Analyzing the Impacts of U.S. Biofuels Production and Trade Policies in a CGE Framework

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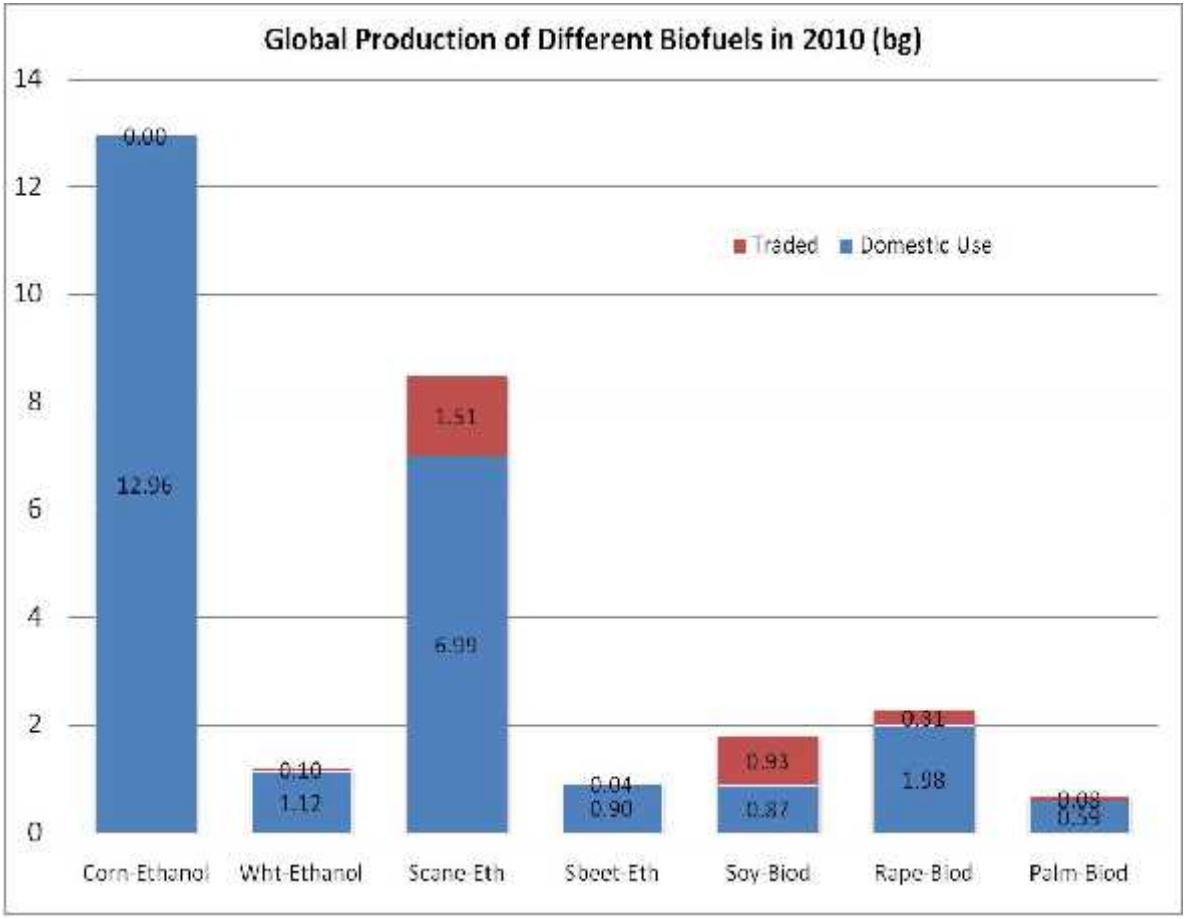
Potential for International Trade in Biofuels

- To have alternative sources of supply to face any uncertainties.
- To balance domestic prices when production cost is high as it is now in the US.
- Growing need of biofuels for blending with petroleum in non-producing countries.



Source: Based on IEA (2010)

Trade Distortions

- **Import Tariff**

Country	Ethanol Import Tariff
USA	2.5 % + 54 cents/g import duty
Brazil	20%
Argentina	20%
Thailand	30%
India	186%
Canada	19 cents / gallon
European Union	87 cents / gallon

- **Ethanol Subsidy (VEETC) in the US**: Blender's credit was 51 cents/gallon**,** reduced to **45 cents** in 2010 (costs about $5.5 billion/year on 12.3 billion gallons of ethanol production). The subsidy for biodiesel is $1/g & cellulosic biofuels is $1.01/g

- **EU tax credit** for biodiesel is about $1/g for ethanol and $1.9/g for biodiesel.

U.S. Domestic and Trade Policies:

- The Domestic Energy Production Act of 2011 – May 2011.
- Ethanol Subsidy and Tariff Repeal Act – May 2011.
- Volumetric Ethanol Excise Tax Credit Repeal Act – March 2011.
- Repeal Ethanol Subsidies Today Act of 2011 – March 2011.
- The Securing America's Future with Energy and Sustainable Technologies Act - July 2010.
- The Affordable Food and Fuel for America Act – July 2009.
- The Imported Ethanol Parity Act – March 2009.
- The US Food, Conservation and Energy Act 2008.

Focus of this study

- Biofuel mandates/targets (2015, non-cellulosic)
  - USA - 17.5 billion gallons (RFS2 – 36bgy by 2022)
  - EU27 - 10.6 billion gallons (10% share by 2020)
  - Brazil – 13.7 billion gallons
- What are the global implications of these biofuel mandates with an emphasis on land use, trade, and GHG emissions?
- What are the implications of U.S. biofuel subsidies & tariffs on global trade and welfare?
- Interaction of biofuel mandates and incentive policies.

Study Approach: Data Base

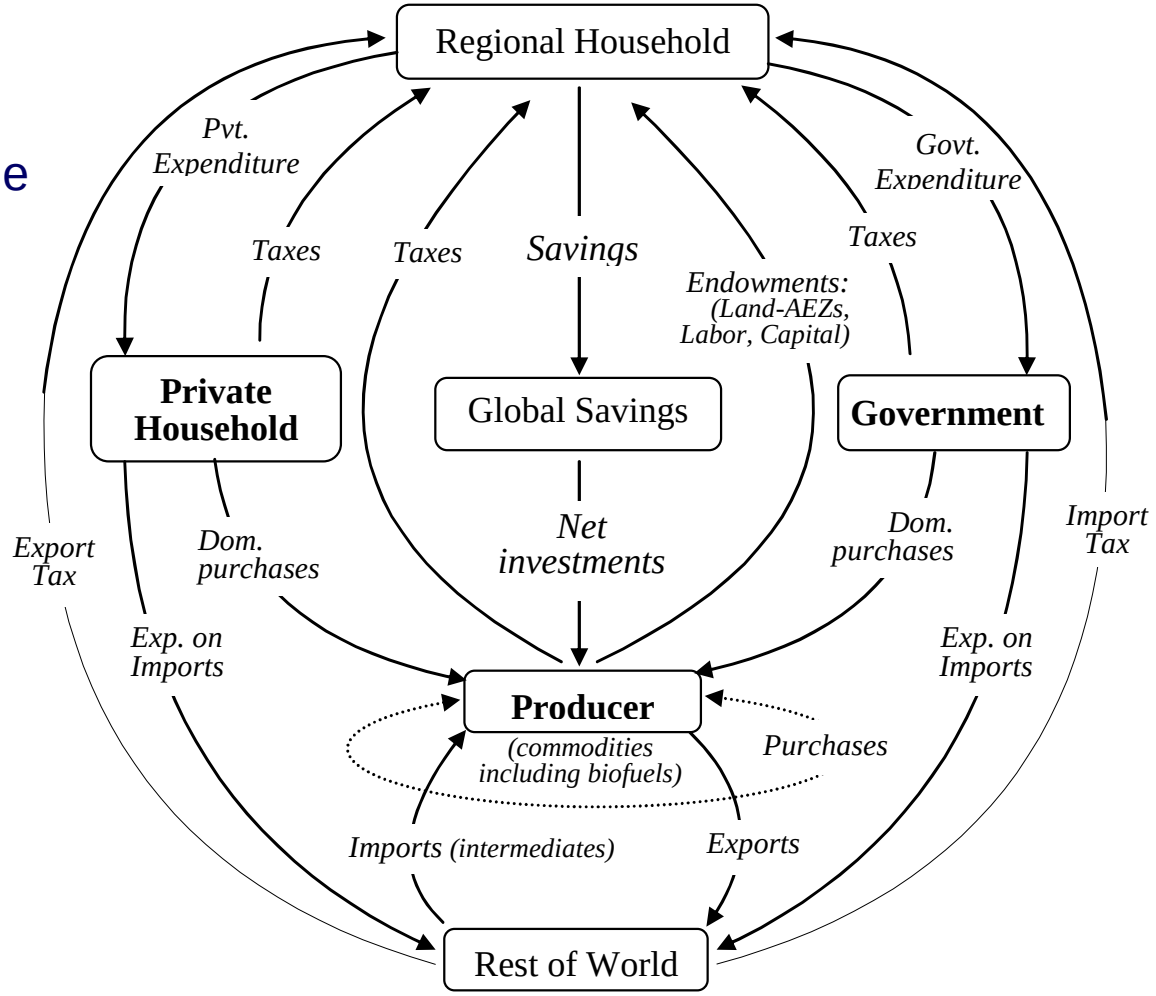
- We start with the GTAP v7.1 data base which pertains to global economy in 2004 and introduce detailed explicit sectors covering agricultural crops, different types of biofuels and by-products.
  - Feedstock crops: Corn, Soybean, Rapeseed/Canola, Palm-oil, Sugar-beet, Sugar-cane
  - Biofuels: ethanol (grain, sugar), biodiesel (soy, rapeseed, palm)
  - By-products: DDGS, vegetable oil-meal
- The data base is aggregated to 25 regions & 39 sectors (no cellulosic biofuels).
- Land endowment data is split into 18 Agro-Ecological Zones (AEZs) in each region (Avetisyan et al. 2011).

Study Approach: Analytical Tool

- We utilize the GTAP-BIO model, a customized version of the Global Trade Analysis Project (GTAP) CGE model capable of differentiating the domestic and imported biofuels based on their source.
- Imported and domestic biofuels are treated as close but not perfect substitutes:
  - We modify the CES production and private consumption structures to allow for substitution of imported ethanol with domestic ethanol, and imported biodiesel with domestic biodiesel.
  - We use elasticities of substitution b/w the four types of ethanol & b/w the three types of biodiesel – similar to that of crude oil.

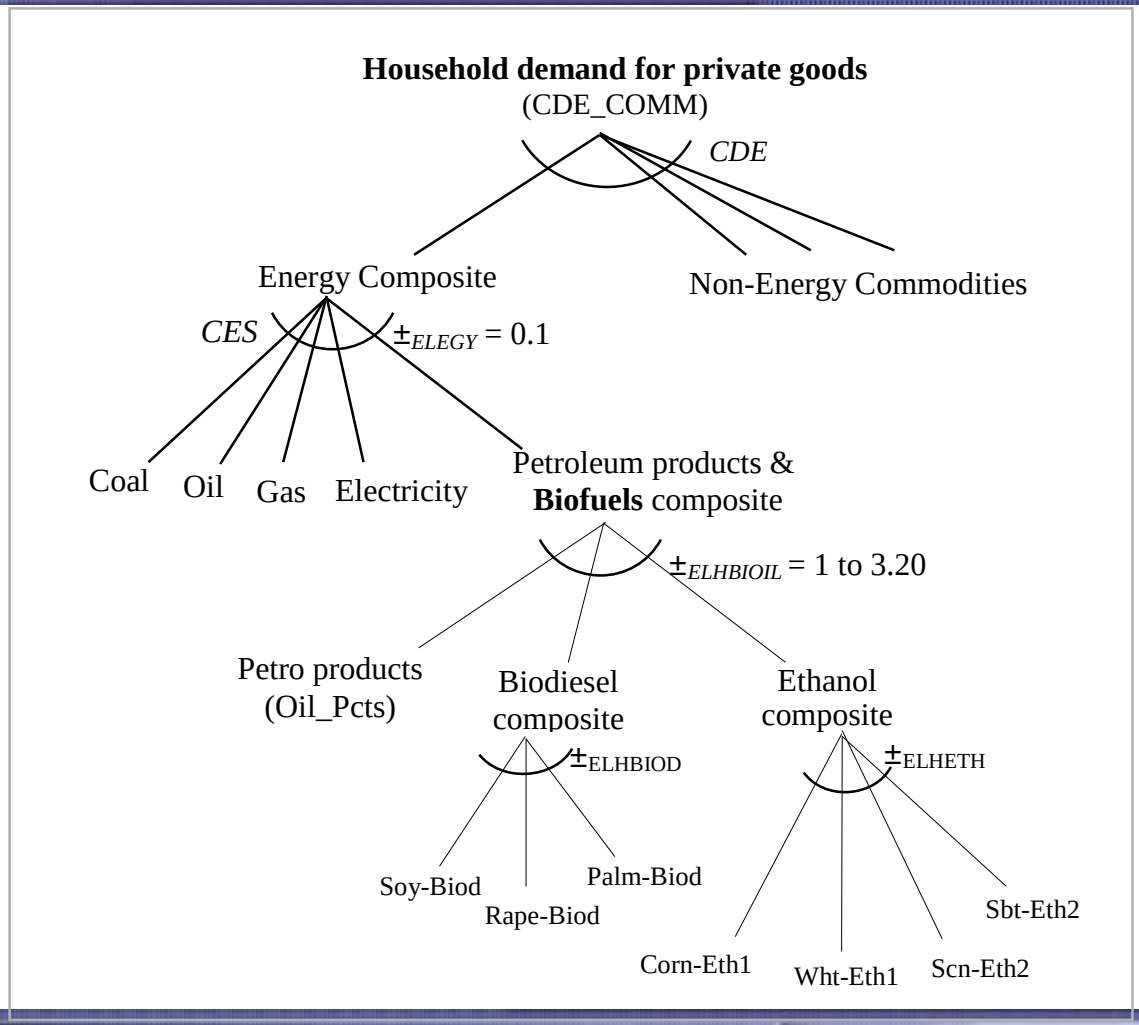
An Overview of GTAP Model (Hertel, 1997)

- Perfect Competition
- Constant returns to scale
- Walrasian adjustment



- Behavioral relationships:
  - Producer – CES
  - Regional HH - CD
  - Private HH - CDE

Household Consumption Structure



Study Approach: Experimental Design

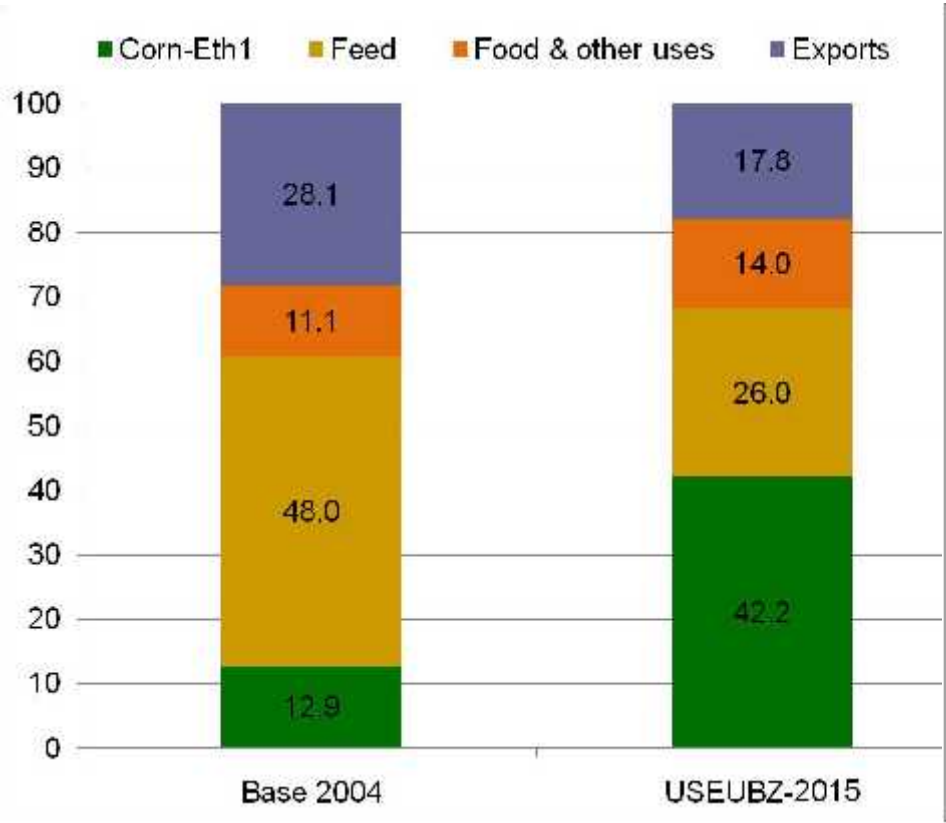
- We start from the 2004 base year and analyze the following policy scenarios:
  1. Shock volume of biofuels to go up as per the US, EU, and Brazil policies, to generate the 2015 biofuels scenario.
  2. Reduce or remove the US import tariff and subsidy for ethanol across alternative base years/ time-intervals: 2004, 2015.
     a) Reduce ethanol blenders' credit from 51¢/g to 45 ¢/g and complete removal of tariff.
     b) Mandates in scenario (1) + scenario (2a) combined.
     c) Reduce ethanol blenders' credit from 51¢/g to 45 ¢/g and reduce import tariff from 54¢/g to 45 ¢/g, so that there is "parity" b/w U.S. and exporting country's ethanol price.
     d) Complete removal of U.S. ethanol blenders' credit and import tariff.

Biofuel Targets in the US, EU, & Brazil

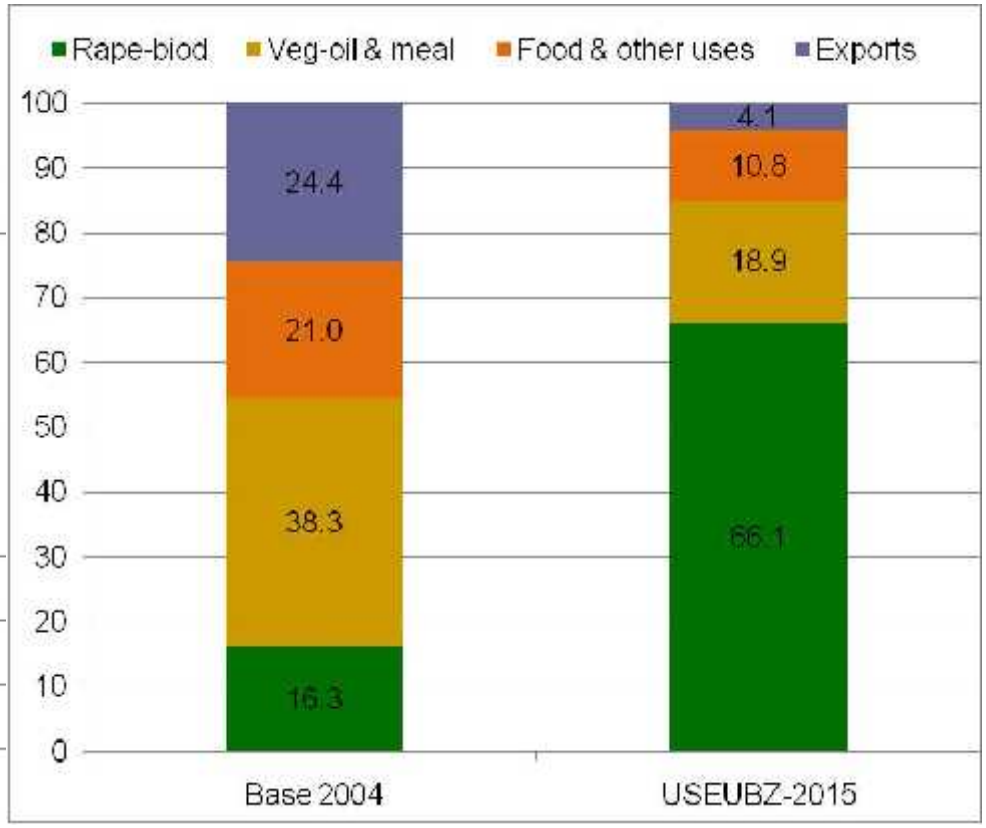
Biofuel Consumption (billion gallons)	USA		EU27		Brazil	
	2004	2015	2004	2015	2004	2015
Corn-Ethanol	3.546	15.000	0	0	0	
Wheat-Ethanol	0		0.194	1.623	0	
Soy-Biodiesel	0.036	1.000	0	0	0.007	1.361
Rape-Biodiesel	0		0.557	6.023	0	
Palm-Biodiesel	0		0.108	0.958	0	
Sugarcane-Ethanol	0	1.500*	0	0	3.665	12.400
Sugarbeet-Ethanol	0.007		0.069	2.038	0	
TOTAL Volume:	3.59	17.50	0.93	10.64	3.67	13.76

* indicates imported.

Disposition of Corn in the US & Rapeseed in the EU (%)

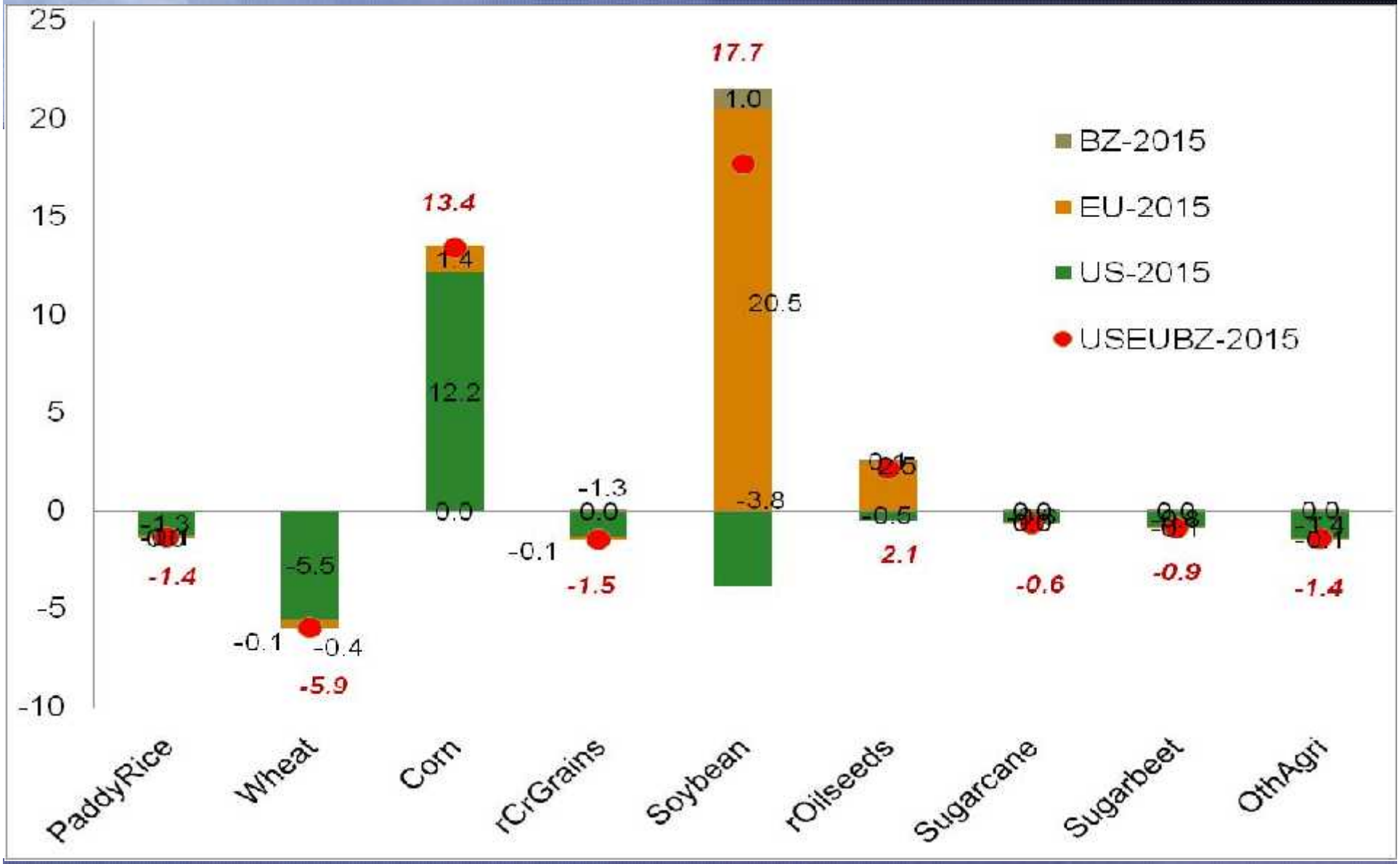


Corn in the US

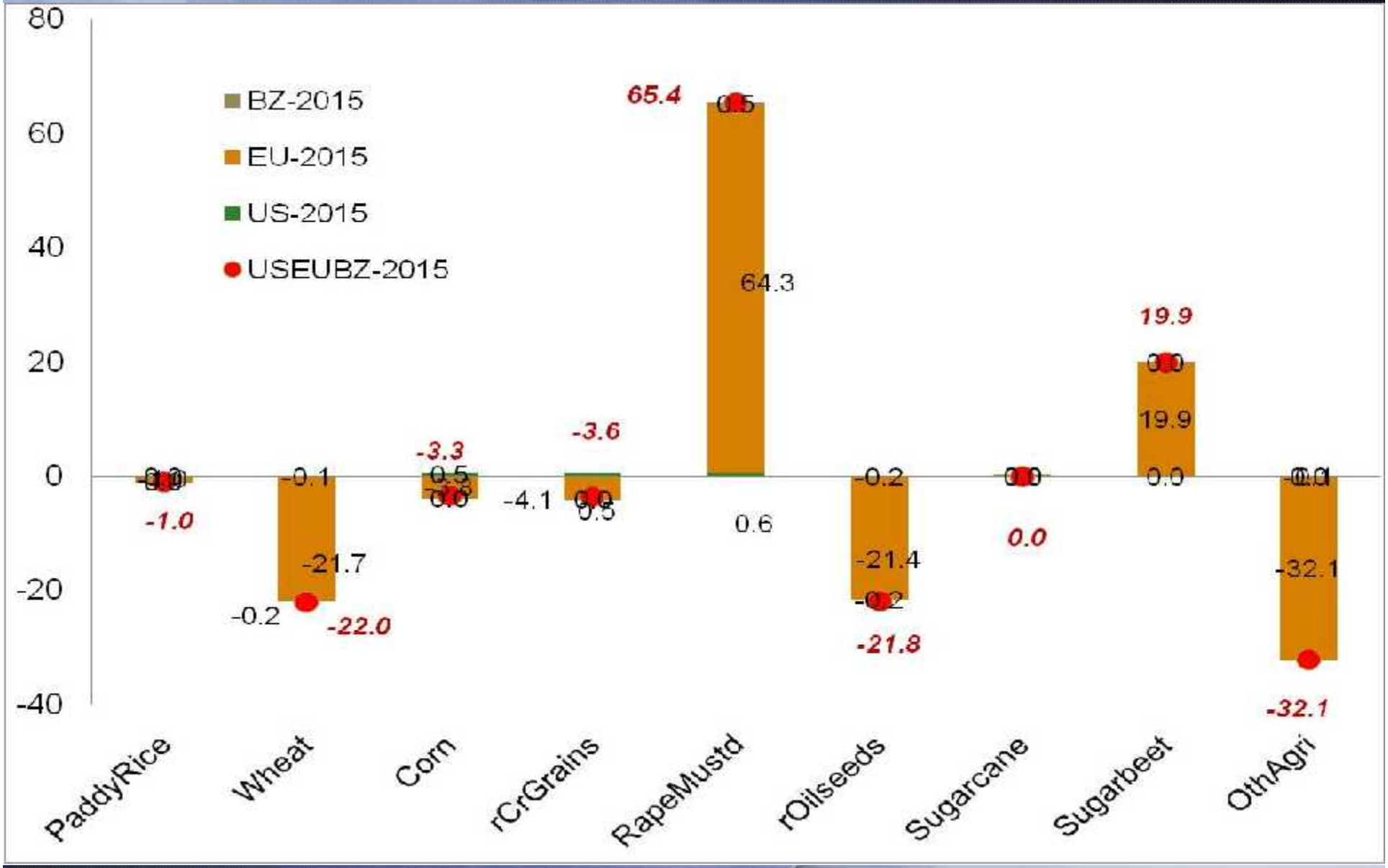


Rapeseed in the EU27

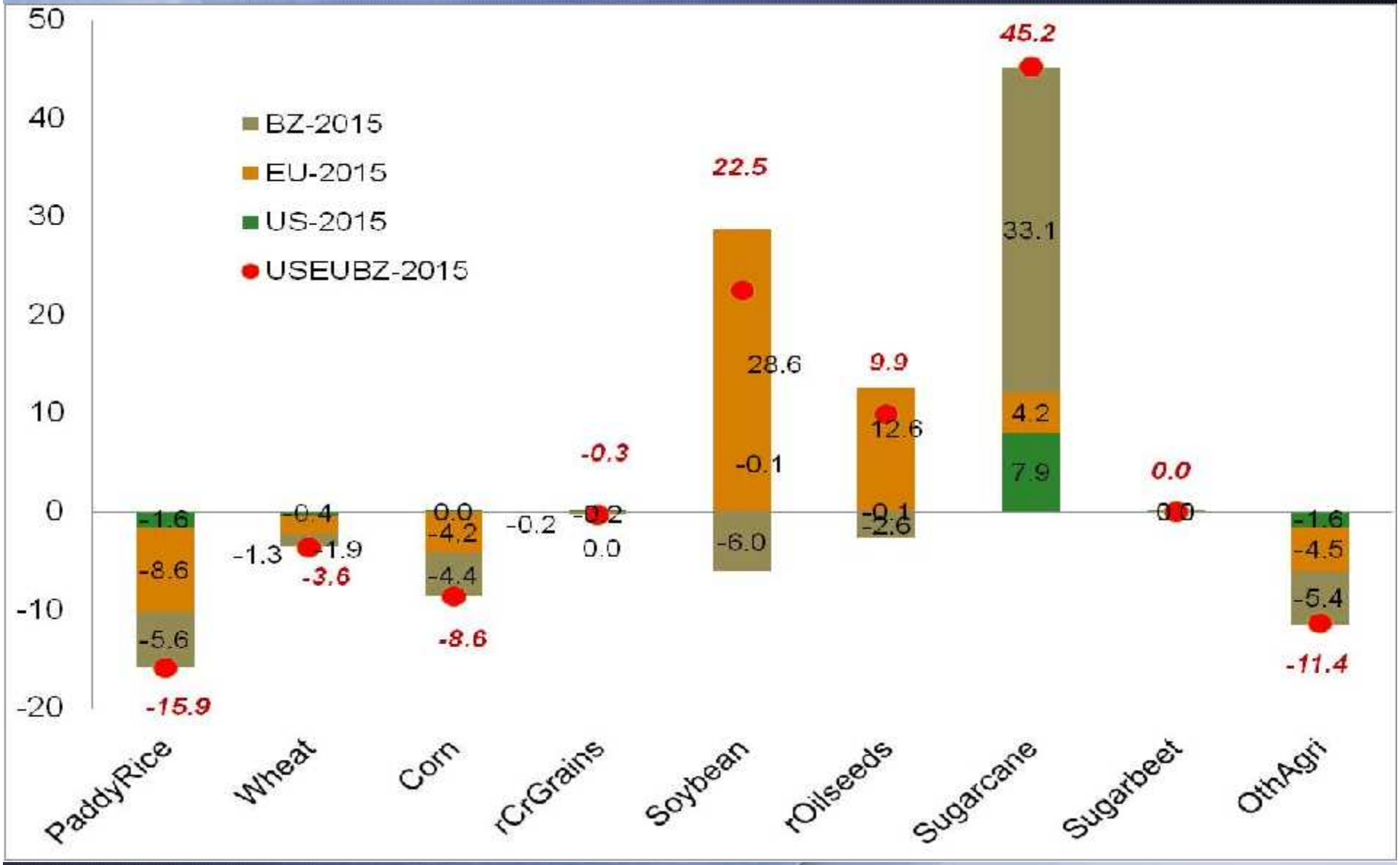
% Change in **US** land-based production (2004–2015 US-EU-BZ Policies)



% Change in **EU** land-based production (2004–2015 US-EU-BZ Policies)



% Change in **Brazil** land-based production (2004–2015 US-EU-BZ Policies)

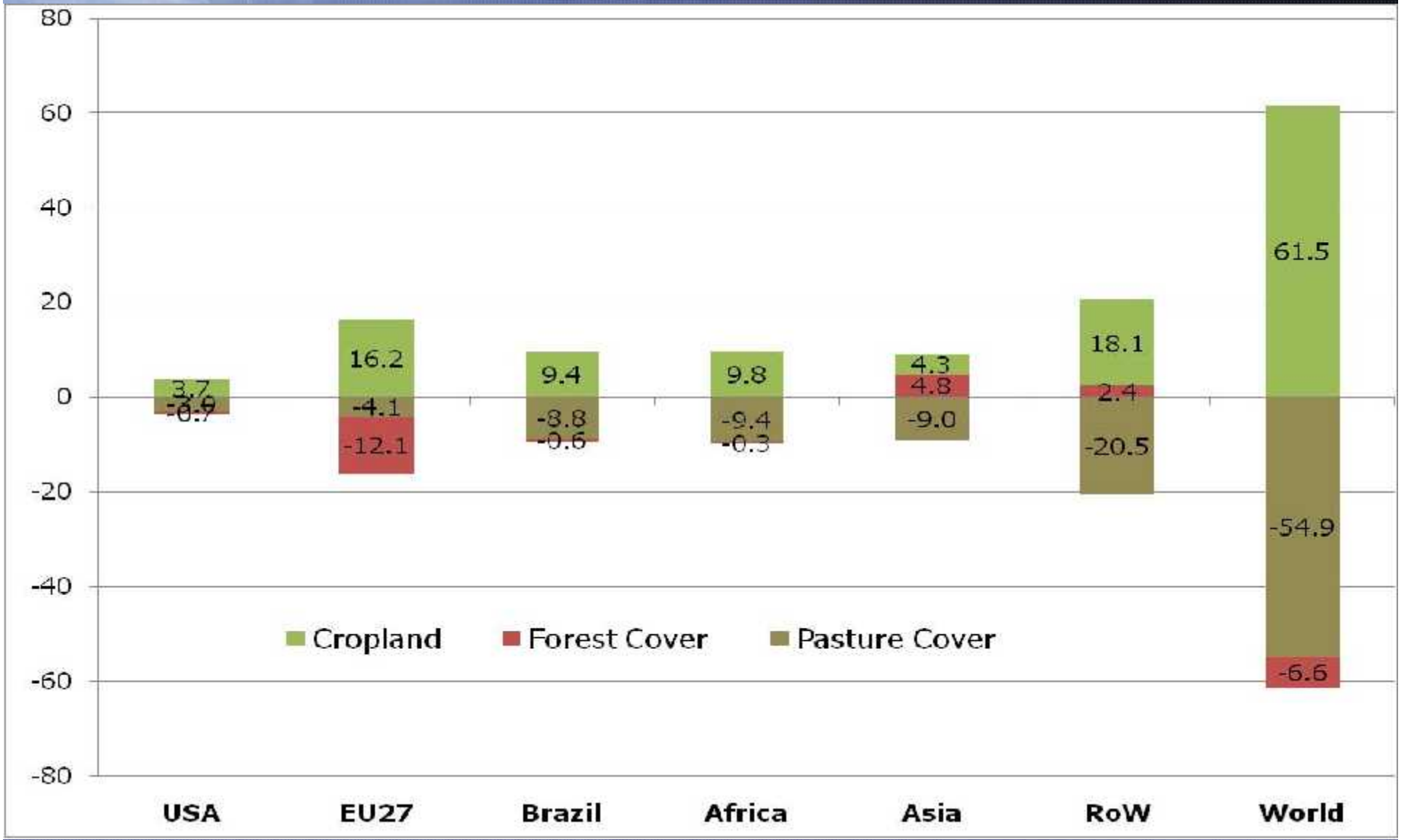


Change in Crop Harvested Area: 2004-2015

(million acres)

	USA	EU27	Brazil	Africa	Asia	RoW	Total
PaddyRice	-1.80	-0.42	-1.35	0.31	2.49	-1.30	-2.08
Wheat	-7.80	-9.42	-0.30	0.20	1.66	-0.87	-16.53
Corn	6.16	-1.30	-2.45	1.91	-0.89	0.34	3.77
rCrGrains	0.68	-1.39	-0.10	0.48	-0.60	0.23	-0.70
Soybean	8.34	1.41	5.82	1.75	1.85	4.53	23.70
RapeMustd	0.30	21.22	0.00	5.25	2.77	6.79	36.34
Palm	0.00	0.00	0.00	1.31	3.70	9.05	14.07
rOilseeds	0.70	5.66	2.55	0.44	0.92	2.26	12.54
Sugarcane	-0.08	0.00	7.84	0.00	-0.31	-0.32	7.14
Sugarbeet	-0.11	3.50	0.00	0.00	-0.03	-0.04	3.32
OthAgri	-2.68	-3.01	-2.62	-1.89	-7.28	-2.57	-20.06
	3.71	16.24	9.40	9.77	4.28	18.11	61.51

Change in Physical Land Cover: 2004-2015 (million acres)



Summary of Domestic & Trade Policy Scenarios (1)

	US Ethanol Prod'n (% ch)	US Market Price of Ethanol (% ch)	US ethanol Imports from Brazil ($ billion)	US import of Crude Oil ($ billion)
Biofuel Mandates: US, EU, & Brazil (2004-15)	323*	9.1	1.02	-4.71
Ethanol Subsidy Reduction and Tariff Removal				
(i) Starting base yr -2004	-39.6	2.2	4.36	-0.93
(ii) Ex-Post base yr-2015	-36.2	0.3	9.87	-0.67
Reduction in ethanol subsidy & tariff (parity) – base yr 2004	-7.3	3.4	0.327	-0.003
Removal of ethanol subsidy & tariff - base yr 2004	-67.1	46.5	5.91	-1.82

Summary of Domestic & Trade Policy Scenarios (2)

	Biofuels increment (EJ)	Total Emission (Million M Tons of CO_{2e})	Emission (grams of CO_{2e} per MJ of Biofuel)
Biofuel Mandates: US, EU, & Brazil (2004-15)	3.27*	4303.0	59.0
Ethanol Subsidy Reduction and Tariff Removal			
(i) Starting base yr -2004	0.21	104.5	21.3
(ii) Ex-Post base yr-2015	0.14	4.6	1.4
Reduction in ethanol subsidy & tariff (parity) – base yr 2004	-0.03	-12.2	-23.5
Removal of ethanol subsidy & tariff - base yr 2004	0.21	101.8	21.7

Change in Trade Balance

($ billions)

Impact of US-EU-Brazil Biofuel Mandates

2004-2015	US	EU	Brazil	RoW	*Total*
Agri and Food	6.6	-35.1	0.8	27.6	-0.2
Biofuels	-0.03	-1	1.5	-0.7	-0.3
Oil Products	13.3	9.6	1.3	-24	0.2
Other	-14.5	25.2	-3.9	-6.6	0.2
Total change	5.4	-1.4	-0.3	-3.8	0

Impact of US Ethanol Subsidy Reduction & Import Tariff Removal

2004 - base	US	EU	Brazil	RoW	*Total*
Agri and Food	0.9	0.2	-1.7	0.4	-0.2
Biofuels	-5.1	0.01	5.1	-0.3	-0.3
Oil Products	1.8	0.3	-0.1	-1.8	0.2
Other	3.5	-0.8	-4.0	1.5	0.2
Total change	1.0	-0.2	-0.7	-0.1	0

Change in Welfare ($ billions)

	Allocative Effcy Effect	Terms of Trade Effect	Total Welfare
2004-2015	**Impact of US-EU-Brazil Biofuel Mandates**		
USA	-14	12	-2
EU	-53	-1	-54
Brazil	-6	4	-2
Japan	1	1	1
Oil Exporters	-2	-24	-26
RoW	0	8	8
World	**-74**	**0**	**-74**
Baseyear-2004	**Impact of US Eth Subsidy Redun & Tariff Removal**		
USA	0.3	-0.5	-0.3
EU	0.6	0.5	1.1
Brazil	0.01	1.3	1.3
Japan	0.1	0.3	0.5
Oil Exporters	-0.2	-2.2	-2.4
RoW	0.1	0.6	0.7
World	**2.2**	**-0.1**	**2.1**

Conclusions

- Simultaneous implementation of biofuel targets in US, EU and Brazil, lead to rise in crop cover in all regions; leading to release of carbon sequestered in pasture and forests (4303 Pg of CO_2e).
- Reduction in US ethanol Subsidy and removal of tariff, if implemented along with Biofuel Mandates has no significant impact on land use.
- With Mandates, US import of sugar-ethanol from Brazil increases by $1 billion. When ethanol subsidy and import tariff are removed, US imports rise by $5.9 billion (oil imports decline by $1.9billion).
- US & EU oil imports fall about $4.7 & $1.8 billions respectively, due to mandates.
- The import tariff “parity” experiment has very little impact on biofuel market & trade.
- The land use emissions due to removal of subsidy and tariff is only 102 Pg of CO_2e.

Further Work

- Introducing cellulosic feedstock and biofuels.
- To expand the model to include marginal lands module (pasture-crop and CRP lands) as they offer potential sectoral competition for land.
- Improve the land supply to allow for proper interaction between marginal lands, regular crops, & dedicated energy crops.

Thank you

Questions and Comments ?