An Evaluation of Impacts that Might Occur as the Role of Biofuels in America Expands

Bio-Based Energy Analysis Group

Photo by Joe Larson, NRCS

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Introduction

- Considerable interest in the potential for on-farm production of cellulosic biomass for ethanol production
  - 100 million acres dedicated energy crops by 2025
  - We can not meet projected goals with corn alone
- However, corn to ethanol is serving as our foundation
  - 2003 ethanol production = 2.8 billion gallons
  - 2006 ethanol production = 4.9 billion gallons
  - Fuels, Consumer Protection, and Energy Efficiency Act of 2007 set a RFS at 36 billion gallons by 2022.
  - By 2016, 18 billion gallons of ethanol will be required.

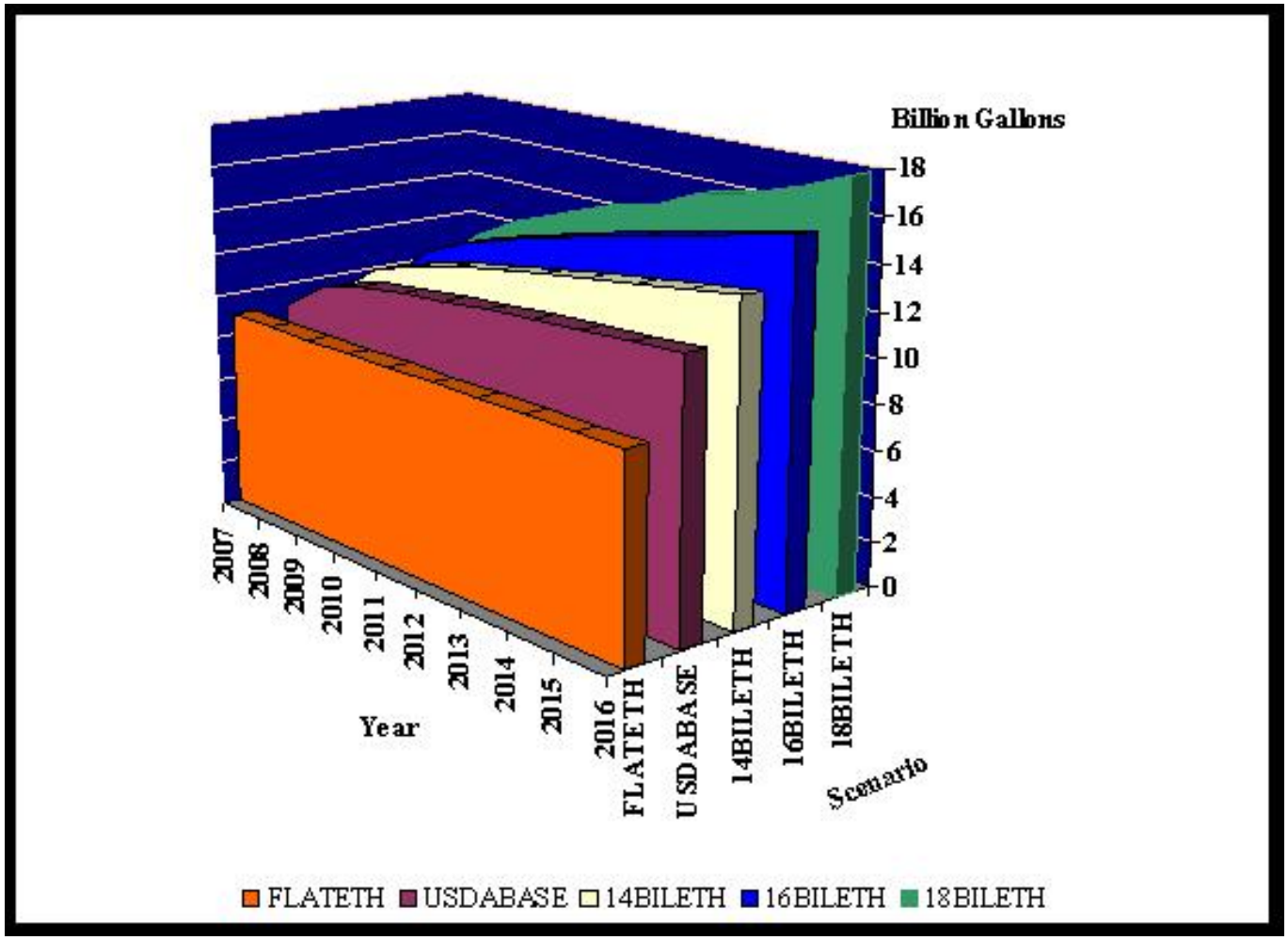
Objectives

- To provide an economic analysis of agriculture's ability to contribute to Congress' goal of supplying 18 billion gallons by 2016
- To evaluate the impact the pursuit of this goal could have on this nation's environment if cellulosic ethanol is not feasible by 2016.

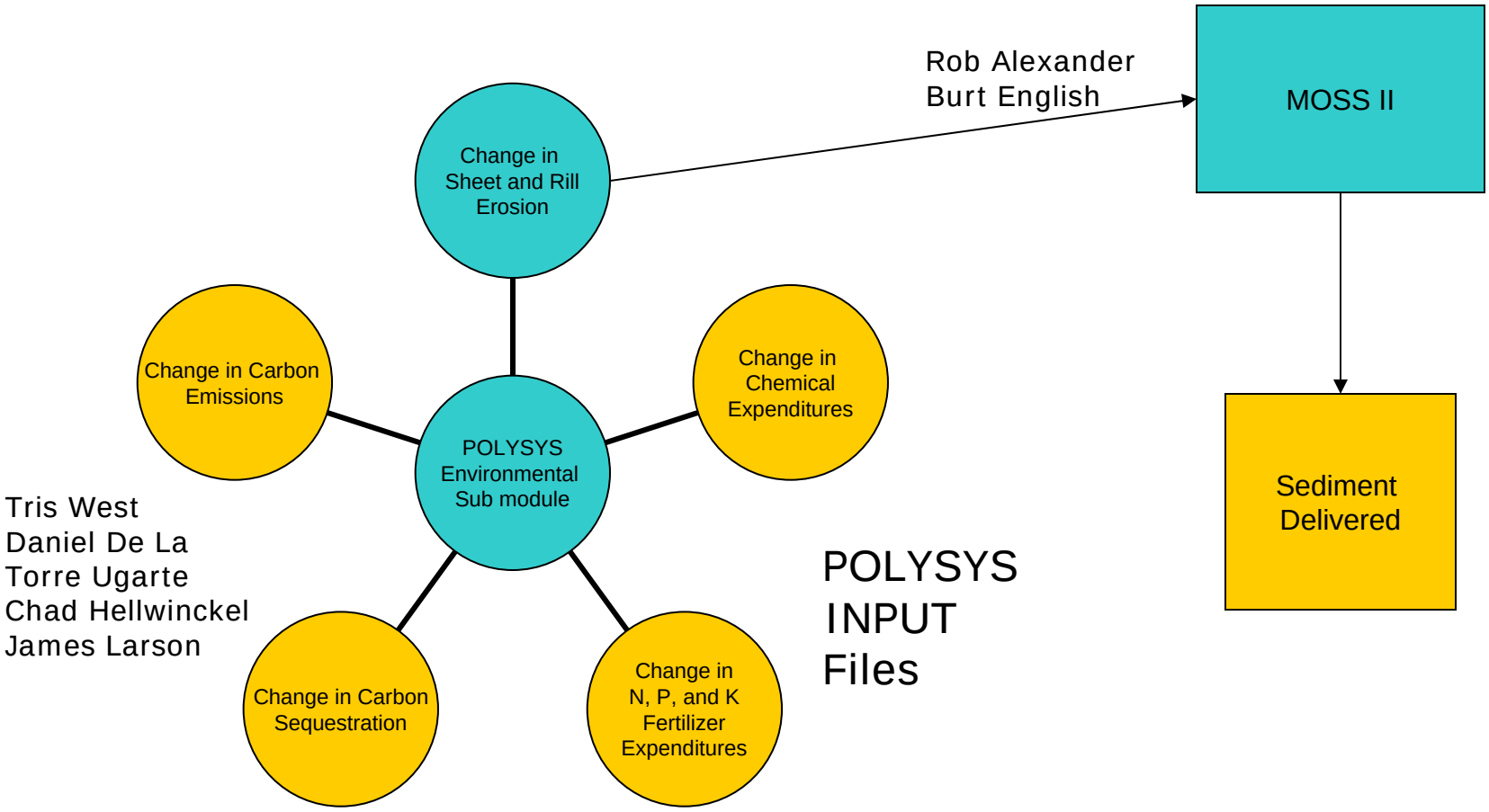
The Modeling Process

- Modeling is an Art
  - Modeling into the future requires an attempt to project numerous variables into the future.
  - To reduce the number of variables we predict, we use a baseline developed by USDA.
  - We change the baseline to accommodate the scenario we wish to study and compare the results to that baseline to determine the changes in the agricultural sector that might occur.

Ethanol Production



POLYSYS Environmental Submodule



Environmental Indices from the POLYSYS environmental submodule:

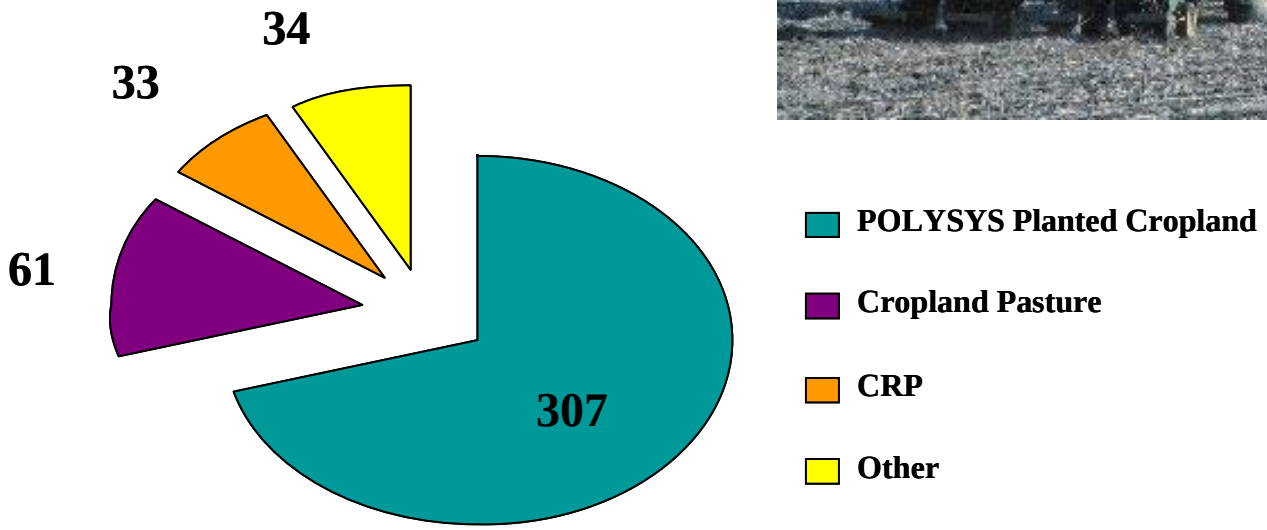
- Land Use
- Erosion
- Herbicide Expenditures
- Fertilizer Expenditures
- Soil Erosion and Sediment Delivery
- Carbon emissions and sequestration

Rate of Growth Increase in Yields Assumed Beyond 2015

	USDA Baseline
Corn (bushels)	1.13%
Sorghum (bushels)	0.76%
Oats (bushels)	0.61%
Barley (bushels)	0.88%
Wheat (bushels)	0.88%
Soybeans (bushels)	0.93%
Cotton (pounds)	0.43%
Rice (pounds)	0.79%

Source: National Resources Conservation Service

Current Land Use 2002



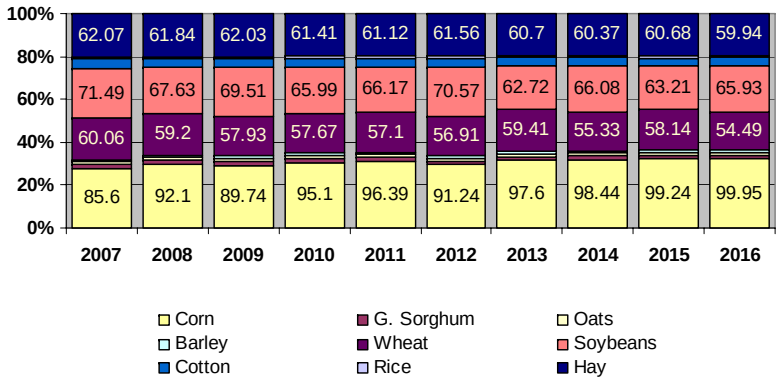
2002 Agricultural Census

Change in Commodity Production as Ethanol Production Changes

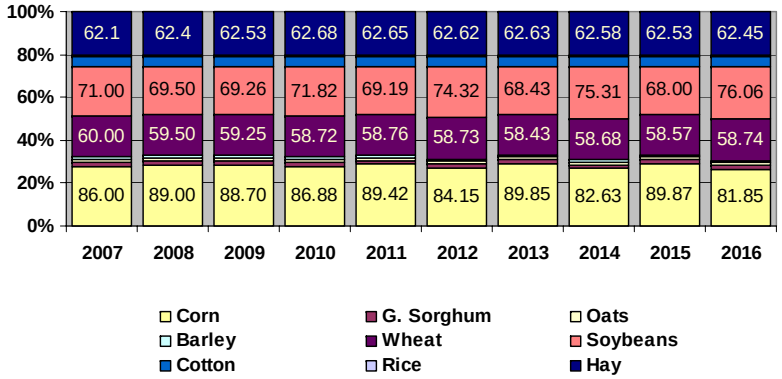
Scenario	Units	2007	2010	2013	2016
			millions of units		
FLATETH-USDABASE					
Cotton	bales	0	0.17	0.27	0.11
Corn	bushels	0	-457	-19	-1,304
Soybeans	bushels	0	132	-21	362
Wheat	bushels	0	12	12	22
14BILETH-USDABASE					
Cotton	bales	0	-1.83	-2.77	0.19
Corn	bushels	0	320	486	312
Soybeans	bushels	0	-26	-67	-32
Wheat	bushels	0	-29	12	-41
16BILETH-USDABASE					
Cotton	bales	0	0.15	0.02	-2.49
Corn	bushels	0	171	357	1,190
Soybeans	bushels	0	-25	-48	-191
Wheat	bushels	0	-11	-35	-33
18BILETH-USDABASE					
Cotton	bales	-0.49	-0.92	-1.99	-1.53
Corn	bushels	-55	749	1,155	1,567
Soybeans	bushels	21	-147	-297	-186
Wheat	bushels	4	-2	34	-129

Land Use

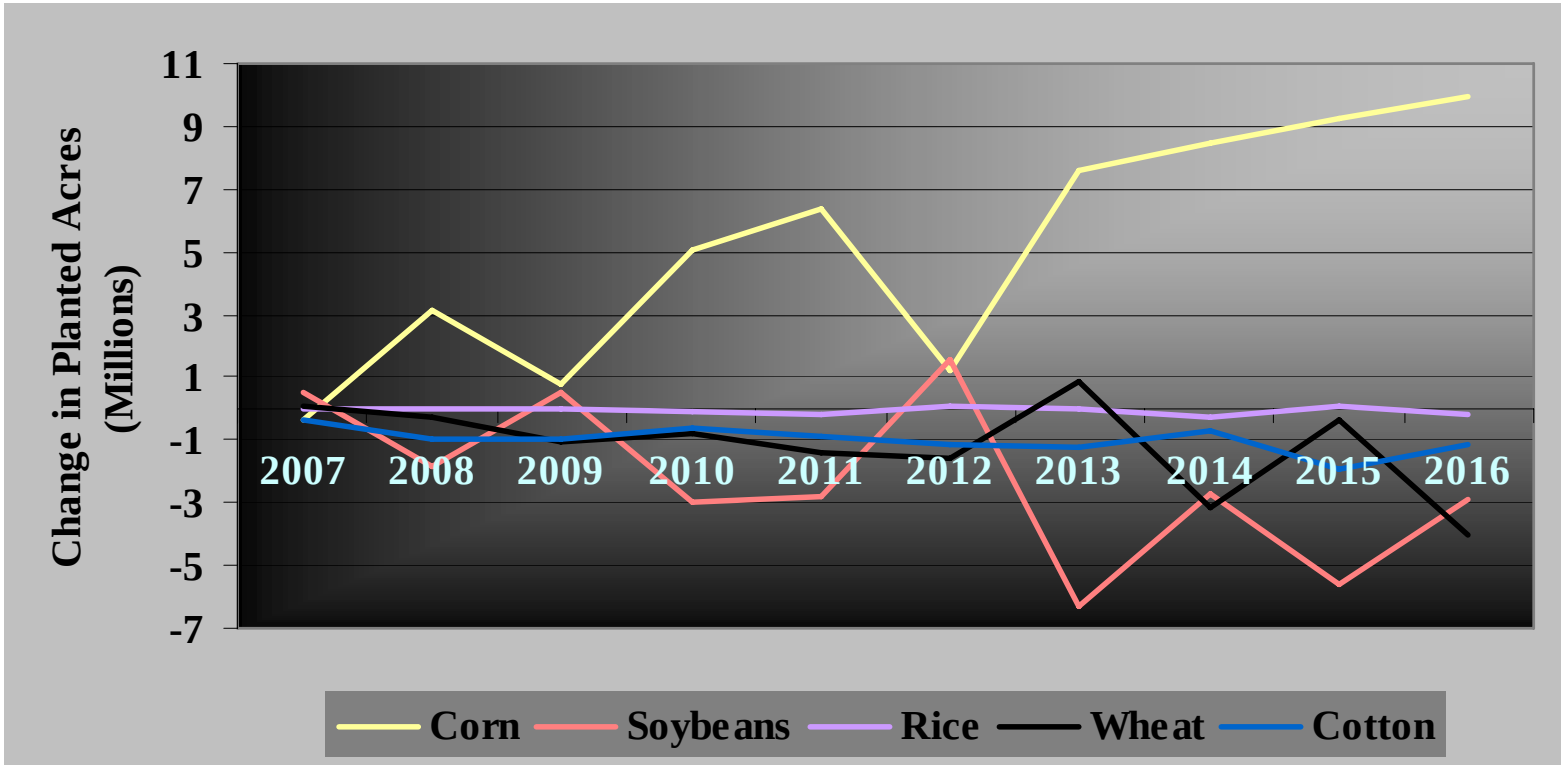
18 Billion gallons



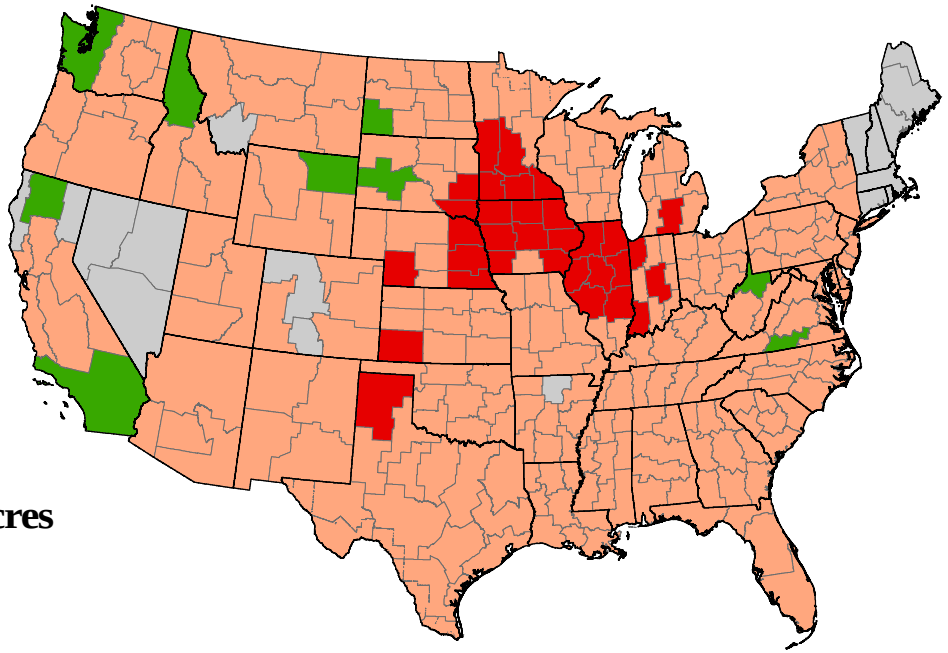
8.6 Billion gallons



Change in Acres compared with the Baseline



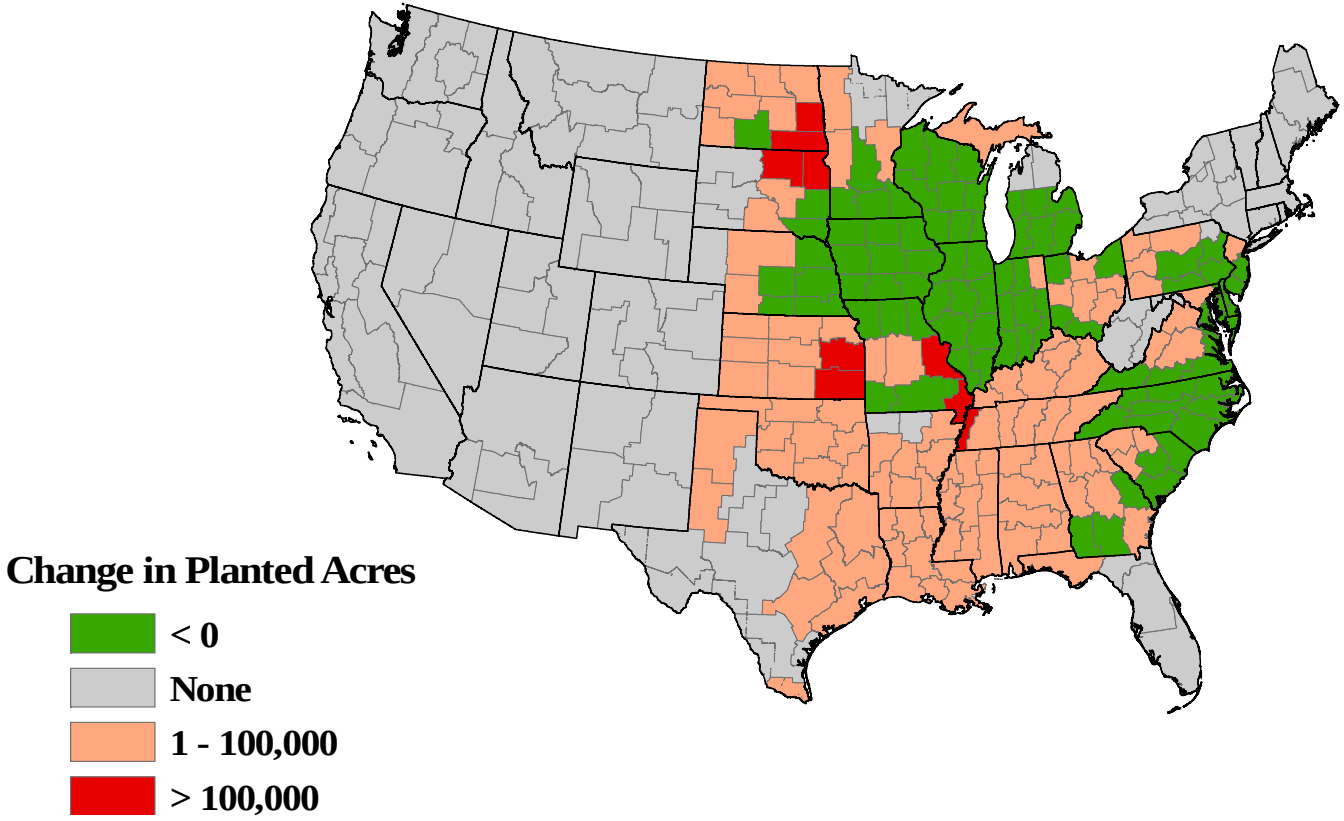
Change in Corn Acres, 2016



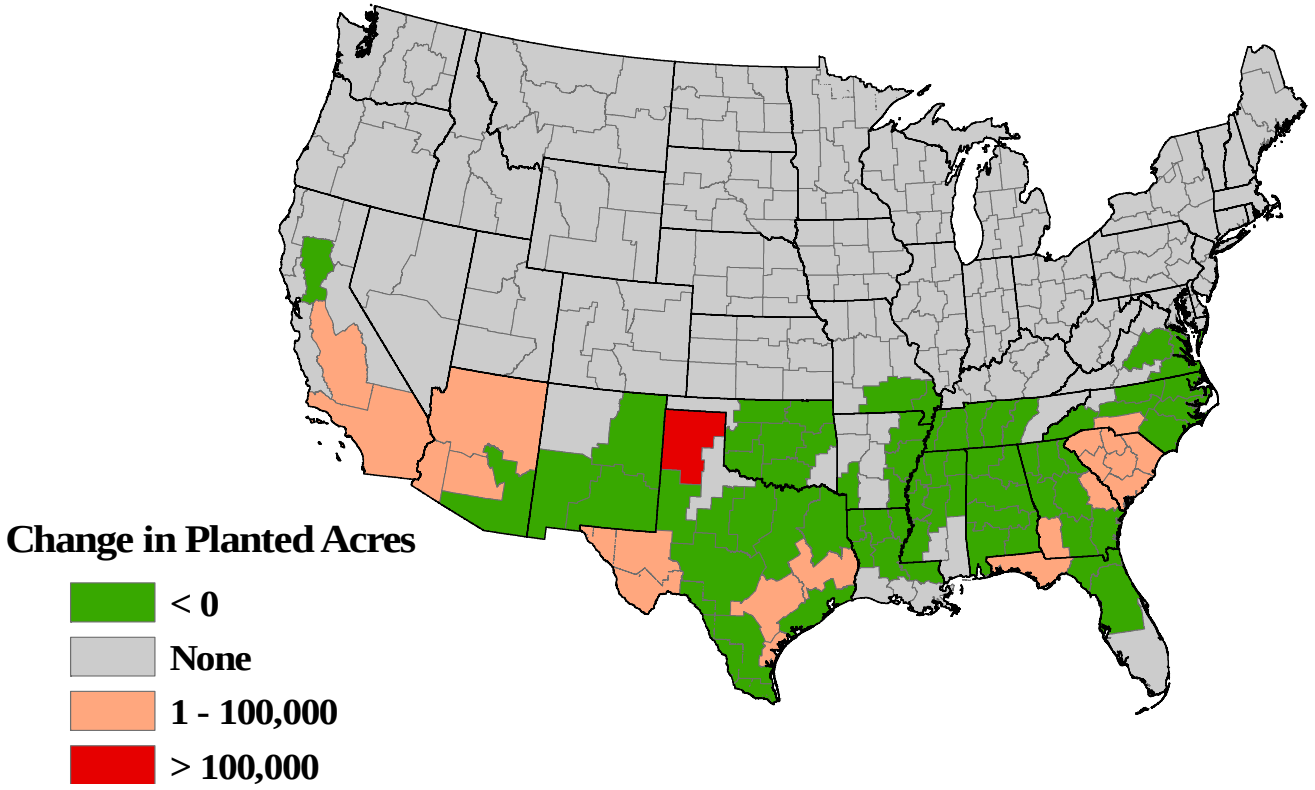
Change in Planted Acres

- < 0
- None
- 1 - 100,000
- > 100,000

Change in Soybean Acres, 2016



Change in Cotton Acres, 2016



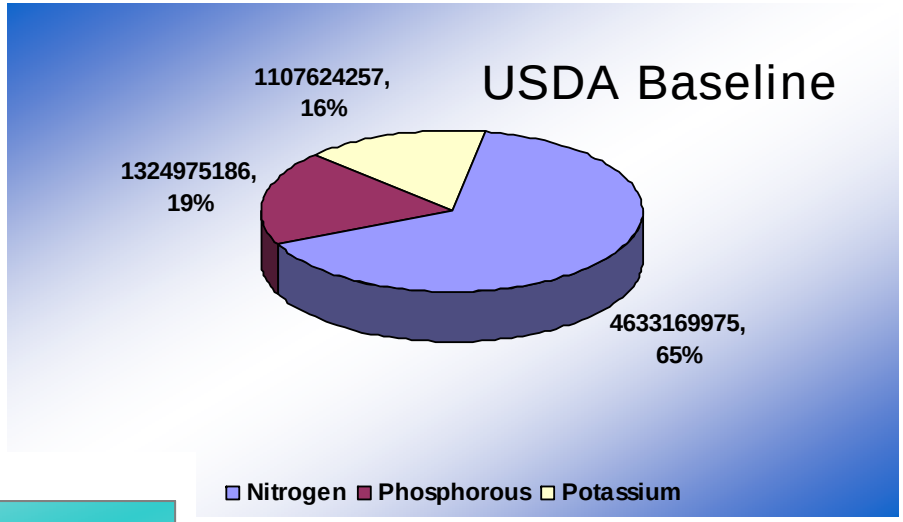
Change in crop commodity prices for the alternative scenarios, 2007-2009, 2010-2012, 2013-2015, and 2016

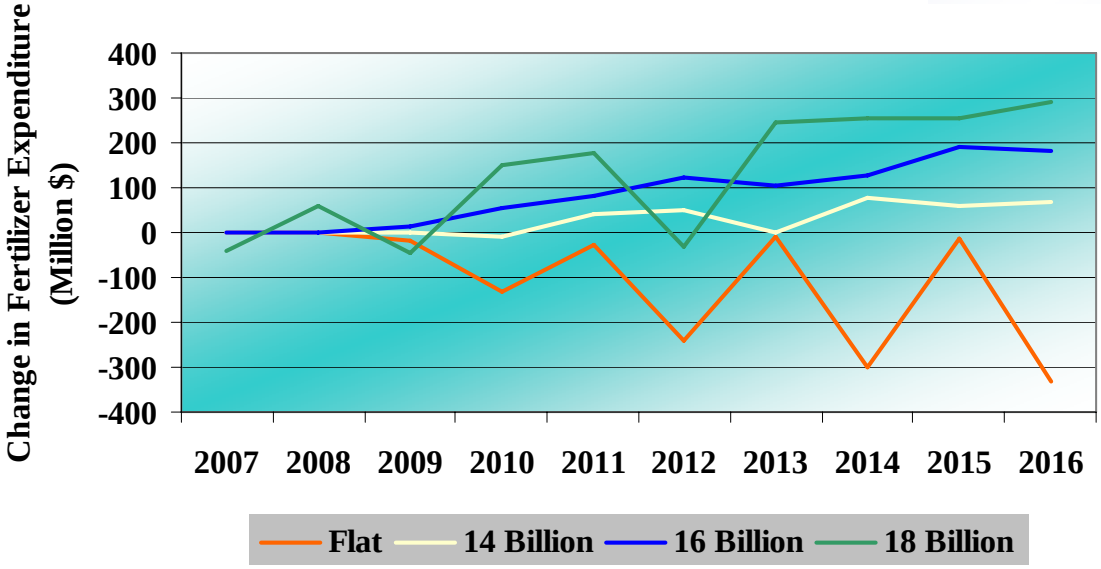
		Three Year Average Projected for:				
Scenario and Crop	Units	2007-2009	2010-2012	2013-2015	Ending Price	Average Over 10 years
14BILETH						
Cotton	pound	0.0%	0.6%	4.9%	0.5%	2.1%
Corn	bushel	1.5%	1.4%	3.1%	9.1%	4.5%
Soybeans	bushel	0.0%	0.5%	4.5%	3.6%	2.2%
Wheat	bushel	0.1%	0.7%	1.0%	2.9%	1.3%
16BILETH						
Cotton	pound	0.6%	0.5%	-0.2%	7.1%	1.6%
Corn	bushel	0.4%	0.7%	7.3%	-3.6%	2.8%
Soybeans	bushel	0.3%	1.3%	4.2%	8.7%	3.5%
Wheat	bushel	0.2%	0.3%	3.4%	1.9%	1.7%
18BILETH						
Cotton	pound	0.7%	0.3%	1.7%	-2.5%	1.2%
Corn	bushel	1.1%	3.1%	1.2%	10.4%	5.2%
Soybeans	bushel	0.1%	0.1%	6.6%	-1.2%	2.0%
Wheat	bushel	0.2%	1.4%	1.4%	9.9%	2.8%

Realized Net Farm Income over the 10 Year Period of Analysis

Scenario	Projected for the Year of: 2007	2010	2013	2016	Total	Average
			Million Dollars			
FLATETH	62,300	61,785	58,277	56,084	595,358	59,536
USDABASE	62,300	68,300	65,800	62,800	651,700	65,170
14BILETH	62,592	69,772	68,128	65,545	670,312	67,031
16BILETH	62,986	71,692	70,427	67,284	686,462	68,646
18BILETH	63,580	73,103	74,869	70,897	707,065	70,707

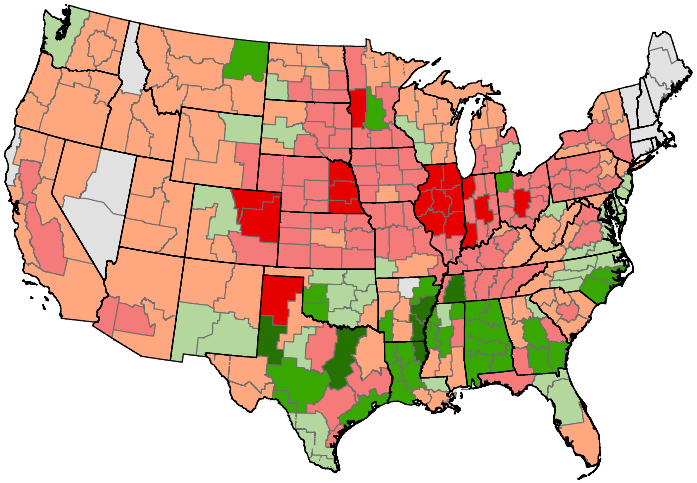
Fertilizer Expenditures



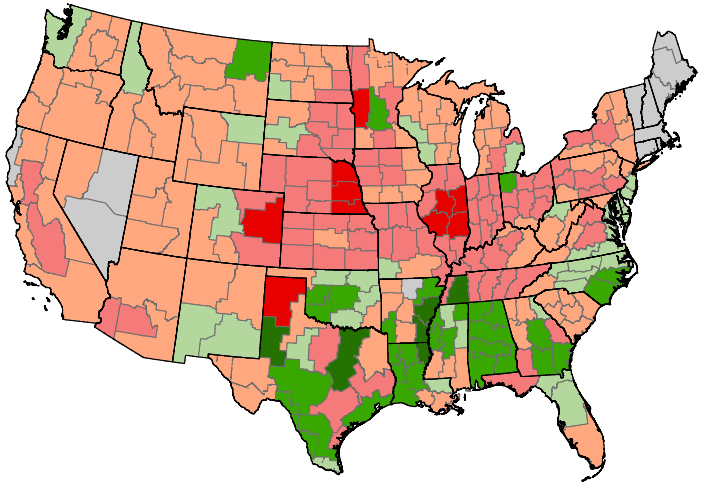


Change in Herbicide Expenditures

18 Billion Gallon Ethanol Alternative compared to the FLATETH and USDA Baseline Solutions



Comparison to FLATETH Scenario



Comparison to USDA Baseline

Change in Herbicide Expenditures

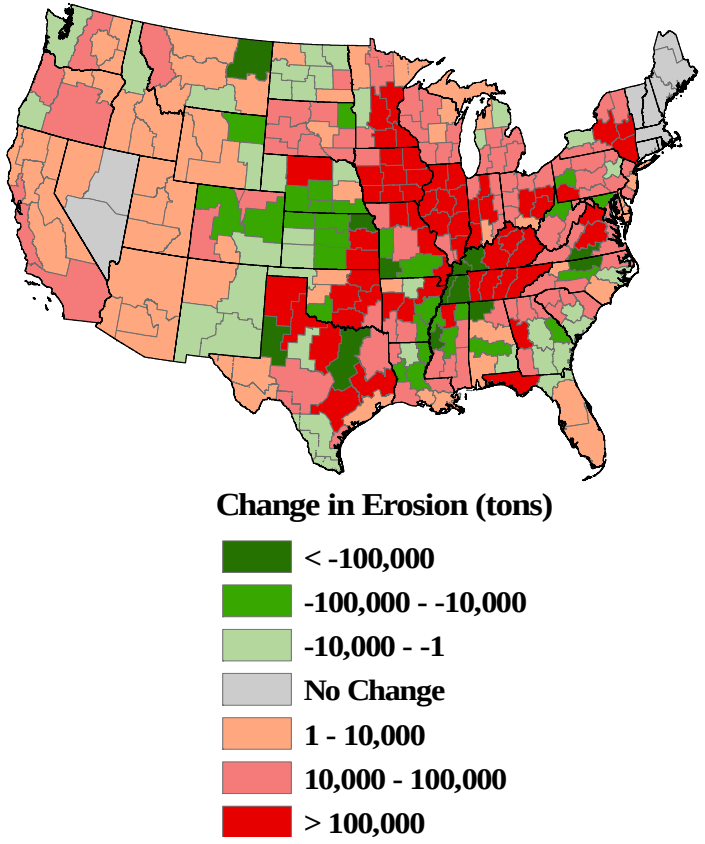
- < -$10,000,000
- -$10,000,000 - -$1,000,000
- -$1,000,000 - -$1
- None
- $1 - $1,000,000
- $1,000,000 - $10,000,000
- > $10,000,000

Change in Erosion

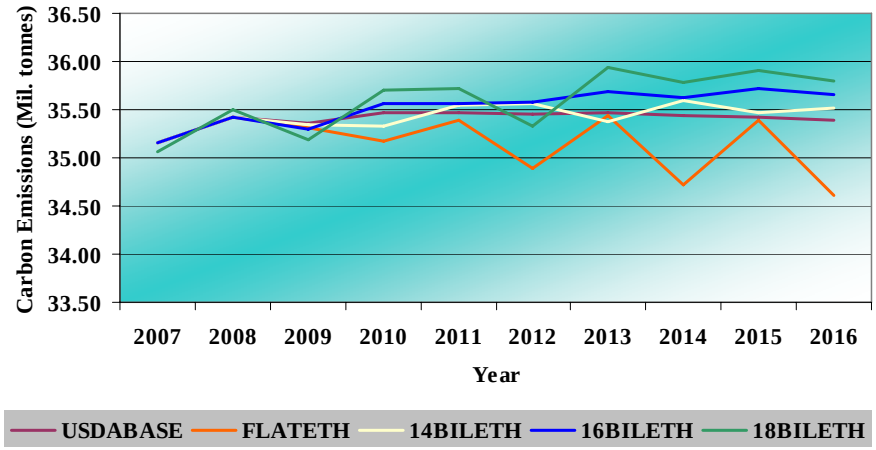
18 billion gallons compared to the USDA Baseline, 2016

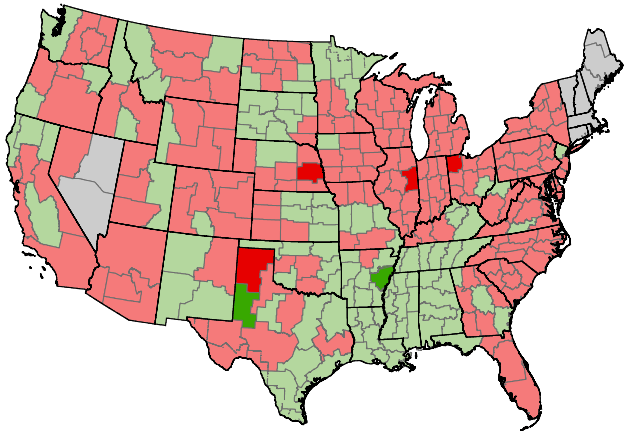
Change from the USDA Baseline

USDA FARM PRDN REGION	SUSPENDED SEDIMENT (000 tons)	DEPOSITED SEDIMENT (000 tons)
Appalachian	1,284,256.78	1,053,173.47
Corn Belt	2,582,397.87	2,080,203.30
Delta States	1,339,352.07	473,488.71
Lake States	328,751.66	307,546.84
Mountain	(25,298.40)	(25,551.05)
Northeast	598,083.87	578,612.90
Northern Plains	164,530.95	152,861.62
Pacific	23,945.98	20,425.63
Southeast	117,142.51	117,142.51
Southern Plains	371,500.79	288,837.74
	6,784,664.09	5,046,741.66



Change in Carbon Emissions
18 billion gallons compared to the USDA Baseline



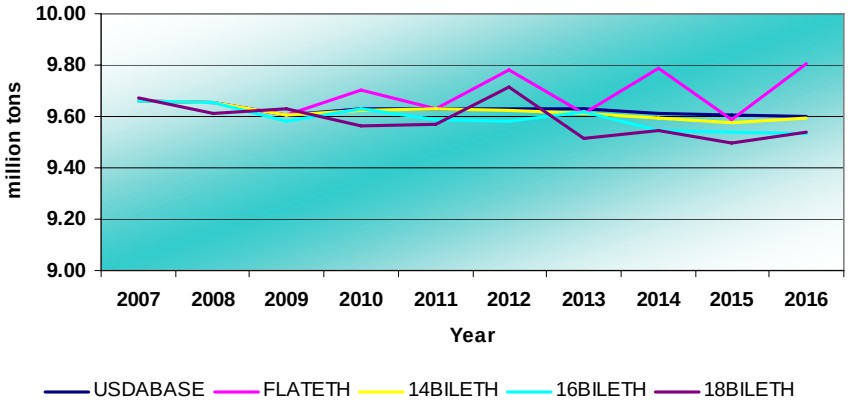


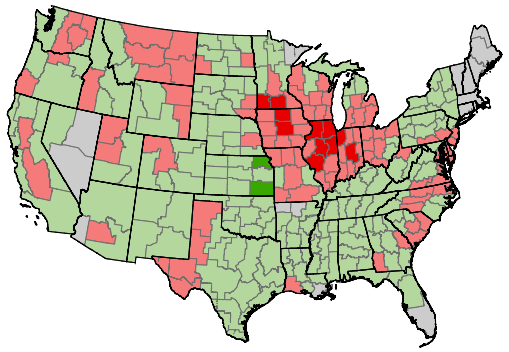
- Change in annual carbon emissions averages 0.19 million tons/year comparing 18BILETH with USDA Baseline

Change in Emissions (Metric Tonnes - Carbon)

- < -25,000
- -25,000 - -1
- None
- 1 - 25,000
- > 25,000

Change in Carbon Sequestration
18 billion gallons compared to the USDA Baseline





Change in Soil Carbon (Metric Tonnes)

- < -6,000
- -6,000 - -1
- None
- 1 - 6,000
- > 6,000

- Changes in land use result in a modest decrease in agriculture's ability to sequester carbon.

Conclusions

- U.S. agriculture can increase ethanol production from grains to 18 billion gallons over the next ten years.
  - For the period 2007 to 2016, the estimated accumulated gains in net farm income exceeds $55 billion,
  - an accumulated potential savings in government payments of 2.4 percent assuming no changes in direct and CRP payments when compared to the USDABASE scenario.
  - Realized net farm income over the ten year period of analysis increases $112 billion as a result of the ethanol industry increasing in scale from 8.6 billion gallons to 18 billion gallons.
  - Increasing corn yields from the 2006 USDA Baseline each year of the analysis culminating in a 19% change by 2016, resulted in decreased acres planted in corn, reduced net farm income primarily as a result of decreased corn prices, and little change in total land in production.

Conclusions

- Land use shifts occur as corn production increases as a result of increased returns for this crop.
  - As land moves away from other crops into corn, prices for those crops are bid up.
  - Cotton shifts westward
  - wheat shifts into the southeast.
  - Corn production increases throughout the United States, but the largest increases occur in the western Corn Belt and eastern Nebraska.
  - Soybeans shifts out of the Corn Belt into the Southeast.
  - By 2016, corn acreage increases to 100 million acres in the 18BILETH scenario, an increase of 10 million acres compared to the USDABASE and an increase of more than 19 million acres when compared to the FLATETH scenario.

Conclusions

- Input use of both non-fertilizer chemicals and fertilizers increase.
- Soil erosion and sedimentation increase.
- Soil carbon sequestered as a result of agricultural production activities decrease
- Carbon emissions as a result of agricultural crop production activities increase.

A Word of Caution

It is important to note, however, that under the assumptions of the analysis, no change in tillage practices were projected. Changes toward no-till would reduce the amount of soil erosion, the amount of carbon emitted and the amount of carbon sequestered. However, chemical inputs would likely increase as chemicals are used instead of mechanical means for weed control.