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U.S. Biofuels Baseline and Impact of E-15 Expansion on Biofuel Markets

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Summary

Earlier this year, the Food and Agricultural Policy Research Institute at the University of Missouri (FAPRI-MU) released baseline projections for agricultural and biofuel markets.[1] That baseline assumes current biofuel policy, including provisions of the Renewable Fuel Standard (RFS2). Consistent with the law, the $0.45 per gallon ethanol blender tax credit, the $0.54 per gallon specific duty on ethanol imports, and the $1.00 per gallon biodiesel blender tax credit expired, as scheduled, at the end of 2011. The additional tax credit for cellulosic biofuel production is assumed to expire at the end of 2012.

This report presents the results of that baseline for the markets most relevant to biofuels as well as two additional scenarios that reflect the uncertainty surrounding the expansion of E-15 into the motor fuel market. Markets that were highlighted in the earlier report include corn, soybeans, ethanol and biodiesel. In addition to those markets, this report also includes the results for cellulosic and other advanced biofuel production as well as the markets for biofuel Renewable Identification Numbers (RINs). Like the earlier report, the results presented here are the averages of 500 stochastically generated outcomes.

The results depend on projections of macroeconomic variables based on information available in January 2012 as well as assumptions about policy implementation. The baseline assumes annual waivers of the cellulosic biofuel mandate (with overall and advanced mandates partially reduced) and subsequent issuance of waiver credits that set the price for cellulosic RINs.[2] In addition, the majority of advanced biofuel not included in the cellulosic biofuel and bio-based diesel mandates is assumed to be sugarcane ethanol primarily imported from Brazil. E-15 expansion occurs slowly in the baseline.

A number of key conclusions can be drawn from the baseline results.

1. **The RFS2 continues to spur domestic ethanol production, but the rate of growth is lower than in the recent past.** In 2012 ethanol production from conventional sources, such as corn starch, is expected to plateau. Contributing factors include capacity constraints as production approaches the "blend wall", expiration of domestic ethanol supports (blender tax credit and the ethanol specific duty) and limits to using conventional ethanol to meet the RFS2 requirements in the future.

[1] See http://www.fapri.missouri.edu/outreach/publications/2012/FAPRI_MU_Report_01_12.pdf.
[2] For a discussion of waiver options, see Meyer and Thompson "Another Thing We Need Know about Biofuel Use Mandates: Waivers," *Choices* 26(2), 2011.

2. **The slowdown in corn-based ethanol production in the baseline affects other markets as well.** As the amount of corn devoted to ethanol production flattens, more corn is available for other uses including food, feed and exports. Corn use after 2014/15 flattens off at close to 5.6 billion bushels as the conventional gap reaches 15 billion gallons. Thereafter, greater advanced biofuel use is required to meet the mandates.

3. **In the longer run mandates rather than the market drive ethanol use for the most part.** Use of ethanol in E-10 blends has expanded rapidly as the higher octane content of ethanol has made these blends profitable relative to a purely fossil fuel product. However, overall fuel use is fairly stagnant in the early years of the baseline, so the E-10 market remains saturated at the blend wall. Use of low-level ethanol blends increases moderately as the E-15 market begins to expand. E-15 expansion in the baseline pushes back the blend wall a little, but additional large increases in ethanol use must come from higher blends, such as E-85. In the baseline we have assumed that the E-15 market expands steadily over the period, with the average blend level in 2021 at 13.3 percent. The implications of this assumption are examined on pages 11 and 12.

4. **In order to meet the RFS2 requirements, there is a rapid expansion in the use of higher-level ethanol blends such as E-85.** The expansion in the E-85 fleet and distribution infrastructure only comes about if ethanol prices fall slightly below their gasoline energy equivalent prices (i.e. an ethanol/gasoline price ratio of roughly two-thirds). Once the flex fuel fleet has grown sufficiently, the ethanol price returns to its energy equivalent level.

5. **Conventional ethanol rack prices fall in the short term.** The elimination of the blender credit caused prices to fall at the end of 2011. As mandates expand close to capacity constraints ethanol prices (and also RIN prices) are bid higher in 2014/15 and 2015/16, raising returns and leading to a small expansion in capacity. Conventional ethanol prices and returns then soften as the conventional gap plateaus.

6. **Biodiesel production increases to 2013 as the mandate is expanded.** We assume that the EPA will increase the biodiesel mandate from 1 billion gallons in 2012 to 1.28 billion gallons in 2013 and beyond. High feedstock prices limit biodiesel expansion while a higher share of biodiesel is derived from corn oil.[3]

[3] Note that these projections were finalized using data available in January 2012. Since then the USDA has increased its estimates of soybean oil in biodiesel substantially, before ending reporting of that series. Data on the volume of corn oil for biodiesel are sparse. A proportion of biodiesel from corn oil or soy oil higher than projected here would affect agricultural market baseline projections and the results of the scenarios.

7. **Ethanol imports rise rapidly beyond the 2011/12 marketing year as the ethanol specific duty expires, Brazilian ethanol prices fall from their recent highs, and as the relevant portion of the RFS2 expands.** U.S. ethanol exports fall sharply from their record high levels in 2011 as Brazil's sugar harvest and domestic ethanol production rebound, and their demand for conventional U.S. ethanol falls. Nevertheless, Brazil's ethanol price exceeds the equivalent U.S. price for the duration of the projection period, leaving open the possibility of continued U.S. ethanol exports. In the absence of the development of other advanced fuels, sugar cane ethanol imported from Brazil is likely to be used to fill the advanced gap. Thus, it can sell at a higher price in the U.S. relative to conventional ethanol. This price differential creates an incentive to import sugar cane ethanol while exporting conventional ethanol concurrently.

8. **Cellulosic ethanol production increases slowly at first before making rapid gains beyond 2015/16.** This reflects our assumptions regarding the pace of cellulosic technology advancement and the elimination of the biofuel producer credit. Cellulosic biofuel production, while increasing substantially, is still far below levels specified by the RFS2. We assume the EPA issues waiver credits and resets the mandate level to the quantity that would be produced where blenders are indifferent between buying a cellulosic RIN to show compliance and the alternative of purchasing a waiver credit plus an advanced RIN.

9. **RIN prices increase over the period.** Baseline RIN prices imply that the mandates become increasingly binding over time. Biodiesel RINs rise with the growing mandate, and then remain flat as the mandate remains binding throughout the projection period. The elimination of the various credits increases RIN prices and therefore the total cost of compliance. Fuel blenders are likely to pass such costs on to final consumers in the form of higher retail fuel prices.

Baseline biofuel policies (Baseline)

Calendar year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Renewable Fuel Standard						(Million gallons)					
(as applied with waivers)	13,950	15,200	16,550	17,430	18,460	18,599	19,172	19,939	21,159	21,968	22,611
Conventional gap	12,600	13,200	13,800	14,400	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Advanced biofuels	1,350	2,000	2,750	3,030	3,460	3,599	4,172	4,939	6,159	6,968	7,611
Cellulosic biofuel	6	10	52	299	364	430	673	938	1,659	2,468	3,111
Biodiesel	800	1,000	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
Advanced gap	544	990	1,418	1,451	1,816	1,889	2,219	2,721	3,220	3,220	3,220
Tax credits and tariffs						(Dollars per gallon)					
Conventional ethanol credit	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biodiesel credit	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ethanol specific duty	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cellulosic producers credit	1.01	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						(Percent)					
Ethanol ad-valorem tariff	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Biodiesel sector (Baseline)

October-September year	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Biodiesel supply and use						(Million gallons)					
Production	1,013	1,132	1,330	1,336	1,334	1,332	1,334	1,333	1,335	1,338	1,337
From soybean oil	425	450	541	506	473	473	474	474	480	484	486
From corn oil	87	147	212	273	333	343	351	357	360	365	368
From other fats and oils	502	534	577	557	528	517	510	503	496	489	483
Net exports	49	47	48	48	49	50	51	52	52	53	48
Domestic disappearance	964	1,085	1,283	1,288	1,285	1,282	1,283	1,282	1,283	1,286	1,290
Fuel prices and tax credit						(Dollars per gallon)					
Biodiesel, rack	4.83	5.18	5.38	5.19	5.06	5.07	5.08	5.07	5.04	5.02	5.00
#2 Diesel, refiner sales	2.92	2.99	2.96	2.95	2.92	2.84	2.73	2.64	2.53	2.60	2.64
#2 Diesel, retail	3.80	3.90	3.86	3.85	3.82	3.74	3.64	3.55	3.44	3.51	3.55
Biodiesel tax credit	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Ethanol supply and use (Baseline)

September-August year	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Petroleum fuel prices					(Dollars per barrel)						
Petroleum, W. Texas interm.	92.36	102.25	112.92	108.15	108.81	108.12	103.37	98.37	93.43	95.13	97.45
Petroleum, refiners acquis.	99.30	103.75	108.05	105.85	104.75	102.03	97.43	92.76	88.08	89.57	91.71
					(Dollars per gallon)						
Unl. gasoline, FOB Omaha	2.89	2.95	2.92	2.90	2.88	2.80	2.69	2.60	2.49	2.54	2.59
Unleaded gasoline, retail	3.52	3.59	3.59	3.62	3.59	3.51	3.41	3.33	3.25	3.31	3.38
Ethanol supply and use					(Million gallons)						
Production	13,804	14,082	14,661	15,510	15,998	16,445	16,855	17,481	18,221	19,005	19,683
From corn	13,565	13,795	14,176	14,846	15,291	15,536	15,699	15,765	15,732	15,819	15,802
Other conventional	234	249	268	302	319	317	306	297	291	290	293
Cellulosic	6	38	216	362	388	592	850	1,419	2,199	2,896	3,588
Imports	379	683	740	1,040	1,131	1,253	1,621	2,052	2,152	2,084	2,323
Domestic disappearance	12,843	13,635	14,423	15,789	16,467	16,989	17,656	18,614	19,446	20,169	21,015
In 15% and lower blends	12,708	13,205	13,419	13,589	14,142	14,709	15,535	16,422	17,345	18,204	18,325
In higher level blends	134	430	1,004	2,201	2,325	2,279	2,121	2,191	2,101	1,965	2,690
Exports	1,330	1,098	948	730	634	679	791	884	886	879	955
Ending stocks	762	795	825	856	884	914	943	979	1,020	1,062	1,097
Ethanol prices					(Dollars per gallon)						
Conventional rack, Omaha	2.33	2.07	2.09	2.31	2.30	2.21	2.11	2.07	2.03	2.02	2.03
AMS spot plant price, Iowa	2.11	1.88	1.89	2.09	2.08	2.00	1.91	1.87	1.84	1.83	1.84
Cellulosic rack	n.a.	n.a.	3.22	3.34	3.27	3.33	3.44	3.61	3.72	3.70	3.80
Other advanced rack	3.23	2.72	2.62	2.64	2.54	2.51	2.53	2.58	2.54	2.53	2.61
Effective retail	2.71	2.47	2.34	2.26	2.34	2.31	2.25	2.21	2.16	2.21	2.21
Ethanol/gasoline retail	77%	69%	65%	62%	65%	66%	66%	66%	67%	67%	65%
RIN values											
Conventional ethanol	0.10	0.26	0.42	0.76	0.67	0.61	0.58	0.60	0.63	0.58	0.61
Advanced ethanol	1.00	0.90	0.95	1.10	0.91	0.91	1.00	1.11	1.14	1.08	1.18
Cellulosic ethanol	1.26	1.46	1.55	1.79	1.64	1.73	1.90	2.15	2.31	2.25	2.38

Cellulosic and other advanced biofuel production (Baseline)

Marketing year	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
					(Million gallons, ethanol equivalent)						
Cellulosic biofuel production	6	38	216	362	388	592	850	1,419	2,199	2,896	3,588
From corn stover	4	30	77	109	127	190	268	426	657	859	1,046
From warm season grasses	2	8	140	253	261	401	576	951	1,411	1,793	2,147
All other	0	0	0	0	0	1	6	42	131	244	395
Other advanced biofuel prod.	0	15	48	97	154	218	287	362	433	500	576
Corn stover					(Million tons)						
Harvested for energy	0.54	1.21	2.22	3.08	3.81	5.23	7.01	9.79	13.42	16.50	19.30
Used for liquid fuels	0.05	0.41	1.02	1.45	1.66	2.46	3.44	5.42	8.28	10.72	12.93
Used for electricity generation	0.49	0.80	1.20	1.63	2.15	2.78	3.57	4.37	5.14	5.78	6.37
Warm season grasses					(Million acres)						
Area harvested	0.00	0.28	0.96	1.49	1.76	2.27	2.87	3.82	4.84	5.70	6.50
					(Tons per acre)						
Yield per harvested acre	n.a.	5.38	5.51	5.65	5.79	5.94	6.09	6.24	6.39	6.55	6.72
					(Million tons)						
Production	0.02	1.49	5.28	8.43	10.18	13.47	17.47	23.81	30.97	37.38	43.66
Used for liquid fuels	0.02	0.10	1.69	3.05	3.16	4.85	6.96	11.49	17.05	21.68	25.95
Used for electricity generation	0.00	1.39	3.59	5.38	7.02	8.62	10.51	12.32	13.92	15.70	17.71

Biofuel RIN supply and utilization (Baseline)

September-August year	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
						(Million gallons)					
Renewable Fuel Standard	14,782	16,123	17,125	18,183	18,531	18,925	19,683	20,752	21,699	22,396	23,421
Advanced biofuels	1,782	2,523	2,925	3,383	3,531	3,925	4,683	5,752	6,699	7,396	8,421
Cellulosic ethanol (waived)	6	38	216	362	388	592	850	1,419	2,199	2,896	3,588
Biodiesel	933	1,187	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
Biodiesel RFS RINs											
Production	964	1,085	1,283	1,288	1,285	1,282	1,283	1,282	1,283	1,286	1,290
Carry In	77	108	2	2	3	5	4	3	1	2	3
Use for biodiesel compliance	933	1,187	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280	1,280
Unused for this mandate	108	6	4	10	8	7	7	5	4	7	12
of which, carry out	108	2	2	3	5	4	3	1	2	3	2
of which, demoted	0	4	2	7	3	3	4	3	3	5	11
Advanced RFS RINs											
Production	1,831	2,364	2,928	3,431	3,601	3,987	4,683	5,756	6,707	7,409	8,421
Biodiesel (in ethanol gallons)	1,446	1,627	1,924	1,932	1,928	1,923	1,925	1,923	1,924	1,929	1,934
Cellulosic	6	38	216	362	388	592	850	1,419	2,199	2,896	3,588
Other Advanced	379	698	788	1,137	1,285	1,471	1,908	2,414	2,585	2,584	2,899
Carry In	113	162	3	5	7	19	25	9	4	5	10
Use for advanced compliance	1,782	2,523	2,925	3,383	3,531	3,925	4,683	5,752	6,699	7,396	8,421
Unused for this mandate	162	3	6	53	77	80	25	12	12	17	9
of which, carry out	162	3	5	7	19	25	9	4	5	10	4
of which, demoted	0	0	1	46	58	55	16	9	8	8	6
Total RFS RINs											
Production	14,289	15,277	16,395	17,818	18,549	19,130	19,868	20,898	21,803	22,597	23,525
Biodiesel (in ethanol gallons)	1,446	1,627	1,924	1,932	1,928	1,923	1,925	1,923	1,924	1,929	1,934
Cellulosic	6	38	216	362	388	592	850	1,419	2,199	2,896	3,588
Other Advanced	379	698	788	1,137	1,285	1,471	1,908	2,414	2,585	2,584	2,899
Conventional	12,458	12,913	13,467	14,387	14,948	15,143	15,185	15,142	15,096	15,188	15,104
Carry In	2,899	2,406	1,560	830	463	454	604	715	781	789	877
Use for total compliance	14,782	16,123	17,125	18,183	18,531	18,925	19,683	20,752	21,699	22,396	23,421
Unused for this mandate	2,406	1,560	830	465	481	659	789	861	885	989	981
of which, carry out	2,406	1,560	830	463	454	604	715	781	789	877	911
of which, expired	0	0	0	2	27	55	73	81	96	112	70
RIN value						(Dollars per gallon)					
Biodiesel RIN	1.47	1.82	1.99	1.87	1.79	1.84	1.90	1.94	1.97	1.92	1.89
Cellulosic RIN allowance val.	1.26	1.46	1.55	1.79	1.64	1.73	1.90	2.15	2.31	2.25	2.38
Advanced RIN	1.00	0.90	0.95	1.10	0.91	0.91	1.00	1.11	1.14	1.08	1.18
Conventional RIN	0.10	0.26	0.42	0.76	0.67	0.61	0.58	0.60	0.63	0.58	0.61
RIN compliance expend.						(Million dollars)					
Total	3,765	6,893	10,521	16,501	15,186	15,088	15,894	18,667	21,482	22,111	25,290

Crop markets (Baseline)

Marketing year	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
CORN											
Area					(Million acres)						
Planted area	91.9	93.5	91.4	91.4	92.0	92.0	91.9	91.6	91.0	90.4	89.7
Harvested area	84.0	85.8	83.9	83.9	84.4	84.4	84.4	84.1	83.4	82.9	82.2
					(Bushels per harvested acre)						
Yield	147.2	162.1	164.4	166.5	168.9	171.3	173.6	175.6	178.0	180.3	182.3
					(Million bushels)						
Supply	13,501	14,770	15,153	15,471	15,769	15,992	16,220	16,371	16,504	16,667	16,769
Beginning stocks	1,128	839	1,346	1,482	1,492	1,519	1,557	1,592	1,645	1,703	1,762
Production	12,358	13,916	13,791	13,974	14,261	14,458	14,648	14,763	14,844	14,950	14,992
Imports	15	15	15	15	15	15	15	15	15	15	15
Domestic use	11,013	11,530	11,642	11,877	12,090	12,201	12,303	12,358	12,390	12,451	12,467
Ethanol and coproducts	4,994	5,070	5,201	5,437	5,590	5,669	5,719	5,733	5,710	5,732	5,715
Food and other	862	880	888	894	900	906	913	921	928	936	943
Feed and residual	4,604	5,023	4,991	4,980	5,031	5,054	5,097	5,129	5,173	5,203	5,226
Exports	1,649	1,893	2,029	2,101	2,160	2,234	2,325	2,367	2,411	2,454	2,492
Ending stocks	839	1,346	1,482	1,492	1,519	1,557	1,592	1,645	1,703	1,762	1,810
					(Dollars per bushel)						
Farm price	5.96	4.81	4.71	4.80	4.83	4.85	4.81	4.77	4.68	4.59	4.56
					(Dollars)						
Market net return/a.	550.88	427.51	415.21	432.38	445.79	458.26	459.94	458.88	453.19	447.74	444.89
SOYBEANS											
Area					(Million acres)						
Planted area	75.0	75.1	75.1	74.9	74.2	74.0	73.9	74.0	74.1	74.2	74.3
Harvested area	73.6	74.1	74.0	73.8	73.2	73.0	72.9	73.0	73.1	73.2	73.3
					(Bushels per harvested acre)						
Yield	41.5	43.8	44.4	44.8	45.4	45.9	46.4	46.9	47.4	47.9	48.3
					(Million bushels)						
Supply	3,286	3,535	3,601	3,624	3,642	3,676	3,708	3,745	3,792	3,832	3,873
Beginning stocks	215	278	301	298	307	308	307	309	310	313	315
Production	3,056	3,243	3,285	3,311	3,320	3,353	3,385	3,422	3,467	3,504	3,543
Imports	15	15	15	15	15	15	15	15	15	15	15
Domestic use	1,733	1,776	1,808	1,822	1,833	1,847	1,862	1,879	1,900	1,918	1,938
Crush	1,615	1,651	1,680	1,693	1,703	1,716	1,729	1,744	1,762	1,778	1,796
Exports	1,275	1,458	1,495	1,496	1,501	1,521	1,538	1,556	1,579	1,598	1,618
Ending stocks	278	301	298	307	308	307	309	310	313	315	317
					(Dollars per bushel)						
Farm price	11.61	11.37	11.37	11.30	11.35	11.48	11.58	11.57	11.46	11.41	11.39
					(Dollars)						
Market net return/a.	331.13	336.01	339.12	338.62	343.97	354.87	362.19	366.47	367.15	368.52	370.38

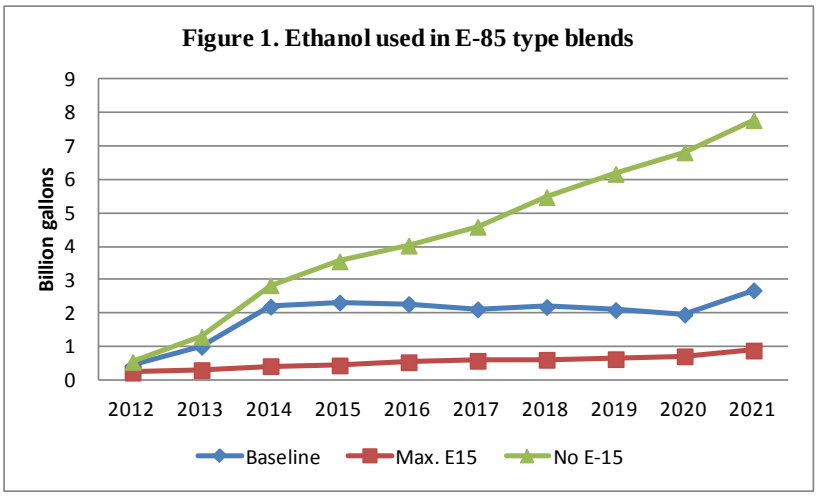
The impact of different assumptions regarding E-15 use

In 2011, the EPA approved E-15 for use in vehicles manufactured after 2001. Several E-15 blends have been registered with the EPA already, but there is still much uncertainty regarding how quickly that fuel will be available to motorists and the volume of E-15 that will be sold. In the baseline E-15 use is assumed to grow steadily over the projection until the average low level blend rate for all gasoline sold in 2021 is 13.3 percent. The blend rate does not reach the 15 percent maximum as there will still be a small number of cars that were manufactured before 2001 at that time. It is additionally assumed that not all of the post-2001 cars use E-15 either through preference or lack of availability.

In addition to the baseline presented above, two scenarios were simulated using the stochastic model to examine the implications of different paths of E-15 use. In one scenario, all fuel is either E-10 or E-85 and no E-15 is sold ("No E-15"). In the other scenario ("Max E-15") E-15 is fully phased in over four years and so from 2015 onwards all post-2001 model vehicles use E-15.[4] A summary of the impact of the scenarios on key variables is given by the tables on page 12.

In the baseline E-85 use grows in the short run to just over 2 billion gallons by 2014. Thereafter, the expansion of E-15 use (as well as the assumption that cellulosic production is well below its mandated level and the total mandate is reduced by this shortfall) means that E-85 use remains flat until the end of the period (Figure 1). Under the Max E-15 scenario E-85 use remains low as the expansion in E-15 use is sufficient to fill the mandates for ethanol use for some time. Where there is no E-15, however, eight billion gallons of ethanol in E-85 is required in 2021. This requires both an expansion in the flex fuel fleet and further investments in E-85 distribution. Some would question whether this level of E-85 consumption is possible given the required changes.

Figure 1. Ethanol used in E-85 type blends

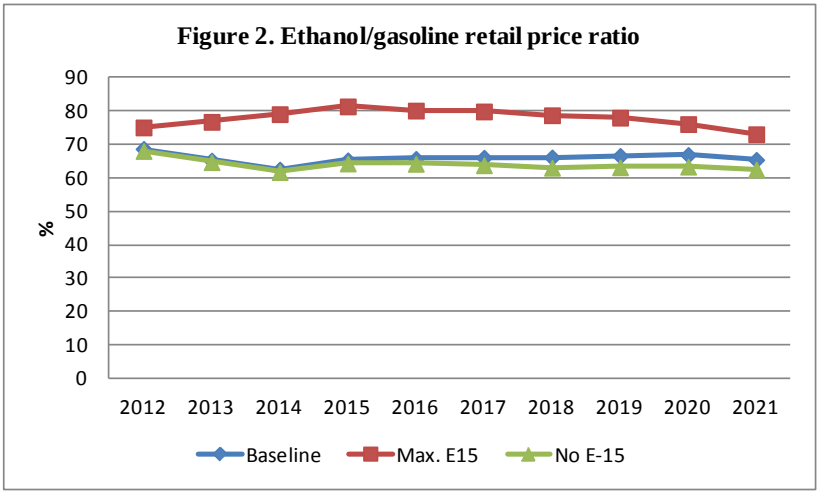


Both the baseline and No E-15 scenario result in mostly binding mandates, so quantities of ethanol used tend towards the legislated volumes in either case. While the expansion of the E-15 market does increase the chances that mandates are not binding, overall ethanol

[4] Note that some cars will still be on the road that were manufactured before 2001 in 2021, and so the ethanol in low level blend rate is slightly less than 15 percent.

use is similar in each of the scenarios, with the main impact of E-15 use changes reflected in the composition of ethanol demand. There is, however, is a large impact on prices. This is illustrated in Figure 2.

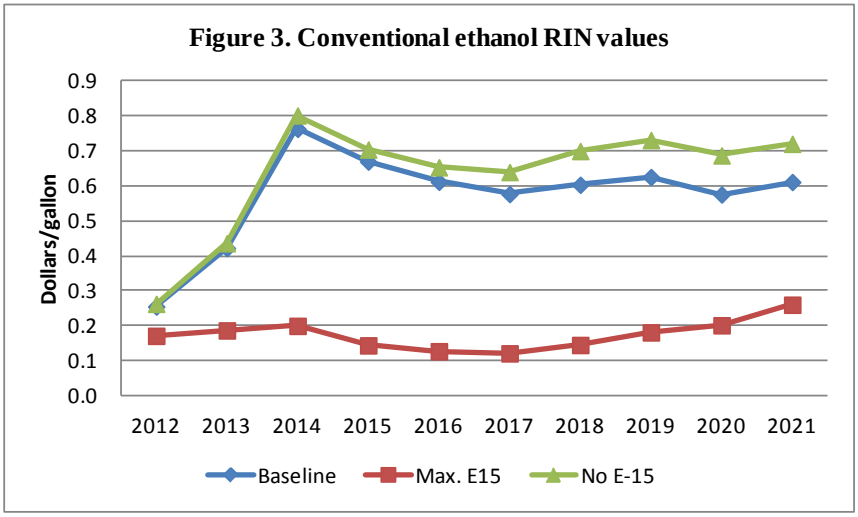
Figure 2. Ethanol/gasoline retail price ratio



In order to generate the large volumes of E-85 use that the mandates would require in the absence of E-15, it is likely that the (implicit) retail price of ethanol would need to fall below its energy equivalent value relative to gasoline, and this is the case in the baseline and No E-15 scenario. Here E-15 blends have been modeled so that to encourage consumption the retail price does not have to fall all the way to energy equivalent, and so their economics are closer to E-10 than E-85. At the pump consumers will have a choice, most likely comparing E-10 to E-15, with the E-15 price discount having to reflect consumers perceptions of mileage differences and any concerns they have over using the fuel.

RIN prices move in the opposite direction to the retail ethanol price. In the Max E-15 scenario conventional RIN prices fall relative to the baseline as the market expands (Figure 3). In the No E-15 case, ethanol retail prices have to fall below energy equivalence levels, so RIN prices rise accordingly. In the Max E-15 scenario mandate compliance costs fall by more than $7 billion in 2021 relative to the baseline. In the no E-15 scenario, costs rise by more than $2 billion.

Figure 3. Conventional ethanol RIN values



The results are sensitive to the assumptions that we have made regarding the implementation of the RFS2. Consumer's attitude towards E-15 is also important. Also significant is the development of 'drop in' fuels, the level of which is assumed to climb to just over half a billion gallons in 2021 in the baseline and remains constant in the scenarios. Faster development of drop in fuels would lessen the impact of the blend wall and E-15 availability on the future of the sector.

Change from Baseline with full penetration of E-15

	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Ethanol dom. disappearance					Million gallons					
In 15% and lower blends	751	1,495	2,223	2,489	2,173	1,970	1,723	1,473	1,317	1,778
In higher level blends	-200	-698	-1,776	-1,880	-1,738	-1,538	-1,578	-1,469	-1,248	-1,800
Conv. ethanol prices					Dollars/gallon					
Omaha rack	0.15	0.18	0.05	0.06	0.03	0.03	-0.03	-0.06	-0.06	-0.08
Effective retail	0.22	0.39	0.55	0.52	0.46	0.42	0.37	0.32	0.27	0.22
RIN values										
Conventional	-0.08	-0.24	-0.56	-0.52	-0.48	-0.46	-0.46	-0.44	-0.37	-0.35
Advanced	-0.21	-0.38	-0.60	-0.56	-0.52	-0.49	-0.45	-0.40	-0.32	-0.29
					Million dollars					
Total RIN compliance expen.	-1,125	-3,277	-8,869	-8,601	-8,254	-8,152	-8,702	-8,779	-7,593	-7,261
					Dollars/bushel					
Corn price	0.09	0.08	0.00	0.06	0.06	0.06	0.01	0.01	0.03	0.01
					Million acres					
Corn area	0.0	0.8	0.8	0.2	0.5	0.6	0.6	0.3	0.1	0.3

Change from Baseline with no E-15

	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22
Ethanol dom. disappearance					Million gallons					
In 15% and lower blends	-166	-326	-630	-1,244	-1,792	-2,543	-3,358	-4,168	-4,950	-5,112
In higher level blends	121	296	641	1,229	1,746	2,467	3,281	4,067	4,847	5,083
Conv. ethanol prices					Dollars/gallon					
Omaha rack	-0.02	0.00	0.01	0.00	-0.01	-0.02	-0.01	-0.01	-0.01	0.01
Effective retail	-0.02	-0.02	-0.02	-0.03	-0.05	-0.07	-0.09	-0.10	-0.11	-0.09
RIN values										
Conventional	0.01	0.01	0.04	0.03	0.04	0.06	0.10	0.11	0.11	0.11
Advanced	0.02	0.02	0.03	0.04	0.05	0.08	0.11	0.11	0.12	0.10
					Million dollars					
Total RIN compliance expen.	112	192	618	574	709	1,118	1,800	2,022	2,209	2,257
					Dollars/bushel					
Corn price	-0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	0.00
					Million acres					
Corn area	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1

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