RFS Impacts:
By the Numbers

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RFS Impacts: By the Numbers

In 2005, Congress passed the Energy Policy Act, establishing the first-ever Renewable Fuel Standard (RFS). In signing the bill, President George W. Bush stated that “Using ethanol and biodiesel will leave our air cleaner. And every time we use a home-grown fuel, we're going to be helping our farmers, and at the same time, be less dependent on foreign sources of energy.”

Two years later in 2007, the Energy Independence and Security Act greatly expanded the scope and impact of the RFS. This time, the President remarked that the expanded RFS was a “…major step toward reducing our dependence on oil, confronting global climate change, expanding production of renewable fuels and giving future generations a nation that is stronger, cleaner and more secure.”

More than a decade after the original RFS was adopted, tremendous progress has been made toward achieving the original objectives of this landmark policy. Renewable fuel production and consumption have grown dramatically. America’s dependence on petroleum—particularly imports—is down significantly. Greenhouse gas emissions from the transportation sector have fallen. The value of agricultural products and farm income hit record levels. And communities across the country have benefited from the job creation, increased tax revenue, and heightened household income that stem from the construction and operation of a biorefinery.

Meanwhile, the doomsday outcomes threatened by opponents of the RFS simply have not materialized. U.S. cropland continues to fall, the Gulf of Mexico “dead zone” continues to shrink, deforestation rates continue to decline, and U.S. and global food price inflation rates are lower than before the RFS was adopted.

This brief analysis draws on data from a variety of sources to examine how the world has changed (and how many things have stayed the same) since adoption of the RFS in 2005 and its expansion in 2007. The data show that by any objective measure, the RFS has been a tremendous success.

June 2017

The RFS Has Driven Substantial Investment and Growth in Renewable Fuels

Operational Ethanol Plants

2005	2007	2016	2005-2016 % Change
81	110	213	+163%

Ethanol Production *(Billion Gals.)*

2005	2007	2016	2005-2016 % Change
3.9	6.5	15.3	+293%

States with Ethanol Plants

2005	2007	2016	2005-2016 % Change
18	23	29	+61%

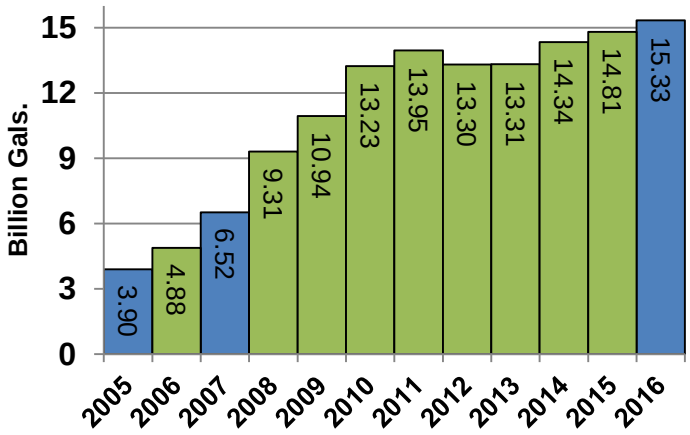
Co-product Animal Feed *(Million MT)*

2005	2007	2016	2005-2016 % Change
11.1	18.4	41.4	+274%

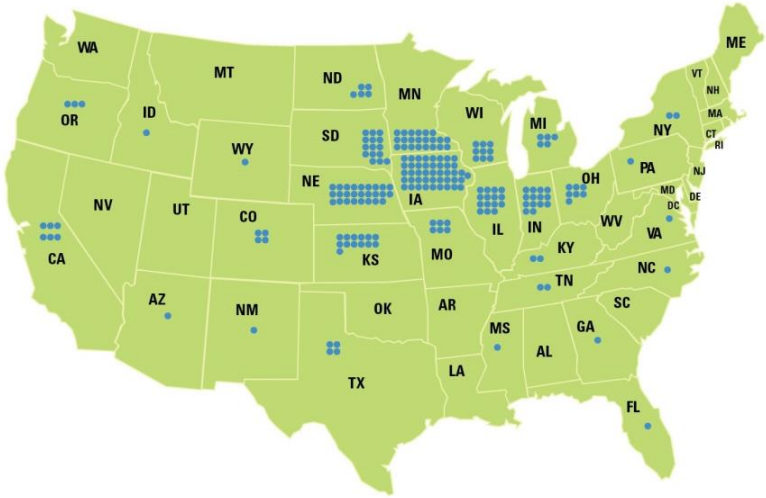
Gross Value of Ethanol Industry Output *(Billion $)*

2005	2007	2016	2005-2016 % Change
$8.1	$17.8	$32.8	+306%

U.S. Ethanol Production



213 Ethanol Plants in 29 States



Ethanol Industry Jobs *(Direct, Indirect, Induced)*

2005	2007	2016	2005-2016% Change
153,725	238,541	339,176	+121%

Advanced & Cellulosic Biofuel Production *(Billion Gallons)*

2005	2007	2016	2005-2016 % Change
0.11	0.49	2.83	2,473%

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The RFS and Agriculture

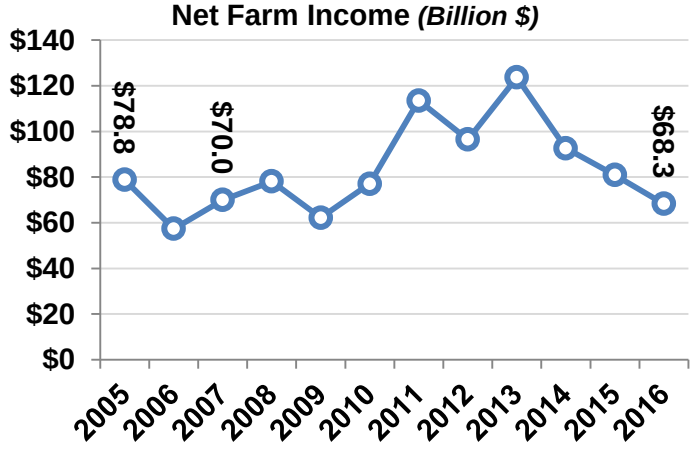
Corn Production *(Billion Bushels)*

2005	2007	2016	2005-2016 % Change
11.1	13.0	15.2	+36%

Average Corn Yield *(Bushels/Acre)*

2005	2007	2016	2005-2016 % Change
147.9	150.7	174.6	+18%

Net Farm Income *(Billion $)*



Corn Acres *(Million Acres)*

2007	2016	2007-2016 % Change
93.5	94.0	+0.5%

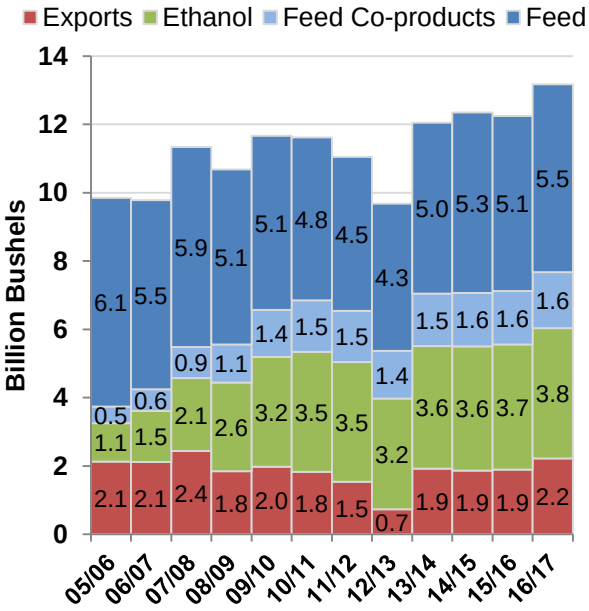
Total Cropland *(Million Acres)*

2007	2016	2007-2016 % Change
402	380	-5%

Corn Price *($/Bushel)*

2007	2016	2007-2016 % Change
$4.20	$3.40	-19%

Major Uses of Corn



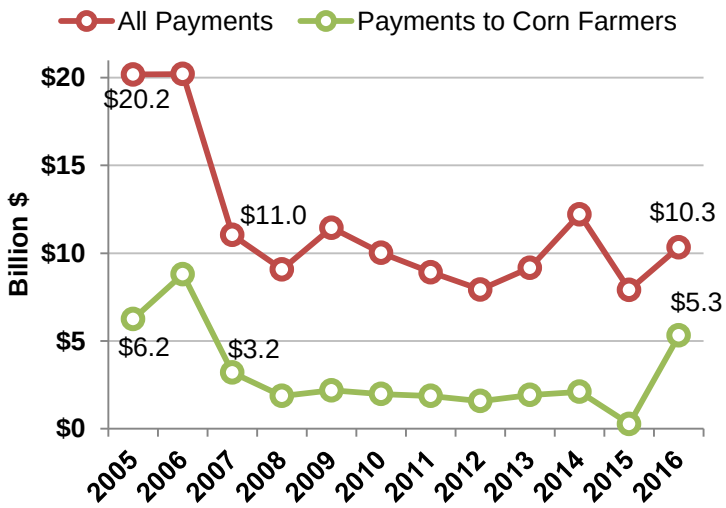
Corn Surplus *(Billion Bushels)*

2005	2007	2016	2005-2016 % Change
1.97	1.62	2.30	+17%

Value of Agricultural Products *(Billion $)*

	2005	2007	2016	2005-2016 % Change
Crops	$116	$150	$188	+62%
Livestock	$125	$139	$168	+35%

Government Farm Program Payments



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The RFS and Energy Markets

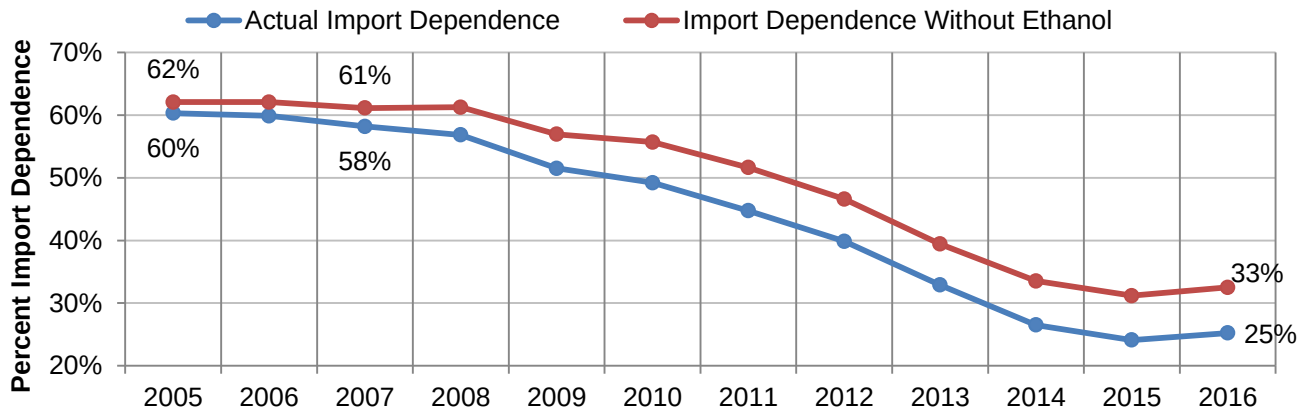
U.S. Gasoline & Ethanol Consumption *(Billion Gallons)*

	2005	2007	2016	2005-2016 Change	2005-2016 % Change
Gasoline Blendstock	136.4	135.5	129.0	-7.4	-5.4%
Ethanol	4.0	6.9	14.4	+10.4	+260%
Total Finished Gasoline	140.4	142.4	143.4	+3.0	+2.1%
Ethanol Blend Rate	2.89%	4.84%	10.04%		

Petroleum Imports

	2005	2007	2016	2005-2016 % Change
Crude Oil Imports *(Billion Barrels)*	3.70	3.66	2.88	-22%
Crude Oil Imports as % of U.S. Demand	67%	66%	49%	
Crude Oil Imports from OPEC *(Billion Barrels)*	1.76	1.97	1.16	-34%
OPEC Share of U.S. Imports	48%	54%	40%	
Gasoline Imports *(Billion Gallons)*	9.24	6.33	0.91	-90%

U.S. Petroleum (Crude Oil & Products) Net Import Dependence with and without Ethanol



Petroleum Product Prices

	2005	2007	2016	2005-2016 % Change
Brent Crude *(per barrel)*	$54.57	$72.44	$43.74	-20%
Retail Gasoline, Reg. *(per gallon)*	$2.30	$2.80	$2.14	-7%
Retail Diesel *(per gallon)*	$2.40	$2.89	$2.30	-4%

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The RFS and Energy Markets

Retail Gas Stations Selling E85/Flex Fuel

2005	2007	2016	2005-2016 % Change
436	1,208	3,610	+728%

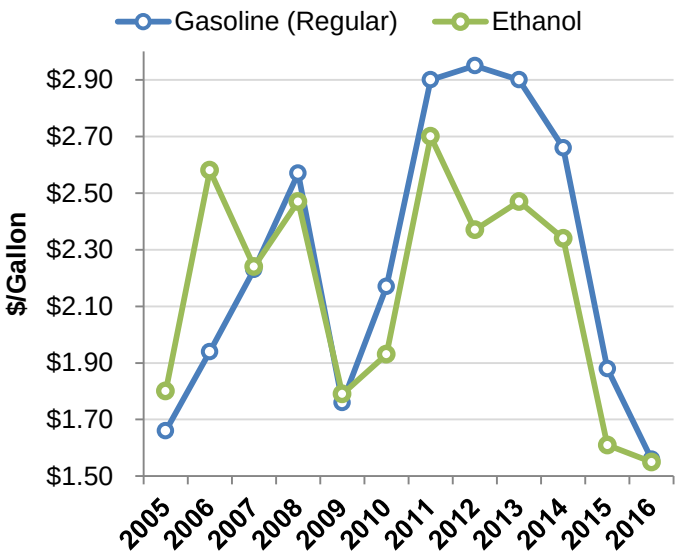
States Offering E85/Flex Fuel

2005	2007	2016	2005-2016 % Change
15	24	44	+193%

Flex Fuel Vehicles

	2007	2016	2007-2016 % Change
On the Road	6.7	22.7	+239%
% of Fleet	2.9%	9.9%	

Wholesale (Rack) Ethanol & Gasoline Prices



Retail Gas Stations Selling E15

2007	2016
0	574

Percent of U.S. Vehicle Fleet Legally Approved to Use E15

2007	2016
0%	87%

Share of New Vehicles (MY2017) Approved by Automaker for E15

2007	2017
0%	81%

Auto Manufacturers Approving the Use of E15 in their Vehicles (by Model Year)

2012	2013	2014	2015	2016	2017
1	2	6	6	8	9
GM	GM	GM	GM	GM	GM
	Ford	Ford	Ford	Ford	Ford
		Honda/Acura*	Honda/Acura	Honda/Acura	Honda/Acura
		Jaguar/Land Rover	Jaguar/Land Rover	Jaguar/Land Rover	Jaguar/Land Rover
		Toyota/Lexus*	Toyota/Lexus*	Toyota/Lexus	Toyota/Lexus
		Volkswagen*	Volkswagen	Volkswagen	Volkswagen
				BMW (Mini)*	BMW (Mini)*
				Fiat-Chrysler	Fiat-Chrysler
					Hyundai/Kia

* denotes E15 approved by automaker for some, but not all, model offerings for specific model year

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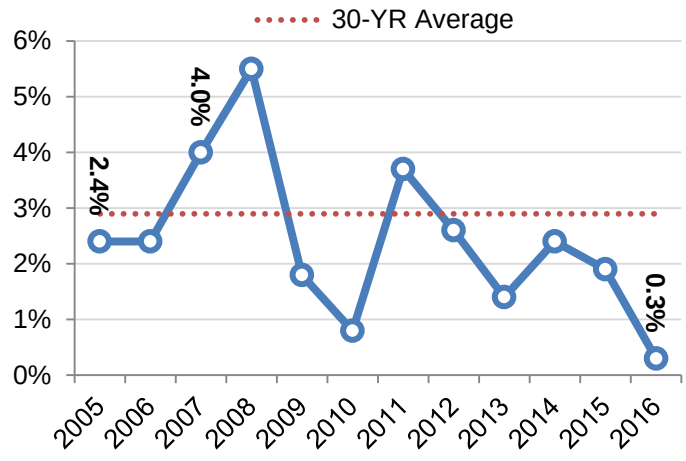
The RFS and Food Markets

Annual Food Price Inflation Rate (All Food)



Food Price Inflation Rates
(% Change from Previous Year)

	2005	2007	2016
Groceries	+1.9%	+4.2%	-1.3%
Restaurants	+3.1%	+3.6%	+2.6%
Red Meat, Poultry, Fish	+2.4%	+3.8%	-3.5%
Cereals & Bakery Items	+1.5%	+4.4%	-0.3%
Dairy	+1.2%	+7.5%	-2.3%

Retail Prices for Select Grocery Items

	2005	2007	2016	2005-2016 % Change (Annual Avg.)
Chicken Breast *(per pound)*	$3.33	$3.43	$3.25	-2% (-0.2%)
All Pork Chops *(per pound)*	$3.23	$3.16	$3.67	+14% (+1.2%)
All Uncooked Ground Beef *(per pound)*	$2.74	$2.85	$4.25	+55% (+5.0%)
Milk *(per gallon)*	$3.19	$3.50	$3.20	+0.5% (+0.0%)
Eggs *(per dozen)*	$1.22	$1.68	$1.68	+38% (+3.5%)

U.S. Milk Production *(Billion Pounds)*

2005	2007	2016	2005-2016 % Change
176.9	185.7	212.4	+20%

U.S. Red Meat & Poultry Production *(Billion Pounds)*

2005	2007	2016	2005-2016 % Change
86.7	91.0	97.3	+12%

World Hunger Statistics

	2005-07	2014-16	% Change
Number Undernourished *(millions)*	942	795	-16%
Percent Undernourished	14.3%	10.9%	

U.N. Global Food Price Index

2007	2016	2007-2016 % Change
161.4	161.5	+0.1%

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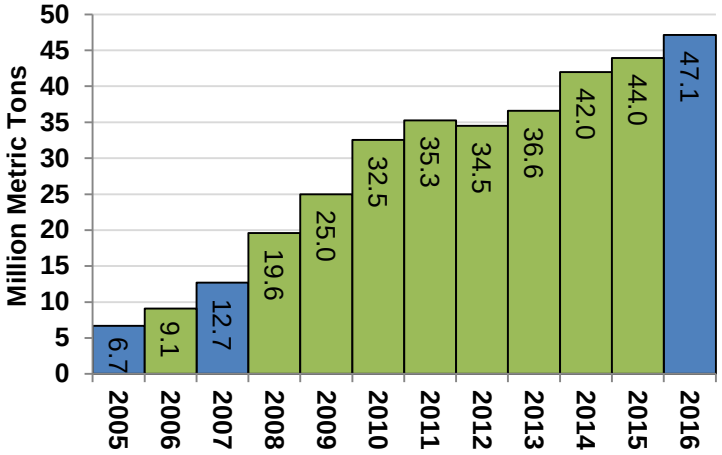
RFS and the Environment

GHG Emissions Avoided by Using Ethanol in Lieu of Gasoline



Ethanol GHG Reduction vs. Gasoline *(Dry Mill Technology, % Reduction)*

2005	2007	2016
-23%	-26%	-43%

GHG Emissions from U.S. Transportation *(Million Tons CO2e)*

2005	2007	2015*	2005-2015 % Change
2,001	1,995	1,807	-10%

National Average Concentration Levels of Key Air Pollutants

	2005	2007	2015*	2005-2015 % Change
Carbon Monoxide *(parts per million)*	2.32	1.97	1.41	-39%
Ozone *(parts per million)*	0.080	0.079	0.069	-14%
Coarse Particulate Matter *(micrograms per cu. meter)*	77.95	70.79	60.92	-22%
Fine Particulate Matter *(micrograms per cu. meter)*	12.82	11.90	8.49	-34%

Deforestation in the Amazon *(Square Miles)*

2005	2007	2016	2005-2016 % Change
7,341	4,498	3,085	-58%

U.S. Forested Area *(Thousand Square Miles)*

2005	2007	2014*	2005-2014 % Change
1,177	1,183	1,196	+1.6%

Irrigation Statistics

	2008	2013*	2008-2013 % Change
% of Corn Acres Irrigated	13.9%	13.9%	
Irrigation per Acre *(Avg. acre-feet/acre)*	1.7	1.6	-6%

Size of Gulf Hypoxic Zone *(Square Miles)*

2007	2016	2007-2016 % Change
7,903	6,824	-14%

*Most recent data available

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Data Sources

1. Operational Ethanol Plants: Renewable Fuels Association (RFA)
2. Ethanol Production: RFA and Energy Information Administration (EIA)
3. States with Ethanol Plants: RFA
4. Co-product Animal Feed: RFA and U.S. Department of Agriculture (USDA)
5. Gross Value of Ethanol Industry Output: RFA based on USDA market values
6. Ethanol Industry Jobs: ABF Economics, LECG Economics
7. Advanced and Cellulosic Biofuel Production: EIA and Environmental Protection Agency (EPA)
8. Corn Production: USDA
9. Average Corn Yield: USDA
10. Corn Acres Planted: USDA
11. Total Cropland: EPA
12. Corn Price: USDA
13. Major Uses of Corn: USDA
14. Net Farm Income: USDA
15. Corn Surplus: USDA
16. Value of Agriculture Products: USDA
17. Government Farm Program Payments: USDA
18. U.S. Gasoline and Ethanol Consumption: EIA
19. Wholesale Ethanol and Gasoline Prices (Omaha Rack): Nebraska Energy Office
20. Petroleum Imports: EIA
21. U.S. Petroleum Net Import Dependence with and without Ethanol: RFA based on EIA data
22. Petroleum Product Prices: EIA
23. Stations Selling E85/Flex Fuel: E85Prices.com and DOE Alternative Fuels Data Center (AFDC)
24. States Offering E85/Flex Fuels: E85Prices.com and AFDC
25. FFVs on the Road: AFDC and EPA
26. Stations Selling E15: RFA and E85prices.com
27. Percent of Vehicle Fleet Legally Approved for E15: RFA based on EPA data
28. Share of New Vehicles Approved by Automakers for E15: RFA
29. Auto Manufacturers Approving the Use of E15 by Model Year: RFA
30. Annual Average Food Price Inflation Rates: USDA and Department of Labor (DOL)
31. Retail Prices for Select Grocery Items: DOL Bureau of Labor Statistics
32. U.S. Milk, Red Meat and Poultry Production: USDA
33. World Hunger Statistics: UN Food & Agriculture Organization (FAO)
34. U.N. Global Food Price Index: FAO
35. GHG Emissions Avoided: RFA based on DOE GREET Model
36. Ethanol GHG Reduction vs. Gasoline: USDA and DOE GREET Model
37. GHG Emissions from U.S. Transportation: EPA
38. Concentration Levels of Key Air Pollutants: EPA
39. Deforestation in the Amazon: Brazil INPE
40. U.S. Forested Area: FAO
41. Irrigation Statistics: USDA
42. Size of Gulf Hypoxic Zone: Louisiana State University