA, BOE, and California Energy Commission analysis.



# Ethanol Logistics – Distribution Terminals

- Ethanol is blended with gasoline at distribution terminals when the tanker truck is loaded with gasoline prior to delivery to the retail station
- California's distribution terminals have been modified to store ethanol and receive ethanol via tanker trucks
- No additional ethanol distribution terminal modifications are expected over the next couple of years as the average concentration of ethanol in gasoline at 10 percent by volume is expected to remain unchanged



## Ethanol Logistics – Rail Handling

- Imports of ethanol via rail are the largest source of supply – nearly 81.8 percent during 2012
- The majority of ethanol delivered to California is shipped in unit trains of between 90 and 100 rail cars
- These deliveries have priority access on rail lines and normally do not stop before arriving at their destinations
- Volume of rail activity could decline assuming greater quantities of ethanol from Brazil and Caribbean Basin Initiative countries is delivered via marine vessel, as well as increased production from California plants
- No additional rail modifications are expected over the next couple of years to accommodate changes in ethanol use



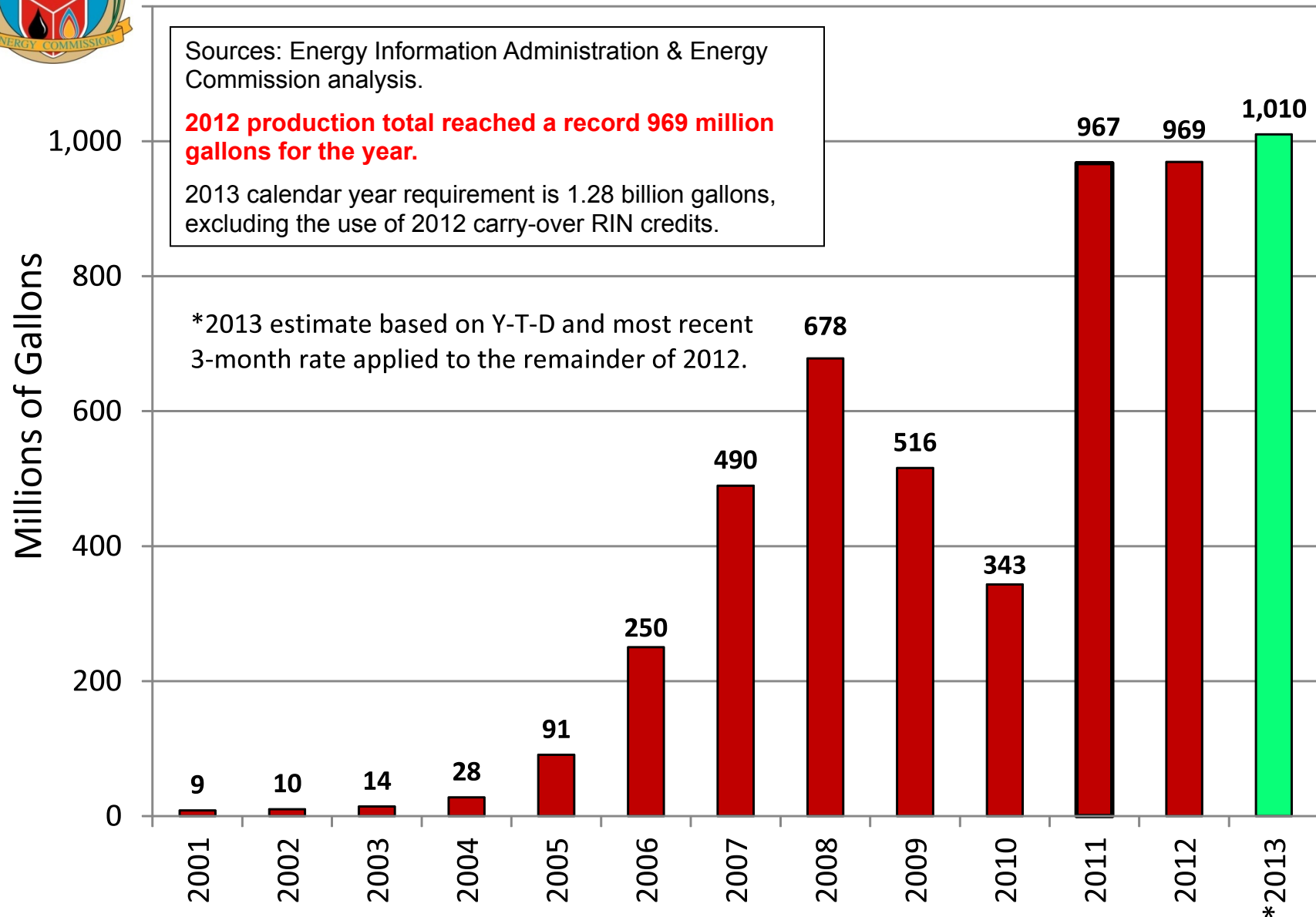


## Ethanol Logistics – Marine Facilities

- If California were to transition to greater use of Brazilian ethanol, there are two pathways for this foreign ethanol to enter California: marine vessels directly from Brazil; and rail shipments from another marine terminal outside of California
- At least one stakeholder has characterized marine import capability for ethanol receipts as being constrained
- Trucking issues could also emerge as the ethanol delivered by marine vessel would still need to be transported to distribution terminals before being blended with gasoline
- The Energy Commission will complete a survey of California refiners during September to assess their plans for changing mixes of biofuels to help achieve compliance with the LCFS
  - Biofuel selection, availability & potential infrastructure constraints

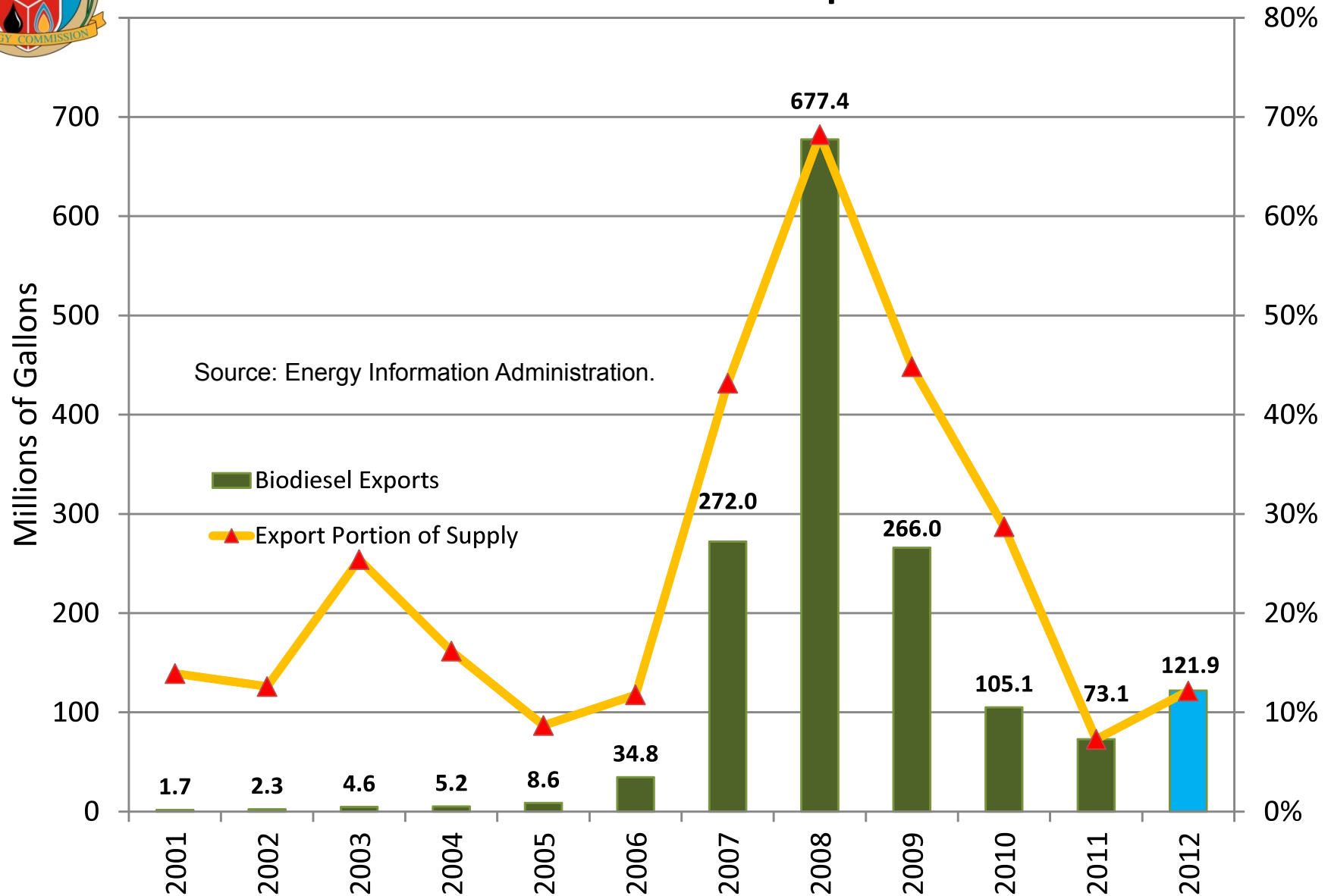


# U.S. Biodiesel Production



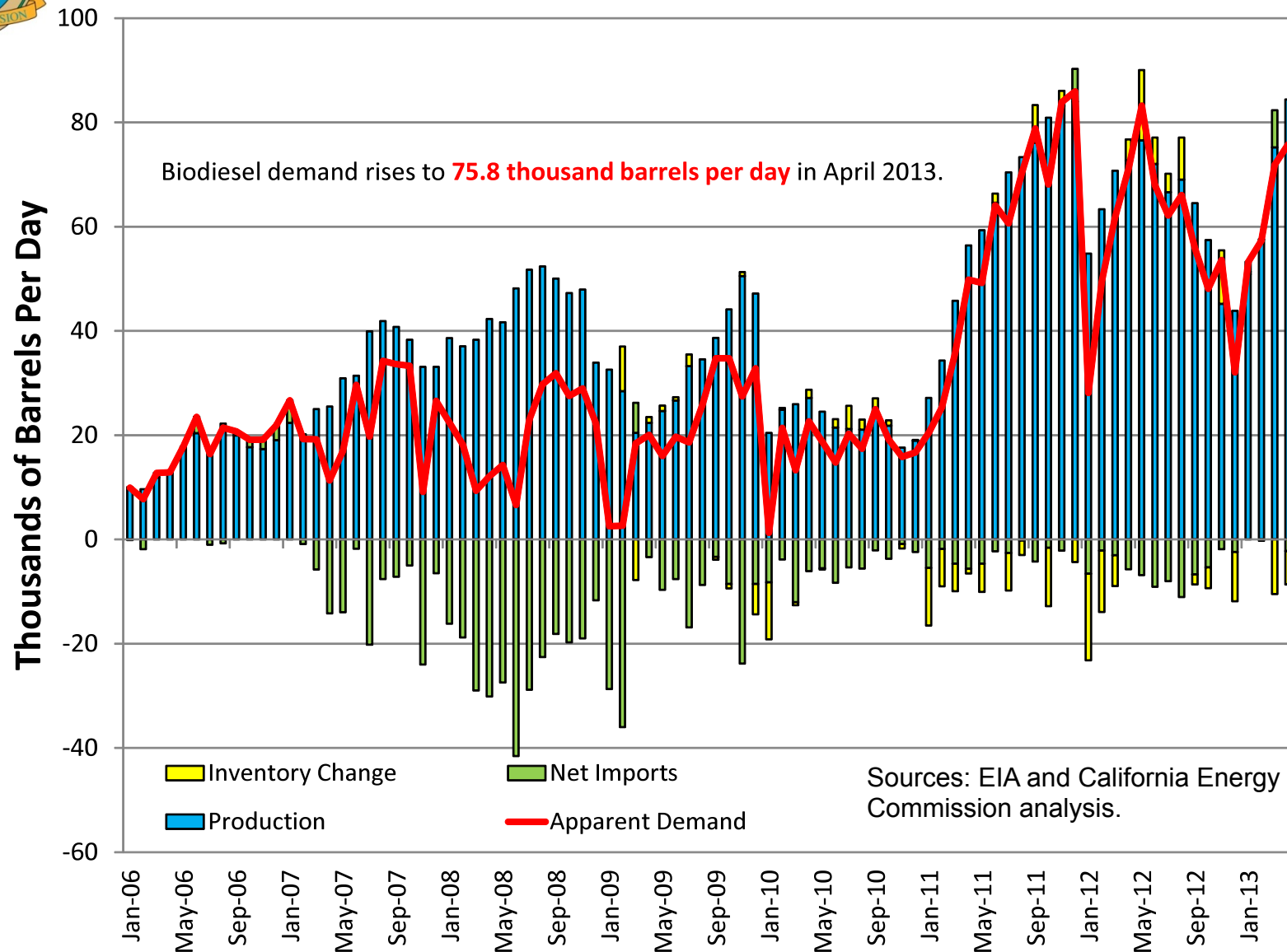


# U.S. Biodiesel Exports



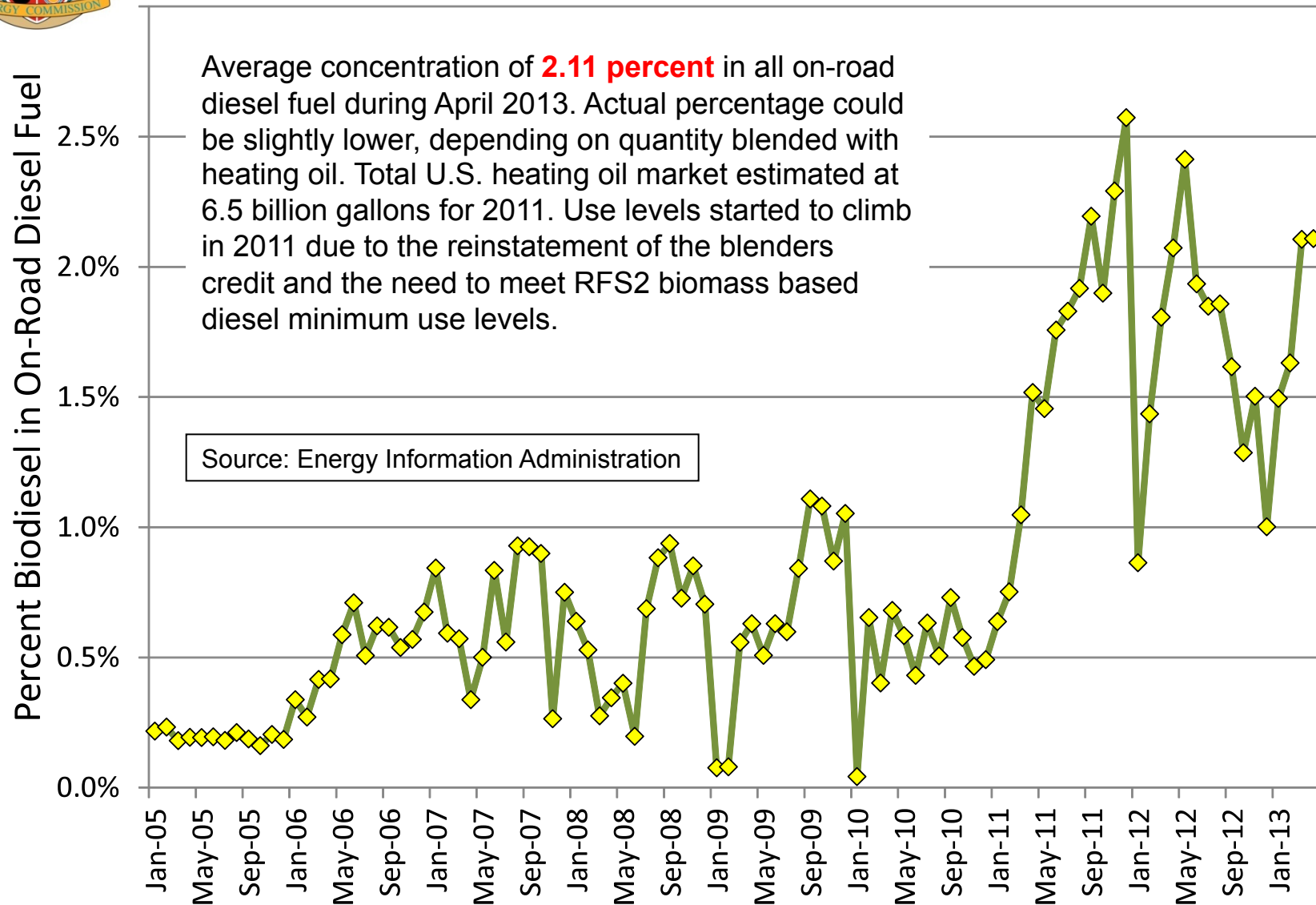


# U.S. Biodiesel Supply and Demand



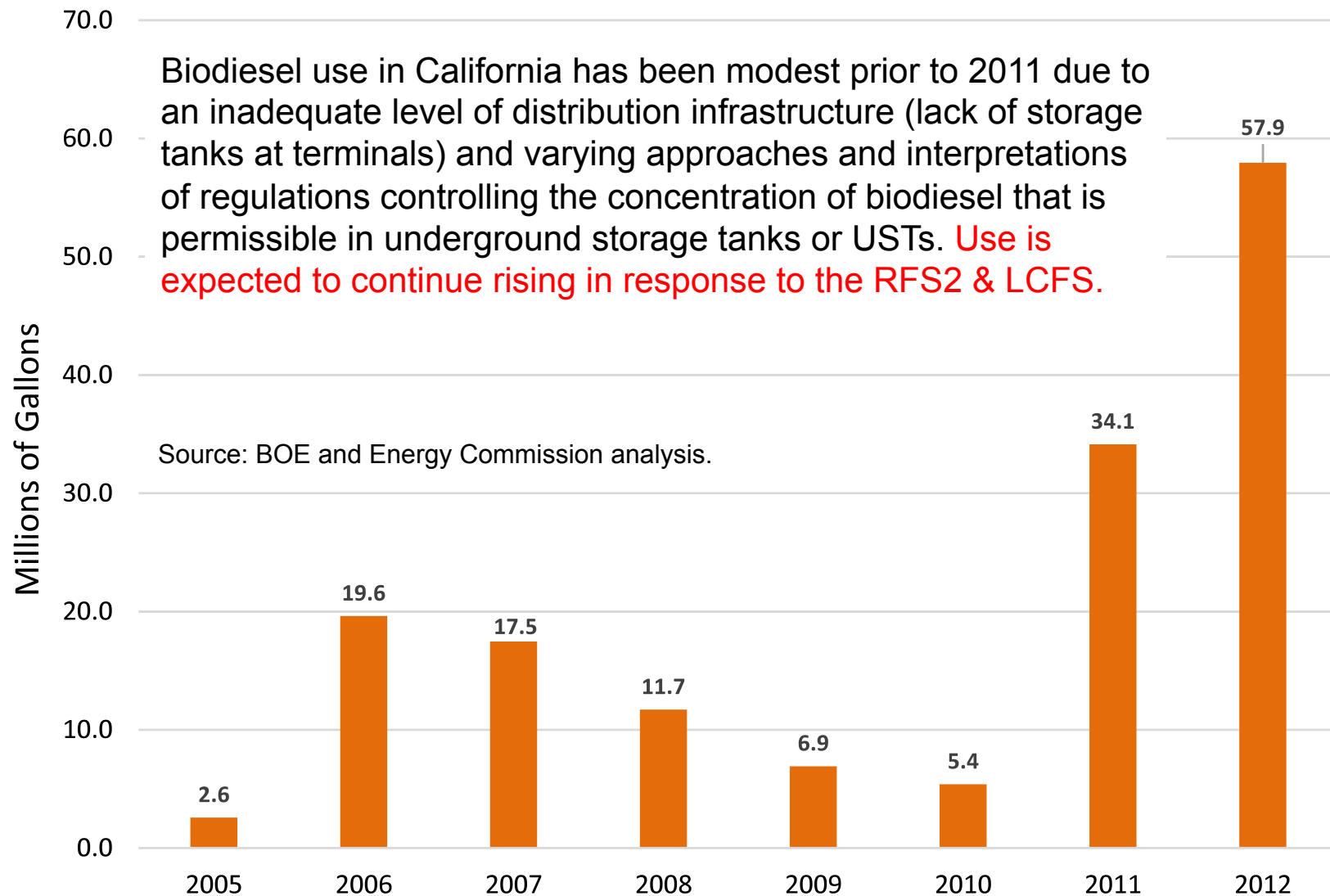


# U.S. Biodiesel Concentration in Diesel Fuel



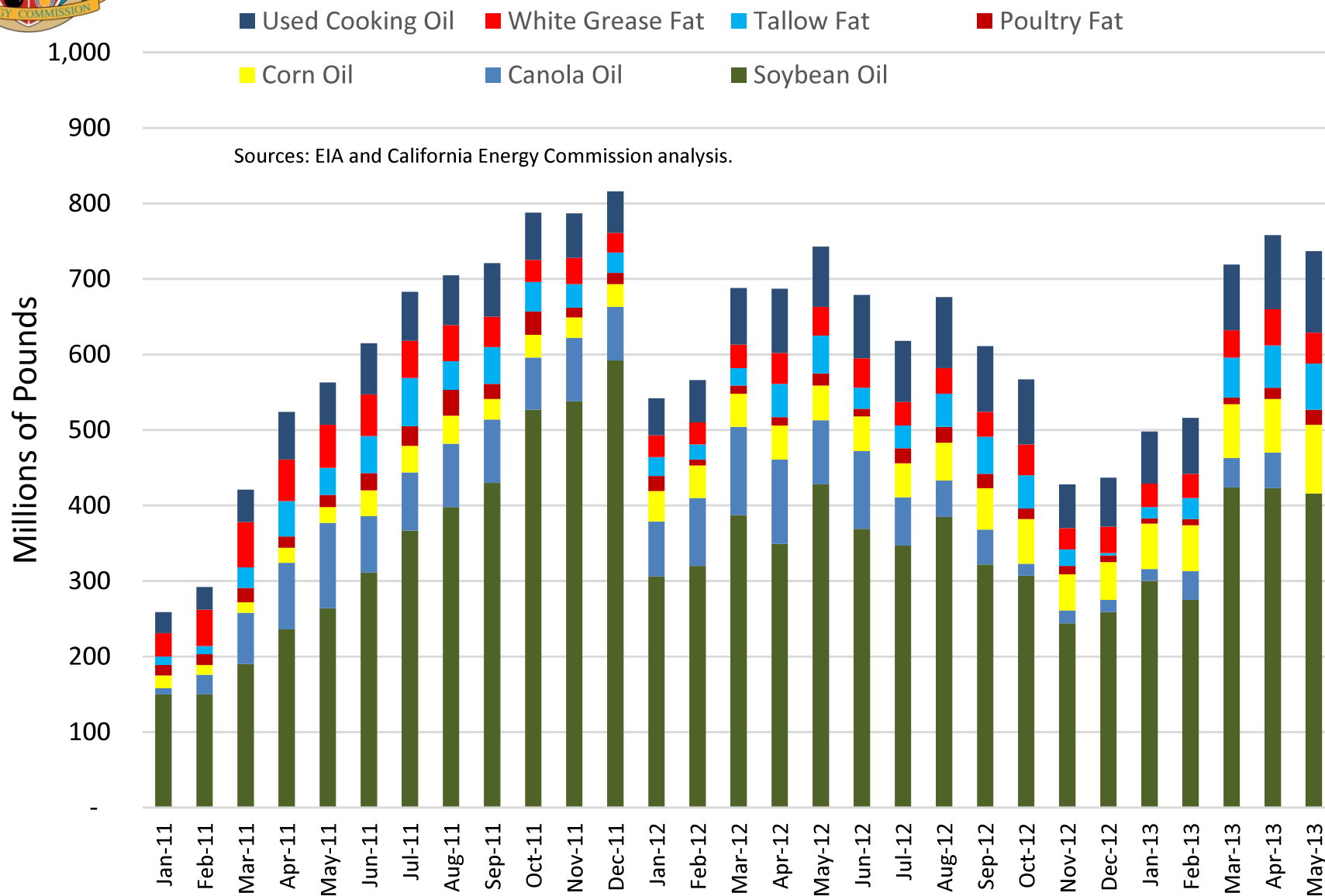


# California Biodiesel Consumption



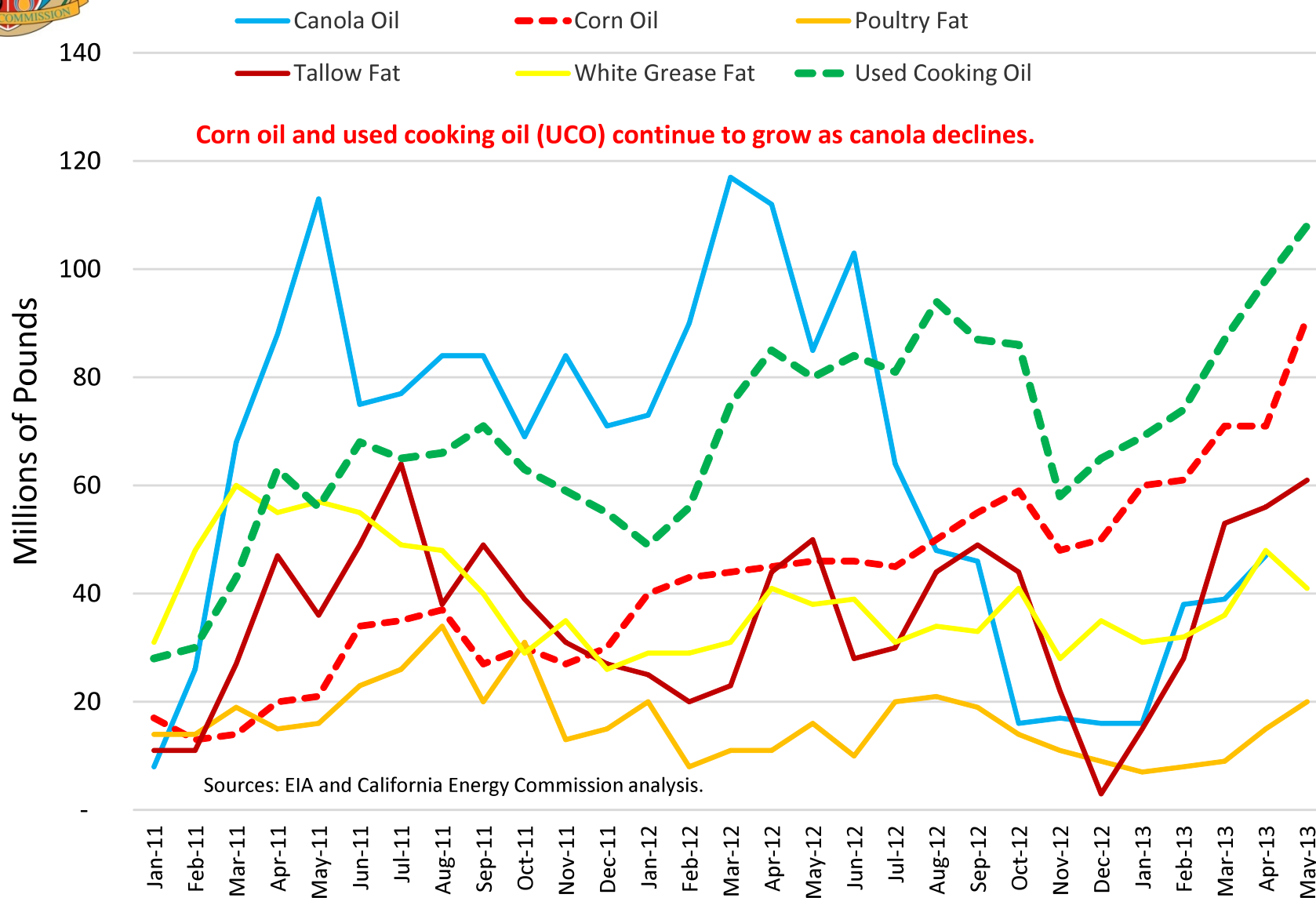


# U.S. Biodiesel Feedstocks - All





# U.S. Biodiesel Feedstocks – Less Soy Oil







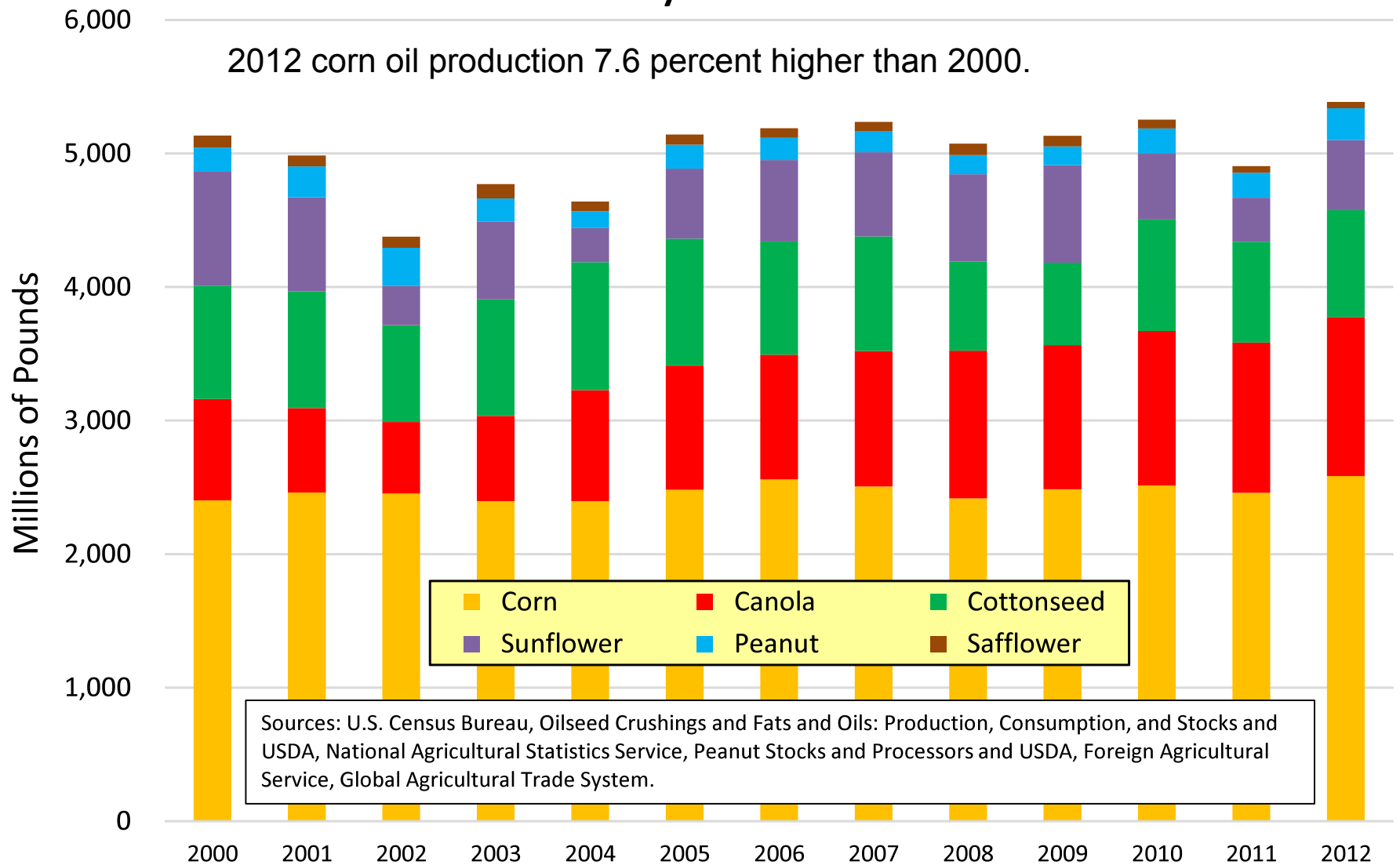
## Biodiesel Availability - Current

- EIA lists 116 biodiesel producers with 2.165 billion gallons per year of production capability
- Facilities were operating at a combined 62.4 percent utilization during May 2013
- There should be sufficient production capacity available to meet the RFS2 biomass-based diesel obligations for 2013 of 1.28 billion gallons
- Adequacy of biodiesel types to help meet LCFS obligations is being assessed by Energy Commission staff
  - Corn oil – 46 MM gallons through May 2013, 62 percent higher than same period the previous year
  - Used cooking oil (UCO) – 57 MM gallons through May 2013, 26 percent higher than previous period



# U.S. Oil Crop Production Less Soybean Oils

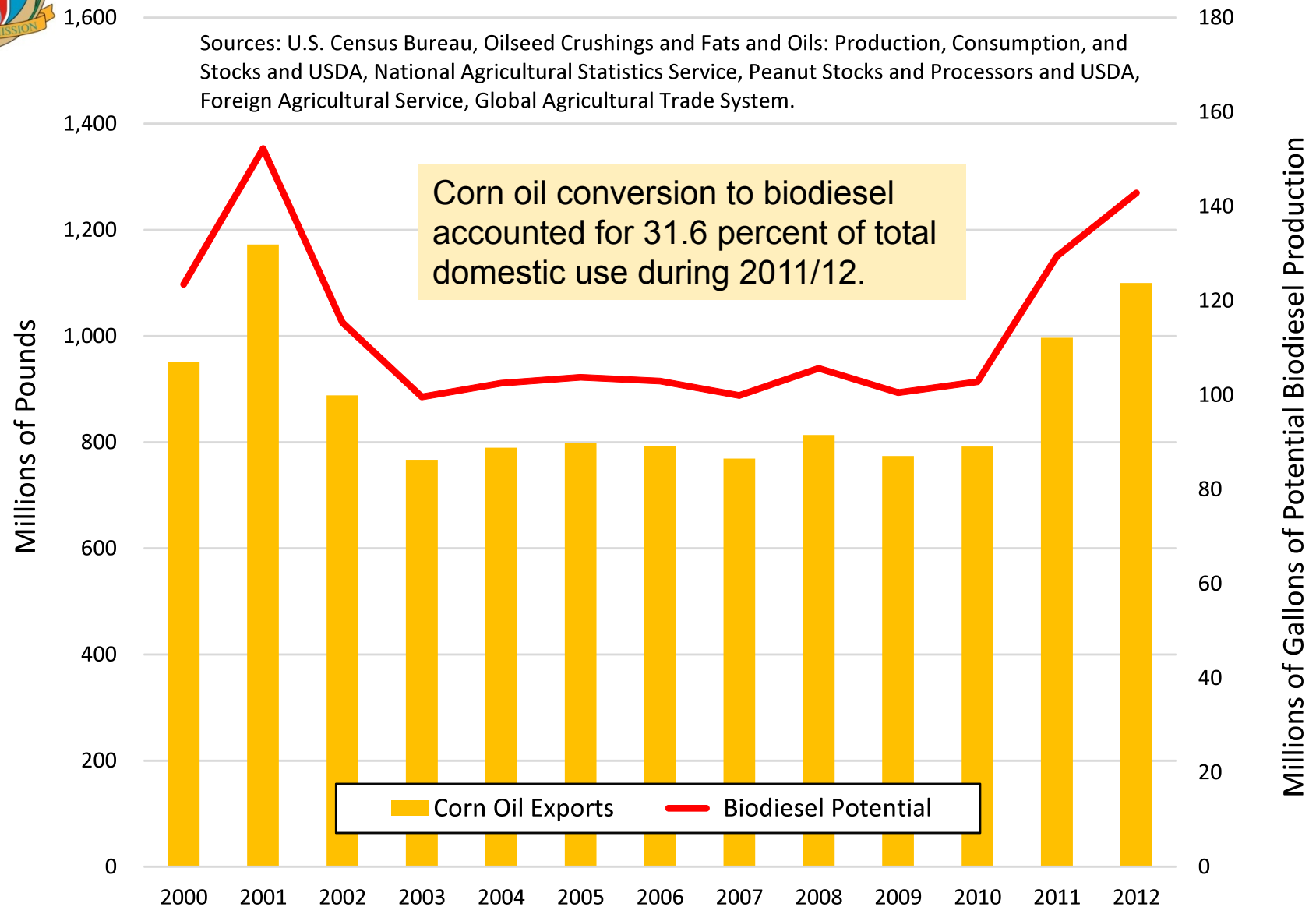
2012 corn oil production 7.6 percent higher than 2000.



Sources: U.S. Census Bureau, Oilseed Crushings and Fats and Oils: Production, Consumption, and Stocks and USDA, National Agricultural Statistics Service, Peanut Stocks and Processors and USDA, Foreign Agricultural Service, Global Agricultural Trade System.



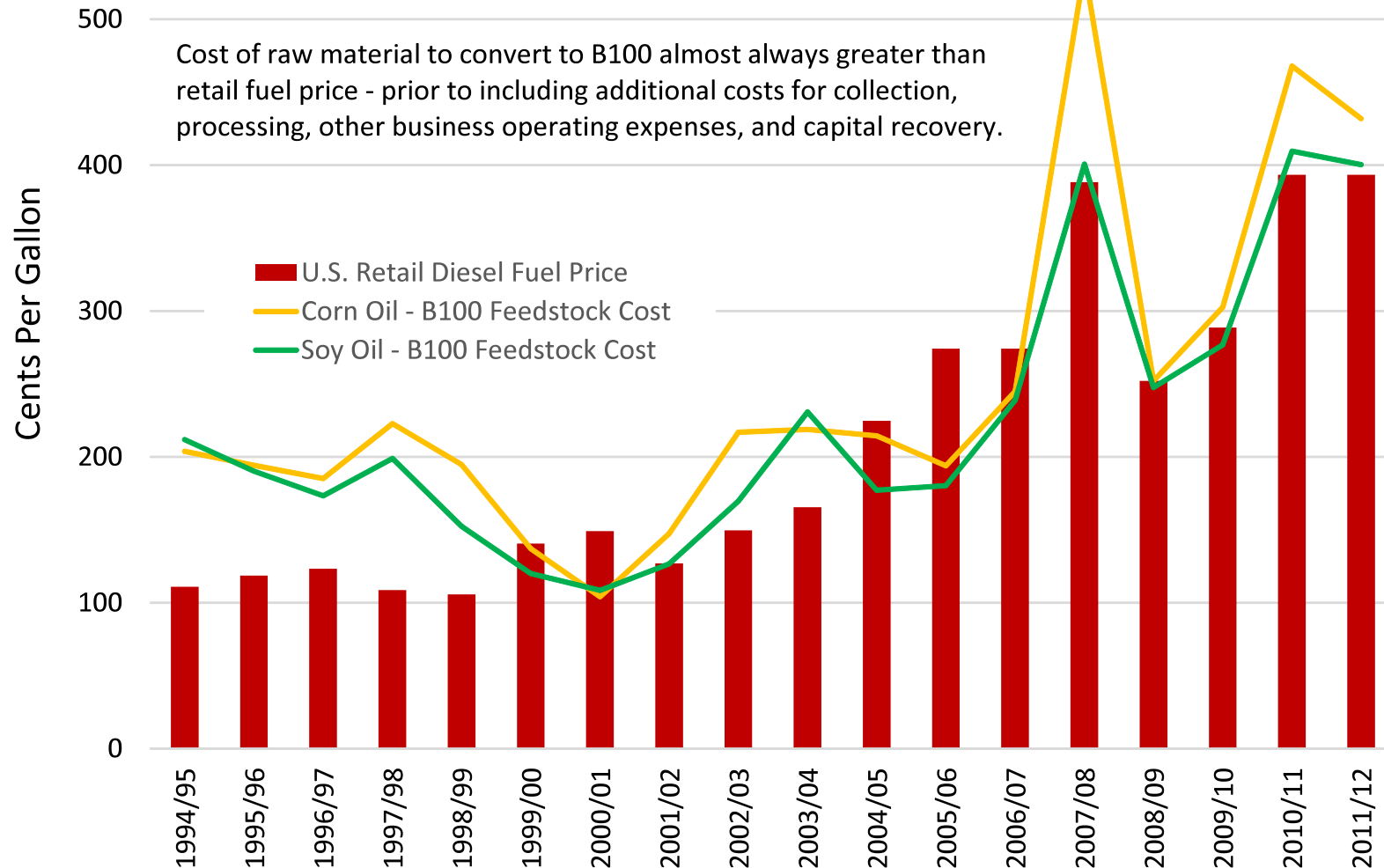
# Corn Oil Exports – Potential Biodiesel Source





# Corn Oil, Soy Oil & Diesel Fuel Prices

Sources: USDA Economics, Statistics and Market Information System (ESMIS) - Oil Crop Yearbook, Tabs 5 and 32; Energy Information Administration; and California Energy Commission analysis.





# Biodiesel Issues

- California biodiesel plants - 50 percent of capacity in 2012
- Limited availability of feedstocks and their higher costs have limited biodiesel growth
- Inadequate storage at distribution terminals decreases blending opportunities
- Biodiesel blends in excess of 5 percent by volume have the potential to increase oxides of nitrogen
  - CARB and industry have continue to work on developing mitigating strategies for B6-B20 blends
  - There will be workshop in October 2013 by CARB to provide an update on the proposed rules
- Vehicle warranty issues in excess of B5 could limit higher biodiesel blends levels in light-duty application

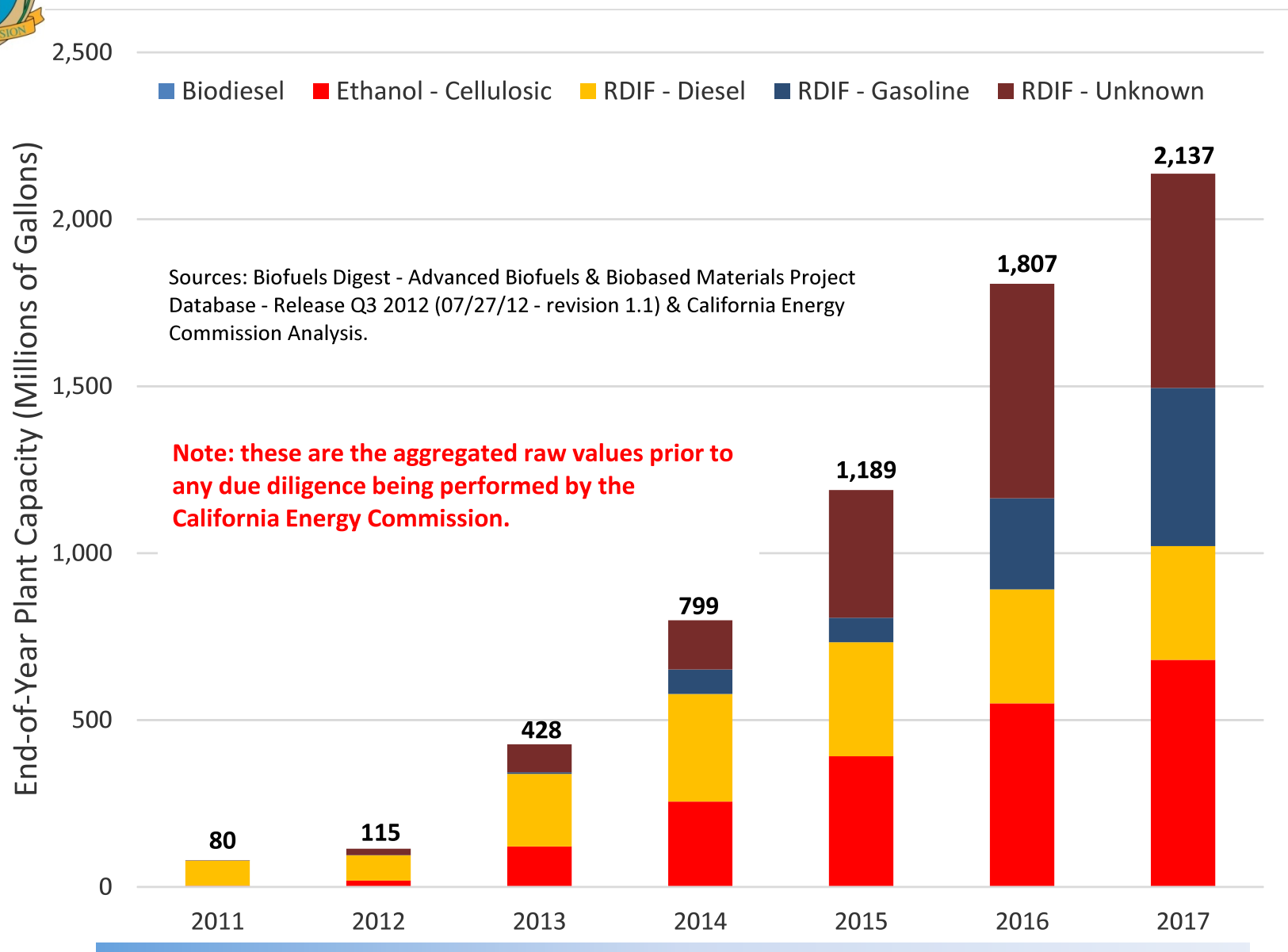


# Advanced Biofuel Production

- Advanced biofuels, as defined under the RFS, have been produced for over a decade
- Use in the RFS2 program has been modest
  - Only 94,091 gallons of cellulosic biofuel since 2012
- Advanced biofuels that are classified as renewable diesel have been produced & submitted into the RFS2 program in much larger quantities and earlier when compared to cellulosic biofuels
  - 46.5 million gallons since 2010
- Progress on commercialization of cellulosic biofuels has been slow and the outlook over the next couple of years is improving but expected to fall well short of RFS2 goals

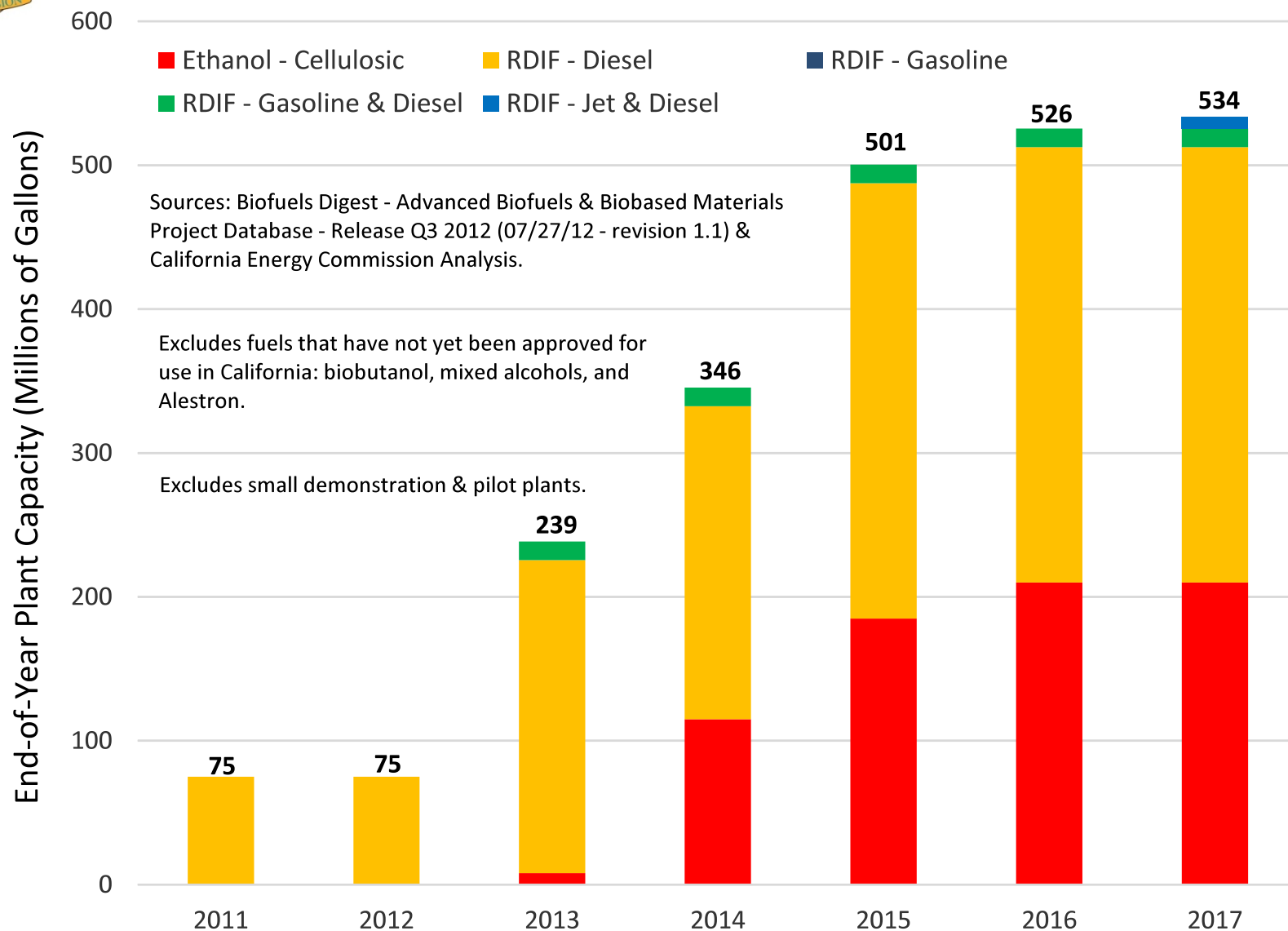


# Advanced Biofuel Availability – Raw Numbers





# Advanced Biofuel Availability – Due Diligence







# Advanced Biofuel Availability – Plant List

Facility	Status	Plant Costs							City	State	Biofuel
		Facility \$\$ MM	\$\$ Per Gallon Of Capacity	2013	2014	2015	2016	2017			
Canergy - 1st commercial	Planned	No Value					25	25	Imperial Valley	California	Cellulosic Ethanol
IneosBIO	Operational	130	16.3	8	8	8	8	8	Vero Beach	Florida	Cellulosic Ethanol
Fiberight - demonstration	Awaiting Modifications	59.5	9.9		6	6	6	6	Blairstown	Iowa	Cellulosic Ethanol
POET-DSM - 1st commercial	Under Construction	261	13.1		20	25	25	25	Emmetsburg	Iowa	Cellulosic Ethanol
Quad County Corn Processors	Under Construction	8.5	4.3		2	2	2	2	Galva	Iowa	Cellulosic Ethanol
Dupont Biofuel Solutions - 1st com.	Under Construction	225	7.5		30	30	30	30	Nevada	Iowa	Cellulosic Ethanol
Abengoa - 1st commercial	Under Construction	685	27.4		25	25	25	25	Hugoton	Kansas	Cellulosic Ethanol
Mascoma - 1st commercial	Planned	232	11.6		20	20	20	20	Kinross	Michigan	Cellulosic Ethanol
Enerkem - 2nd commercial	Planned	100	10.0			10	10	10	Pontotoc	Mississippi	Cellulosic Ethanol
Fulcrum - 1st commercial	Planned	175	17.5			10	10	10	McCarran	Nevada	Cellulosic Ethanol
Beta Renewables	Planned	99	5.0			20	20	20	Sampson County	North Carolina	Cellulosic Ethanol
ZeaChem - 1st commercial	Planned	391	15.6			25	25	25	Boardman	Oregon	Cellulosic Ethanol
Advanced Biofuels - 1st com.	Planned	No Value			4	4	4	4	Moses Lake	Washington	Cellulosic Ethanol
Paradigm BioAviation - 1st com.	Planned	120	15.0					8	Bloomington	Illinois	RDIF - Jet, ULSD & Naph.
Dynamic Fuels	Temporarily Idled	150	2.0	75	75	75	75	75	Geismar	Louisiana	RDIF - Diesel
Diamond Green Diesel	Operational	368	2.6	143	143	143	143	143	Norco	Louisiana	RDIF - Diesel
Emerald Biofuels	Planned	No Value				85	85	85	Plaquemine	Louisiana	RDIF - Diesel
KIOR - 1st commercial	Operational	213	16.4	13	13	13	13	13	Columbus	Mississippi	RDIF - Gasoline & Diesel

- No cellulosic ethanol facilities greater than 30 MM gallons over the next several years – EIA forecasts between 232 million & 366 million gallons by 2020
- Renewable diesel fuel continues to make strong progress, including developments by Diamond Green Diesel & Neste
- RDIF gasoline progress slow, to date



# Advanced Biofuel Issues

- Cellulosic biofuel progress has been significantly slower than expectations
  - Expensive technology
- Drop-in diesel fuel progress is ramping up at a more rapid pace than drop-in gasoline
- Feedstock availability animal fats & used cooking oils will ultimately limit production capacity for renewable fuels from these sources
  - *“Our Diamond Green Diesel facility will convert up to 11% of the U.S.’ animal fat and used cooking oil into renewable diesel”*
- No infrastructure modifications anticipated for cellulosic and advanced biofuels
  - Exception of expanded use of E15 & E85 to move beyond the 10 percent ethanol “blend wall”