

Future U.S. Biofuels: Current Situation, Potentials, Policies, and Uncertainties

Farzad Taheripour

Based on Joint Research with Wallace E. Tyner

Special Topic in Educational Technology

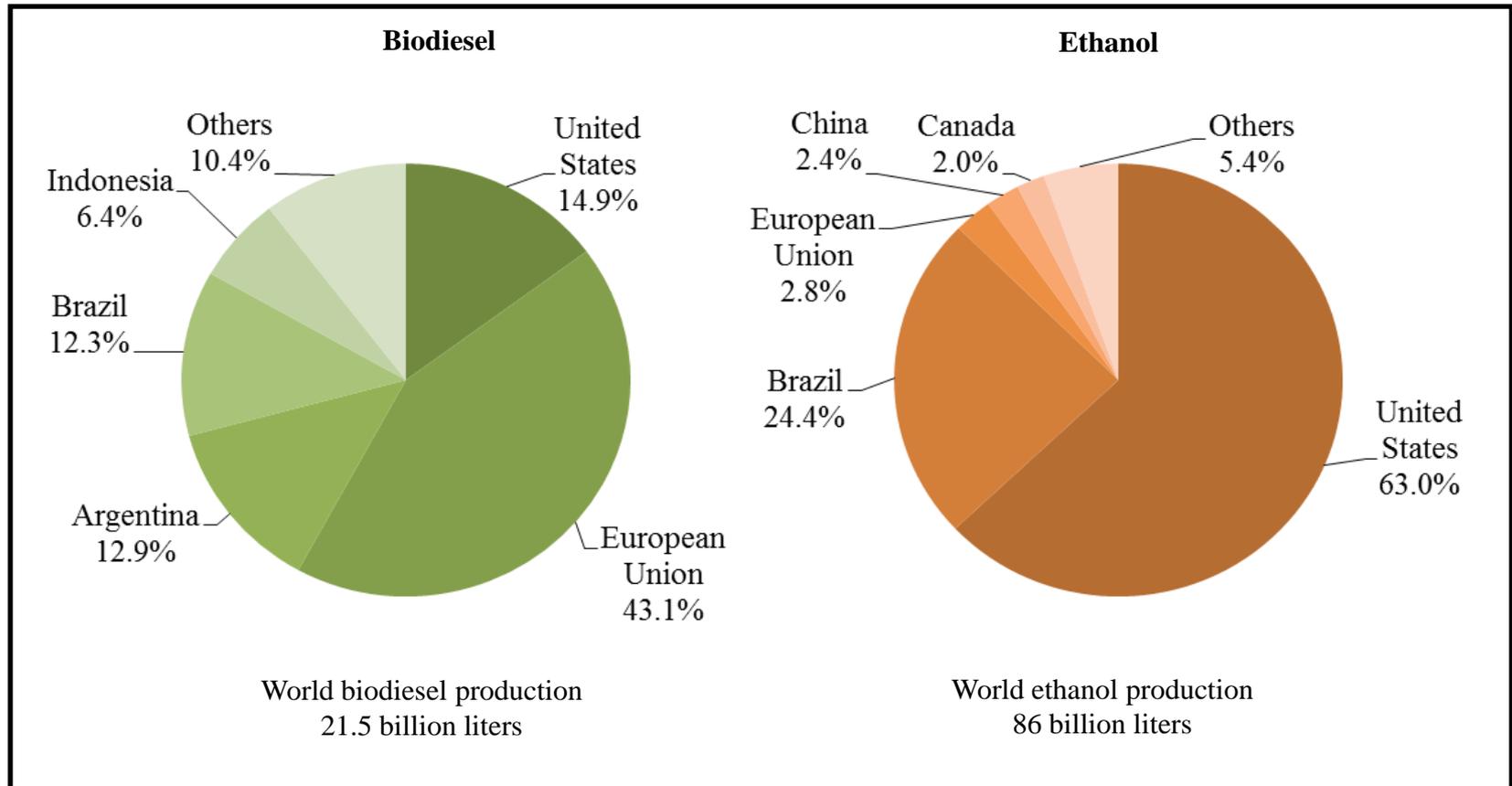
Purdue University

2013

Presentation Outline

- Global Biofuel industry: Current Situation,
- US ethanol industry: Current Situation,
- Current US biofuel policies,
- Biofuel uncertainty – first generation,
- The Blend Wall,
- Welfare and land use implications
- Biofuel uncertainty – second generation,
- Conclusion.

Global production of liquid biofuels in 2012

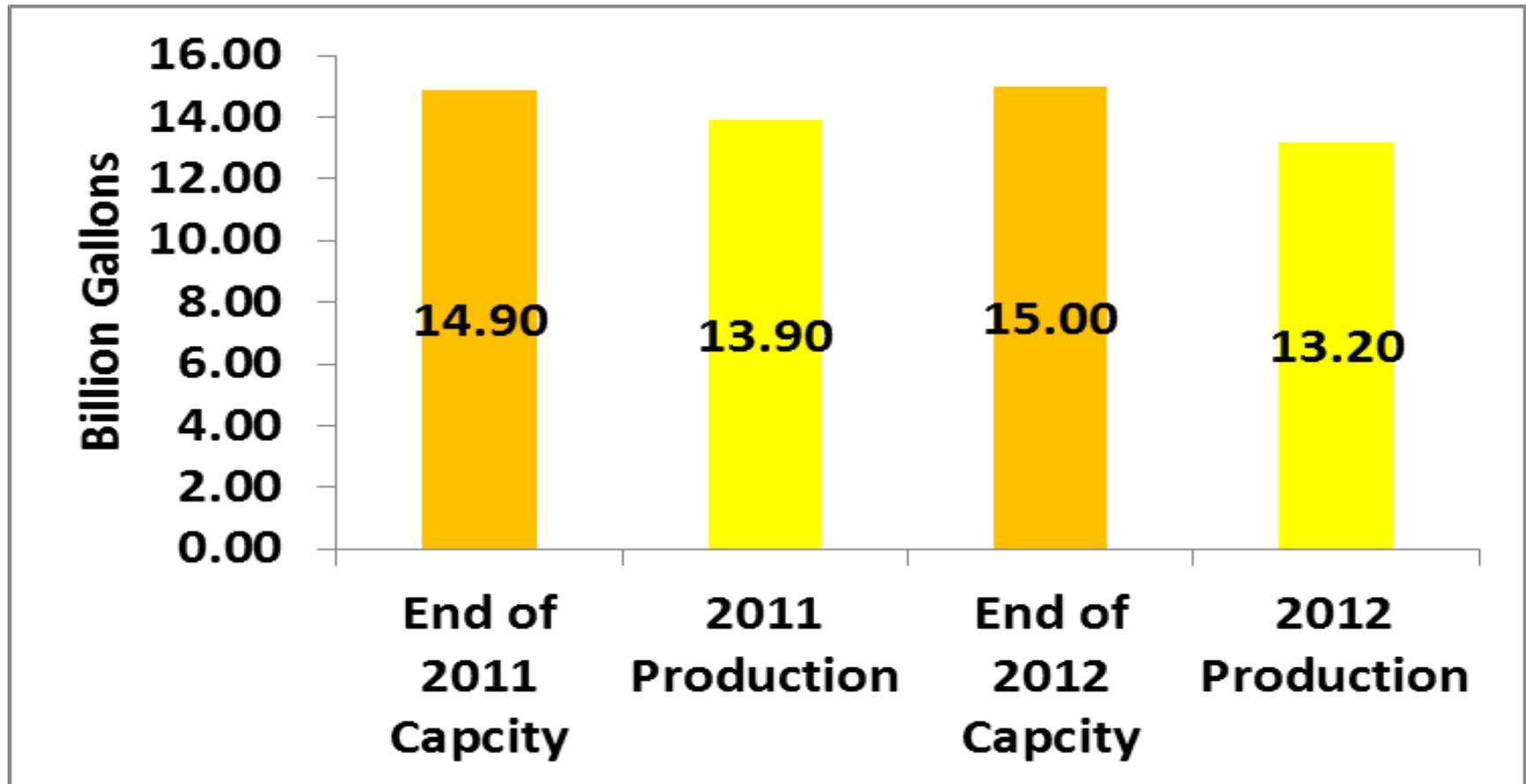


More than 40% of US corn and 25% of US Soybeans are used for ethanol and biodiesel

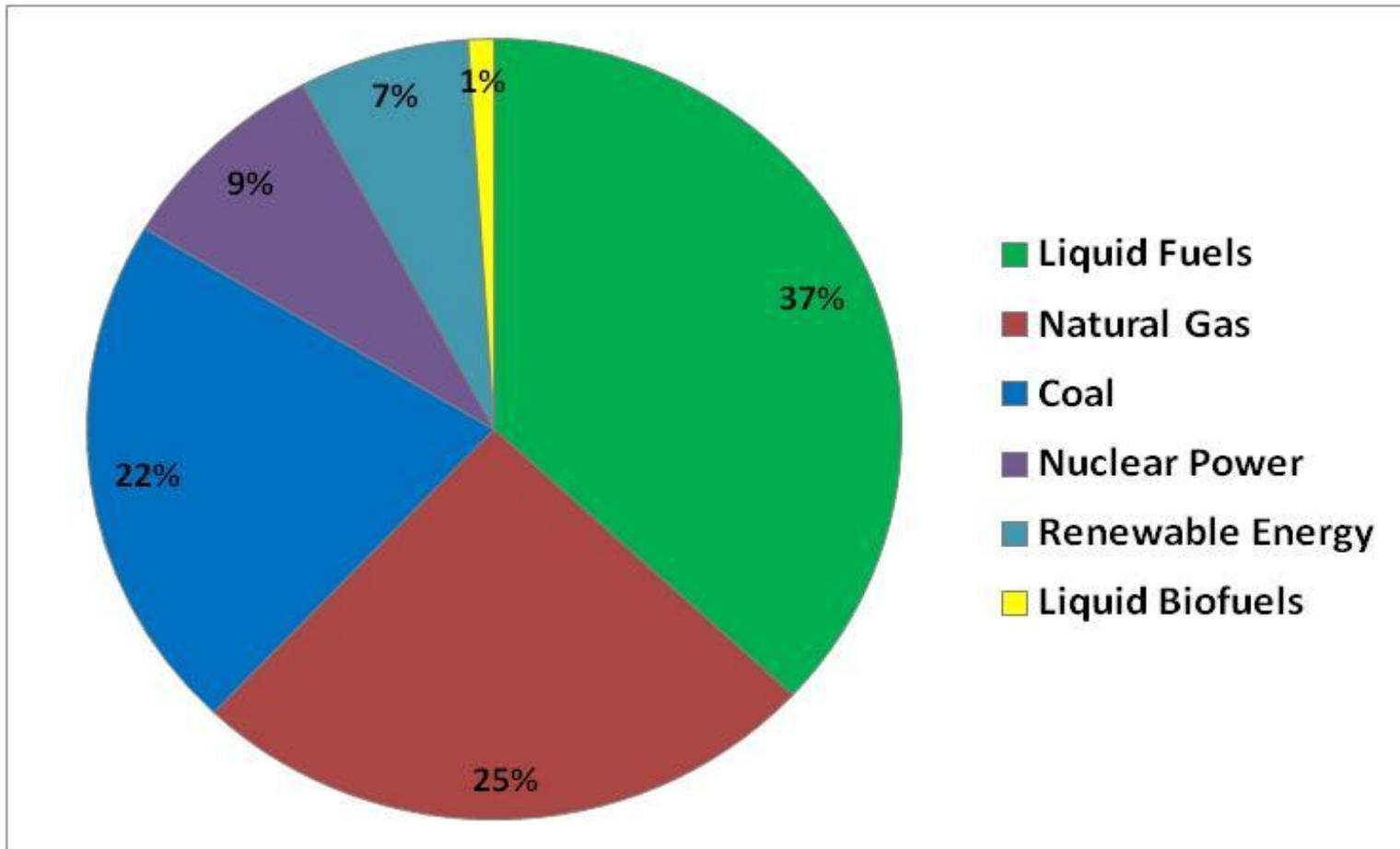
60% of Brazilian sugarcane is used for ethanol

26% of palm oil, 19% of soy oil, and 31% of rapeseed oil are used in industrial uses world wide

US Ethanol: Installed Capacity and Production

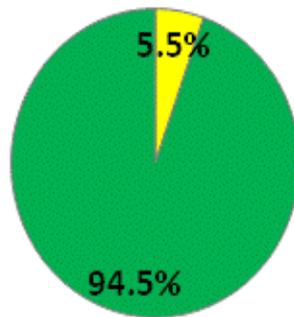


Share of biofuels in US energy consumption (2010)



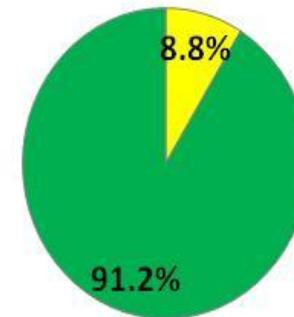
Share of ethanol in US motor gasoline: 2010`

Share of ethanol in motor gasoline
(energy content)



■ Ethanol ■ Gasoline

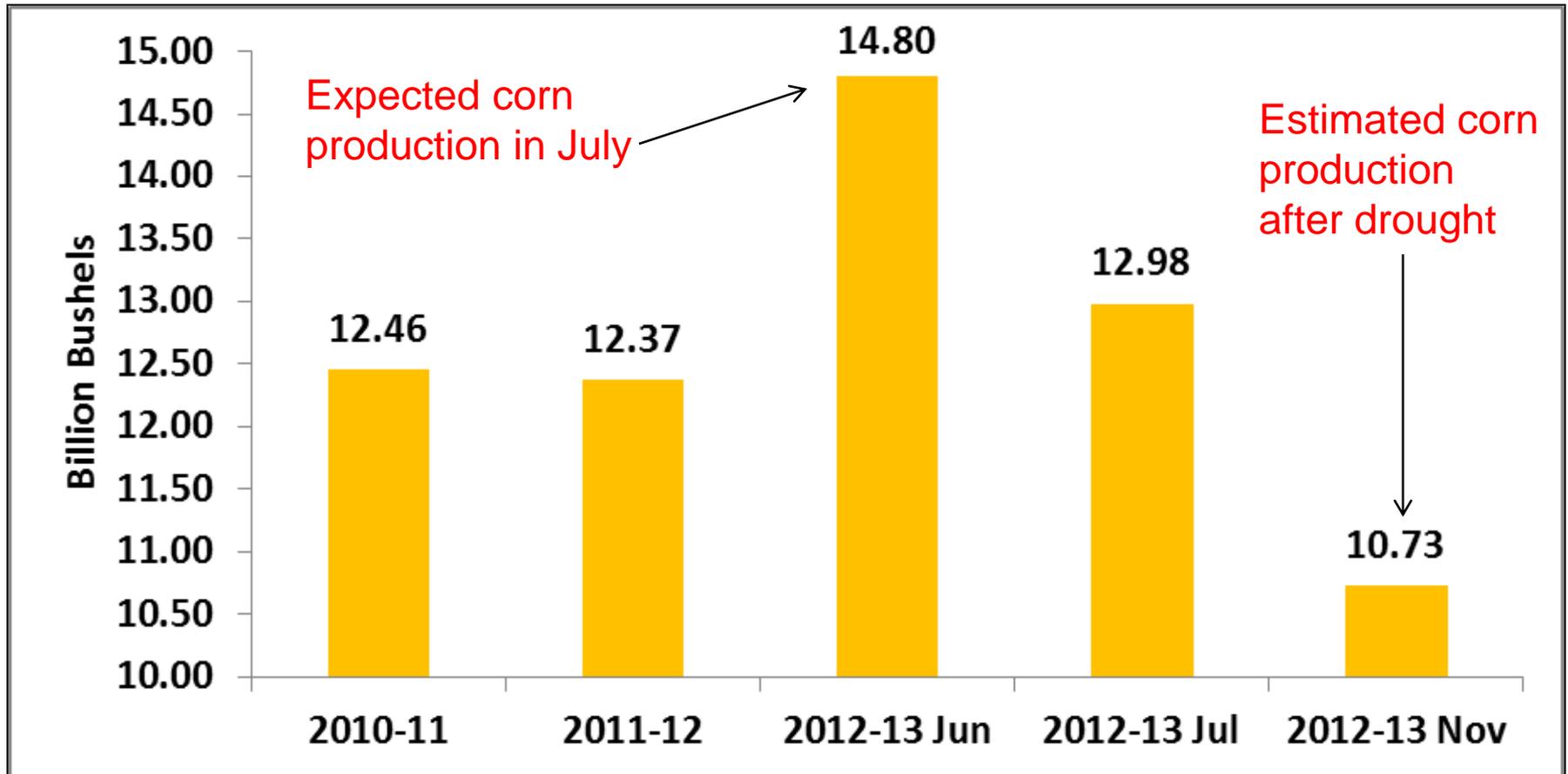
Share of ethanol in motor gasoline
(volumetric share)



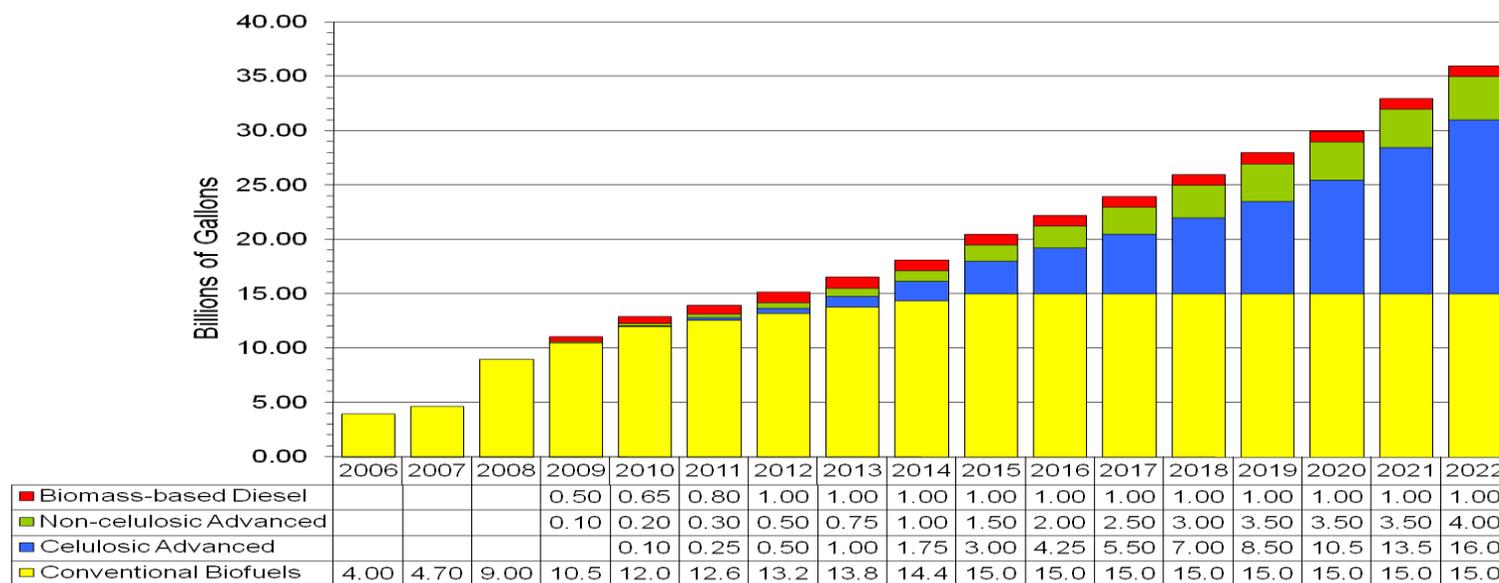
■ Ethanol ■ Gasoline

US EPA rules allow 10% ethanol – recently approved 15%
The effective blending rate is about 9%.
The US ethanol industry is now facing the blend wall.

Drought and Reduction in Corn Production



Renewable fuel standard (volumetric)



Currently, the US ethanol and biodiesel outputs are beyond the RFS levels

Very limited amounts of cellulosic biofuels are produced

The first commercial cellulosic ethanol plant started to produce a drop in biofuel in 2013 with 13 million gallons capacity per year (look for KiOR online).

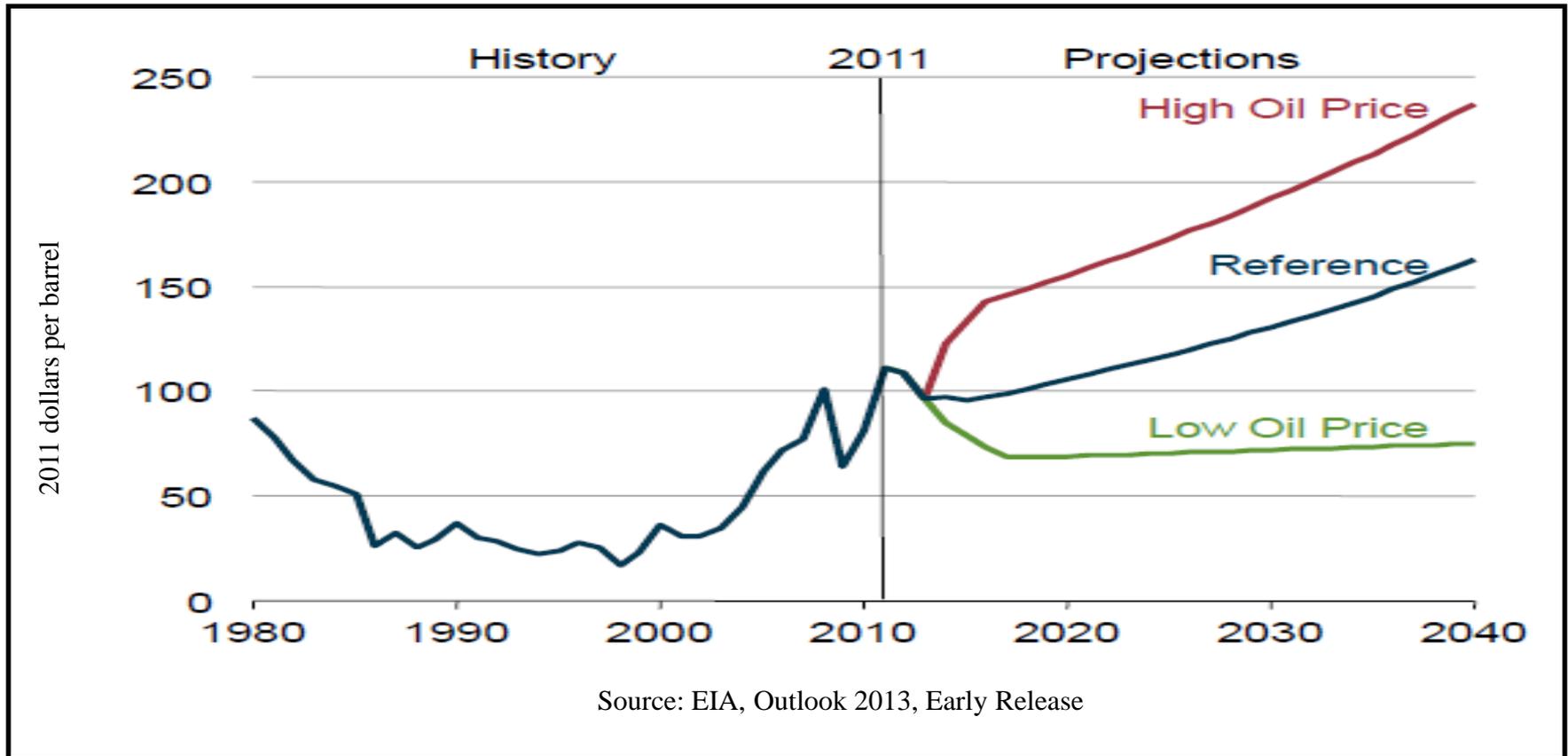
Current US biofuel policies

- **Subsidy initiatives:**
 - Federal ethanol subsidy of \$0.0 per gallon,
 - Federal biodiesel subsidy of \$1 per gallon,
 - Federal cellulosic ethanol subsidy of \$1.01 per gallon,
 - There are some state subsidies as well.
- **Trade protection:**
 - US protected its ethanol industry using a tariff policy in the past (\$0.54 per gallon specific tariff plus a 2.5% ad valorem tariff). The \$0.54 per gallon tariff is expired.

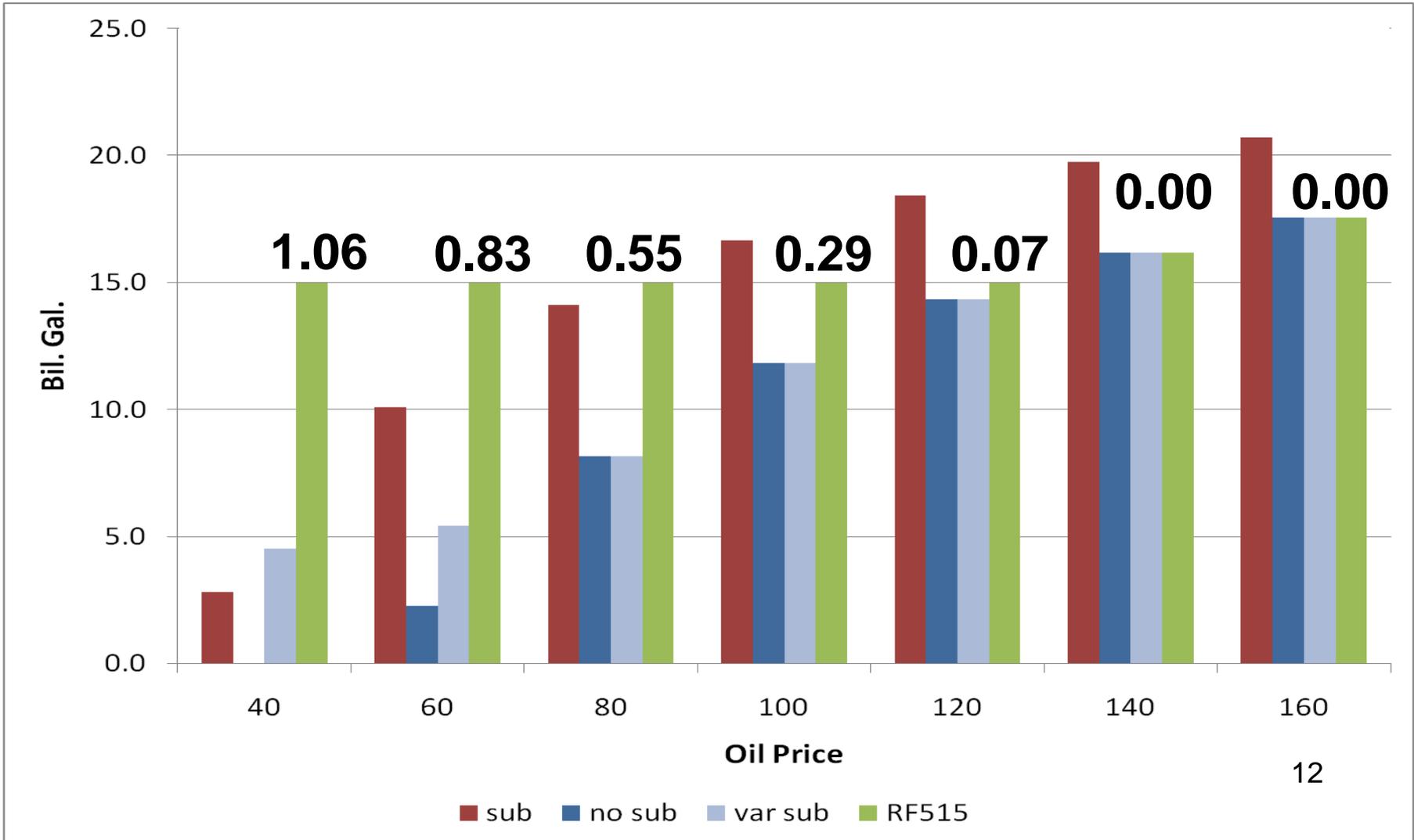
Biofuel uncertainty – first generation

- For corn ethanol there are four major sources of uncertainty:
 - Future oil prices,
 - Demand for ethanol - blending wall,
 - Competition with Brazilian ethanol,
 - Government policy.
- These uncertainties will affect future expansion of corn ethanol.
- However, corn ethanol industry will be in a relatively stable situation, if mandate remains in effect.

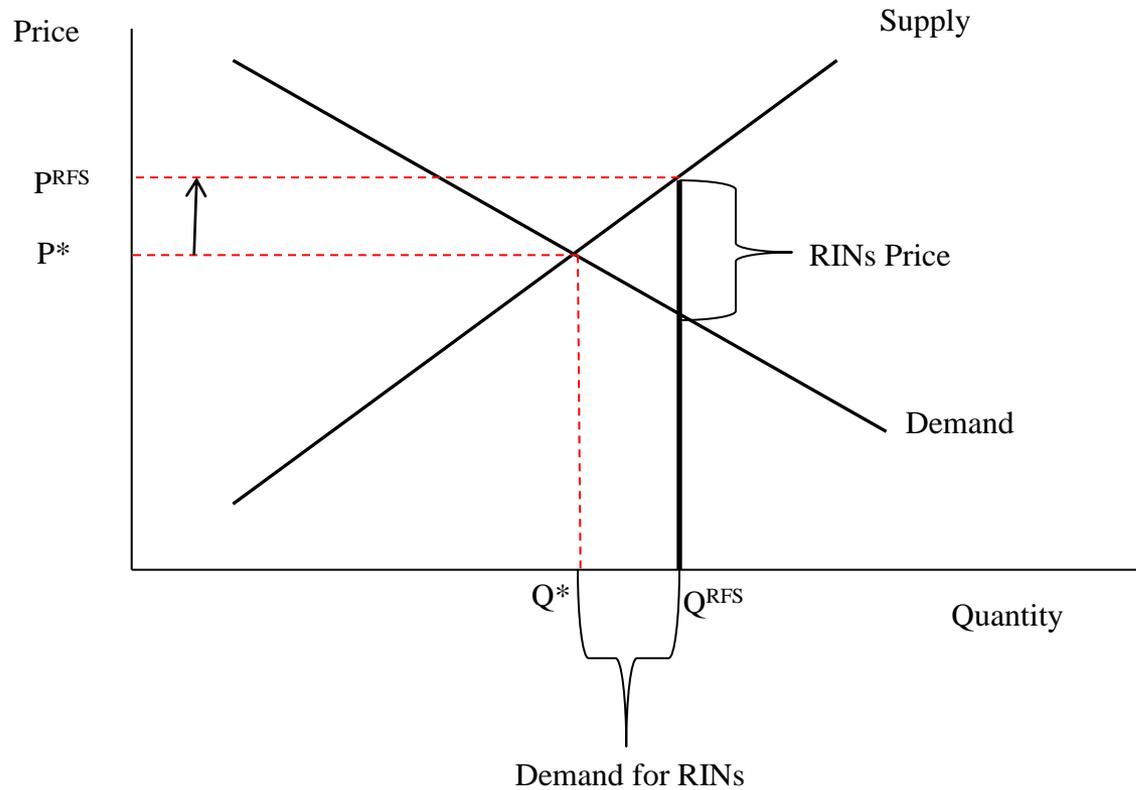
Average annual world oil prices in three cases



Ethanol production with no blending wall`



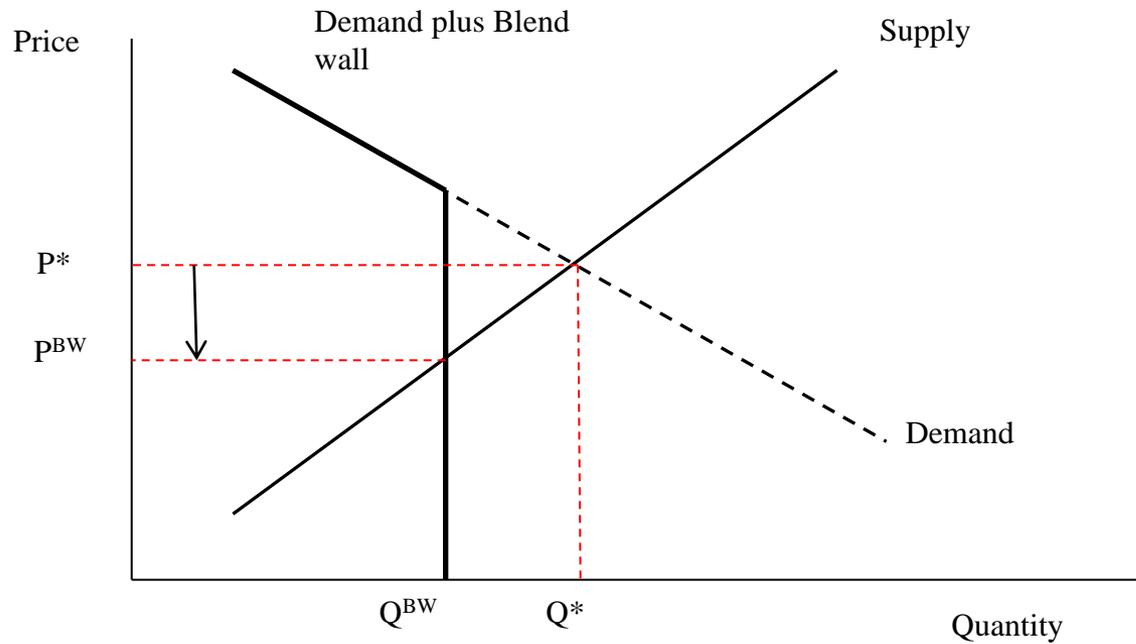
Biofuel Mandate



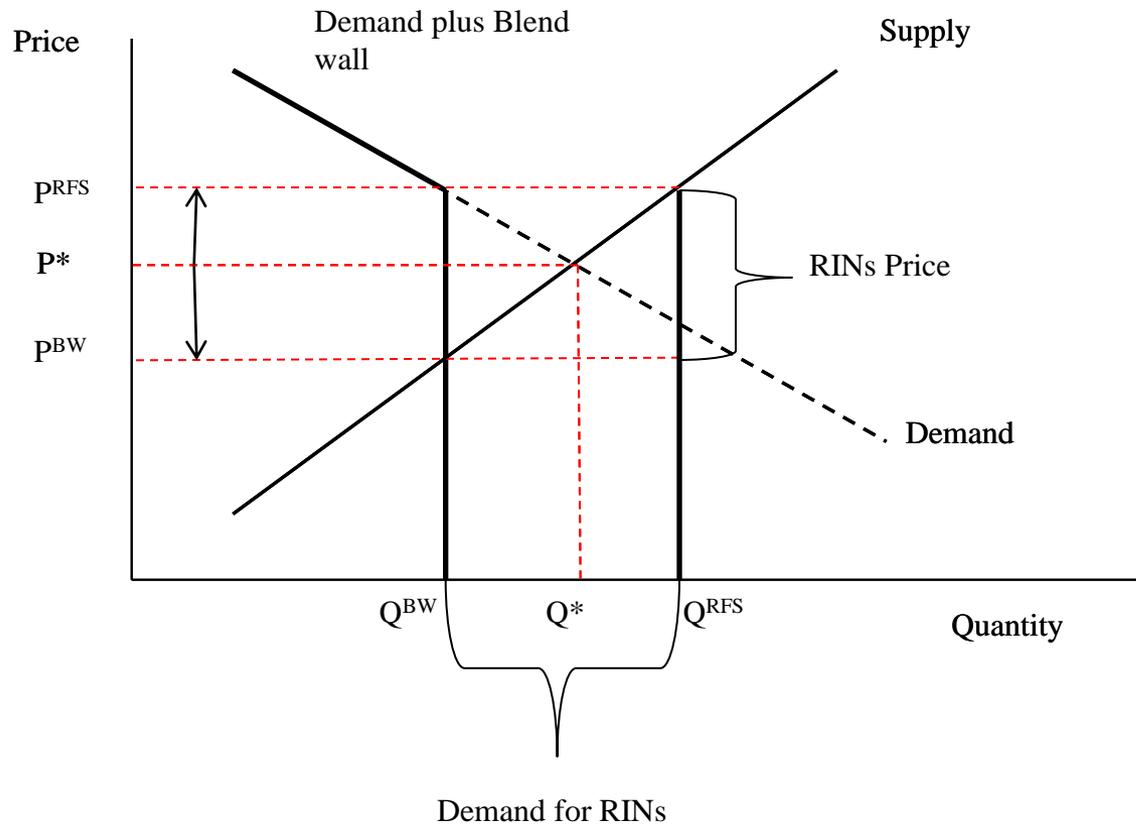
The blend wall

- We consume about 140 billion gallons of gasoline type fuel annually, so a 10% blend limit would be a max of 14 billion gallons of ethanol.
- However, the effective blend limit is much lower, about 13.3 billion gallon.
- At the wall, there is more ethanol capacity than market absorptive capacity, so ethanol price falls.
- Ethanol price falls to the breakeven with corn for the marginal producer that just meets the wall limit.
- The recent EPA proposed change to 15% for 2001+ vehicles if implemented would shift the blend wall to 19 billion gallons

Blending wall



Mandate and Blending wall



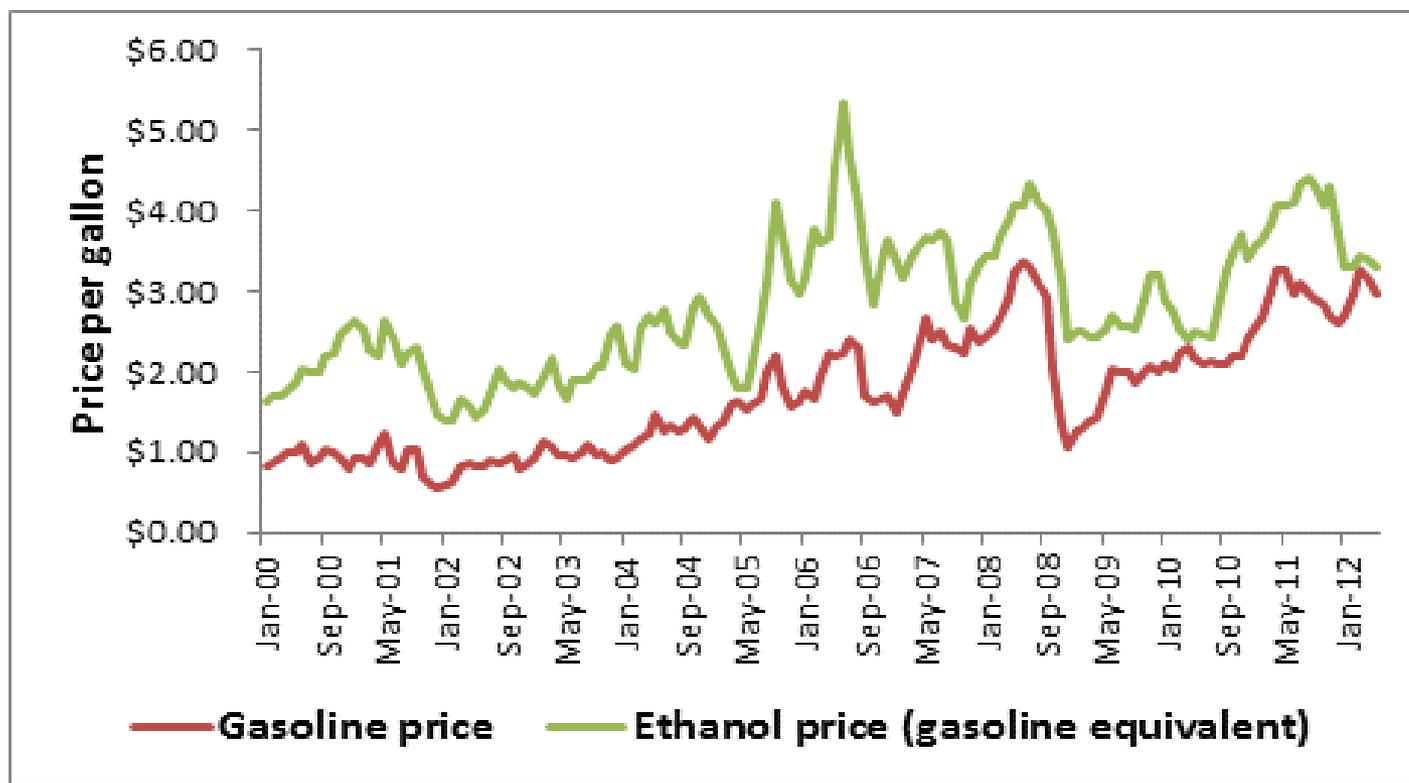
Second generation of biofuels

- **Feedstock:**
 - Agricultural residues,
 - Forest residues,
 - Dedicated crops,
 - Other residues,
- A wide variety of conversion processes are being investigated for the second generation of biofuels,
- We now have only one plant in the US which produces cellulosic biofuels at commercial level (13 million gallons per year capacity located in Columbus, Mississippi.
- This plant produces a drop in biofuels.
- The implemented technology combines a catalyst system with a fluid catalytic cracking technology.

Why we produce biofuels

- To reduce oil imports,
- To reduce GHGs,
- To improve national security.
- How about welfare?

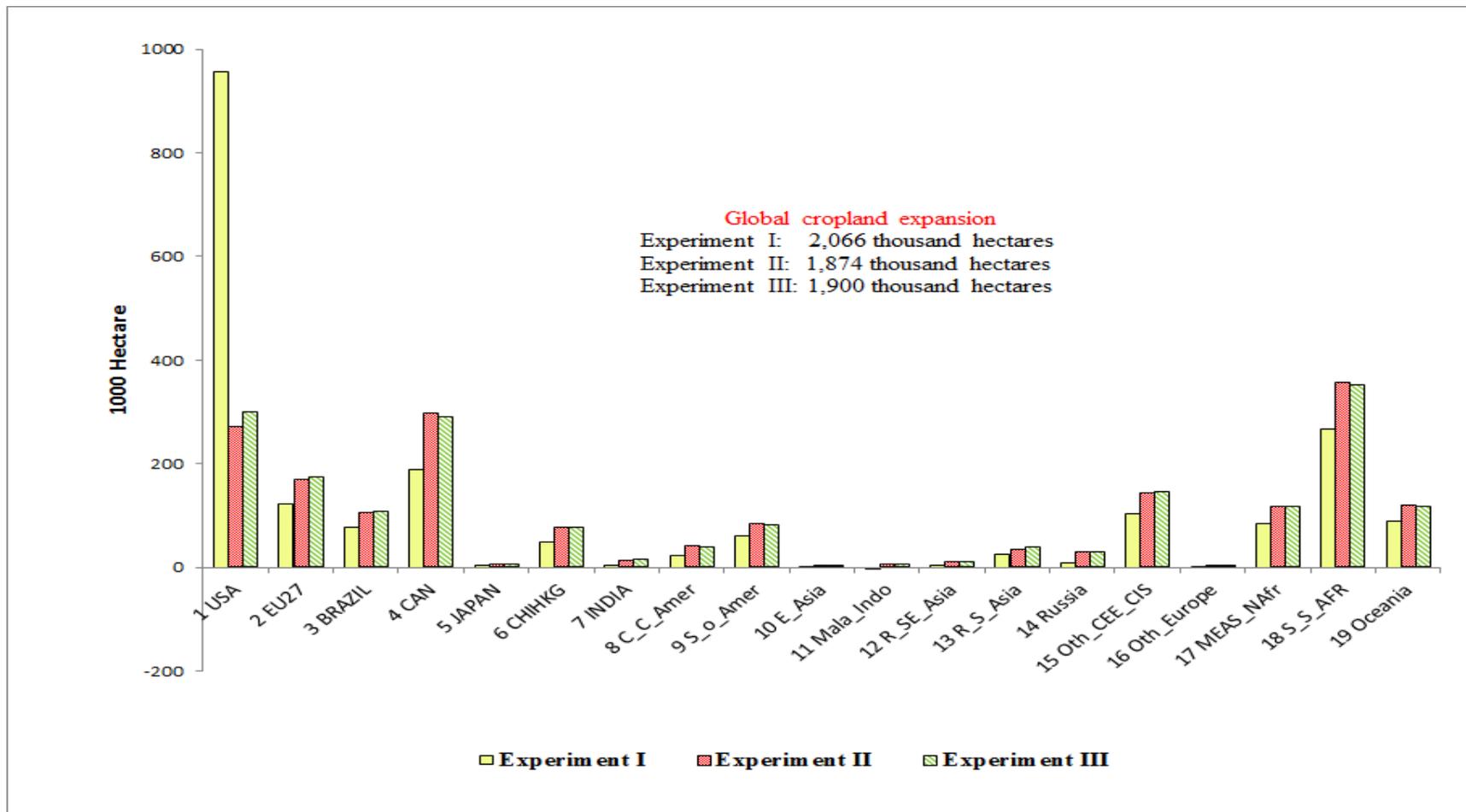
Price comparison



Welfare impacts

Region	Experiment I	Experiment II	Experiment III
USA	-16,822	-15,339	-14,795
EU27	1,952	1,312	132
BRAZIL	173	194	151
CAN	-624	-588	-316
JAPAN	318	-168	-528
CHIHKG	134	67	-44
INDIA	503	448	262
C_C_Amer	-1,597	-1,616	-833
S_o_Amer	-643	-557	-279
E_Asia	411	175	-63
Mala_Indo	-66	-53	-9
R_SE_Asia	221	215	145
R_S_Asia	63	51	25
Russia	-940	-917	-724
Oth_CEE_CIS	42	26	-3
Oth_Europe	-443	-427	-330
MEAS_NAfr	-3,611	-3,503	-2,501
S_S_AFR	-897	-808	-474
Oceania	92	123	134
World	-21,734	-21,365	-20,050

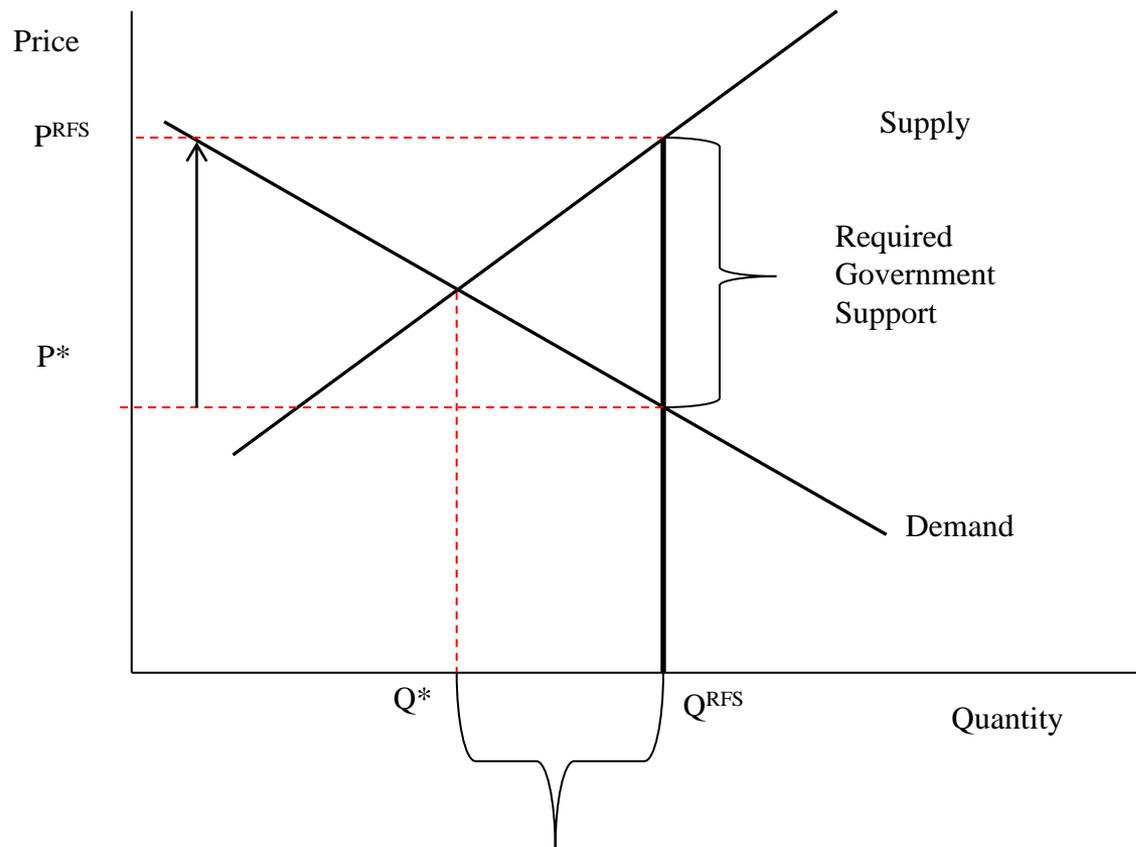
Land use impacts



Biofuel uncertainty – second generation

- For cellulosic biofuels there are six major sources of uncertainty:
 - Future oil prices,
 - Feed stock costs and availability by region,
 - Conversion costs and efficiencies,
 - Final product (ethanol versus bio-gasoline)
 - Environmental impacts,
 - Government policy.
- The combination of all of these uncertainties makes analysis of biofuels impacts highly uncertain.
- Add in the condition of the financial markets at present, and cellulosic biofuel investment becomes quite problematic.

Biofuel Mandate



GAP between
Production and RINs

Conclusions

- Biofuel production could reduce GHG emissions
- The induced land use changes due to biofuel production eliminate a portion in saving in GHG emissions.
- Biofuel production may not increase welfare,
- We have the resource base to meet the RFS and beyond for cellulosic biofuels.
- The costs will be higher than previously estimated, but likely economic at \$120 crude oil, or lower with subsidies.
- The five uncertainties loom large in the near term as they inhibit private sector investment.
- Cellulose biofuels will not come on without strong incentives or a credible mandate.
- With new the new gas extraction technology we may not see a major expansion in biofuel production in near future.

Thank you!
Questions and Comments