The Myth of High RIN Prices as Proof of the Blend Wall

- **Data recently released by EPA challenges conventional wisdom that the so-called blend wall caused RIN prices to rise in 2013.**
- **Refiners and importers blended ethanol into obligated gasoline volumes beyond the 10 percent limit as early as 2010.**
- **Refiners' and importers' use of compliance flexibility reveals they did not experience RIN shortages at any point.**
- **EPA's rulemaking delays and unwarranted changes to the RFS based on blend wall assumptions harmed biofuel producers while providing obligated parties relief from a problem that didn't exist.**

In 2007, Congress updated the Renewable Fuel Standard (RFS) and set a statutory schedule for annual increases in production and use of biofuels to reach 36 billion gallons in 2022. The 36 billion gallon volume set by Congress was projected to be 20 percent of transportation fuel use by 2022. The so-called blend wall is a theoretical 10 percent limit on the amount of ethanol that can be blended into gasoline in the United States, purportedly due to infrastructure and market constraints. While the RFS does not require ethanol use – other biofuels can be used to reach the 36 billion gallon goal – stakeholders understood from the start that the program would require new infrastructure and market changes to overcome the predicted constraints.

A seminal 2012 paper from researchers at the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri predicted that when fuel refiners encountered the 10 percent limit on blending, they would experience a shortage of RFS compliance credits – known as Renewable Identification Numbers (RINs) – and

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see a sharp increase in compliance costs.[1] The FAPRI authors developed an accounting model comparing the congressionally established fuel volumes to the number of available RINs; they then projected that the 10 percent blend wall limit would be unavoidable by 2015. It has subsequently become widely accepted that dramatic spikes in spot market RIN prices in 2013 provided direct evidence that U.S. fuel refiners and importers had reached the 10 percent blend wall.[2,3]

The U.S. Environmental Protection Agency (EPA) delayed issuing annual rules and postponed RFS compliance deadlines for refiners and importers in 2013, 2014, 2015 and 2016 as it considered the impact of the RIN price spikes and the post hoc conclusion that U.S. refiners had encountered the blend wall. In a multiyear rule issued in November 2015, the agency finalized far-reaching changes to the RFS program in an attempt to relieve U.S. refiners from high RIN prices and presumed RIN shortages.[4,5]

Data recently released by EPA in response to a Freedom of Information Act (FOIA) request enables an accurate accounting of how obligated parties achieved RFS compliance from 2010 through 2015, using available RINs and alternate compliance flexibilities.[6] A true accounting of RINs and other compliance options demonstrates that refiners and importers reached the 10 percent blending limit as early as 2010 and definitely surpassed it in 2012. At no point in time did refiners and importers experience an aggregate shortage of RINs as the FAPRI paper predicted. Contrary

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[1] Thompson, W. et al. (2012) "A Question Worth Billions: Why Isn't the Conventional RIN Price Higher?" Columbia, MO: Food and Agricultural Policy Research Institute. FAPRI-MU Report #12-12.
[2] Stock, J.H. (2015) "The Renewable Fuel Standard: A Path Forward." New York: Columbia University School of International and Public Affairs and Center on Global Energy Policy.
[3] Knittel, C.R. et al. (2015) "The Pass-Through of RIN Prices to Wholesale and Retail Fuels under the Renewable Fuel Standard." Cambridge, MA: Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology.
[4] 80 Fed. Reg. (77428-29), Monday, Dec. 14, 2015.
[5] Letter from Byron J. Bunker, Director, Compliance Division, Office of Transportation and Air Quality, USEPA to Paul Winters, BIO. "RE: Freedom of Information Act request EPA-HQ-2015-004861." Aug. 8, 2016. https://foiaonline.regulations.gov/foia/action/public/view/request?objectId=090004d2805fef3f.
[6] EPA. (2016) "Annual Compliance Data for Obligated Parties and Renewable Fuel Exporters under the Renewable Fuel Standard (RFS) Program." https://www.epa.gov/fuels-registration-reporting-and-compliance-help/annual-compliance-data-obligated-parties-and.

to the commonly accepted interpretation, the 2013 rise in spot market RIN prices cannot be explained as a consequence of either the so-called blend wall or a shortage of RINs. Further, EPA's actions have had no impact on RIN supplies or prices. EPA should therefore reverse the changes it made to the RFS program.

An abundance of compliance options

Under the RFS, petroleum refiners and importers are assigned an annual Renewable Volume Obligation (RVO), indicating the percentage of their refined or imported fuel that must be renewable in order to meet the congressionally set schedule for production and use of biofuels. Entities incurring an RVO are referred to as obligated parties. RINs are the compliance credits generated under the RFS program that obligated parties use to demonstrate compliance with their annual RVOs. EPA establishes the percentage RVOs on an annual basis by dividing the congressionally set schedule by the amount of U.S. fuel consumption projected for the year by the U.S. Energy Information Administration (EIA).

Obligated parties are assigned four distinct RVOs each year – for cellulosic biofuel, biomass-based diesel (BBD), advanced biofuel and conventional biofuel – and they must retire sufficient eligible and valid RINs to satisfy each. RVOs are nested; e.g., RINs retired to meet the cellulosic or the BBD RVO also concurrently satisfy the advanced and overall RVO.

In establishing regulations for the RFS program, EPA provided obligated parties flexibility in complying with annual RVOs. As directed by Congress, the agency established the RIN system under the RFS to provide credits for refiners and importers who use more renewable fuel than required. As with other fuel regulations under the Clean Air Act, RFS RINs also equalize the compliance burden among obligated parties. Equalization of the compliance burden enables obligated parties who exceed their individual requirements to transfer (or sell) credits to those who fall short of the obligations.

EPA established different RIN codes (D3 – D7) to distinguish the various categories of biofuels eligible to meet the nested RVOs. EPA publishes separate data on RINs

generated by type of fuel produced; however, the agency does not report or publish data on the type of fuel associated with RINs retired to meet obligations.

Per the statute, RINs are valid to meet annual RVOs for one year from the date they are generated. EPA's regulations enable individual obligated parties to meet up to 20 percent of an annual RVO using "carryover RINs," which are excess RINs generated in the preceding year. RINs that are not used to satisfy an RVO in the year they are generated or the subsequent year expire unused.

EPA regulations, as directed by Congress, also allow individual obligated parties to carry forward a deficit in an annual RVO, essentially deferring all or part of that RVO to the following year. The statute and regulations specify, though, that the individual obligated party must satisfy the full "deficit carryforward" in the subsequent year along with the annual RVO; an individual obligated party may not have a deficit carryforward in the same RVO two years in a row. **The deficit carryforward provision creates a more stringent obligation for obligated parties; its use provides the clearest indication of relative difficulty in meeting the annual RVOs.**

The regulations ensure that the congressionally established volumes of renewable fuels are used within the United States. The compliance options allow obligated parties some flexibility from year to year, but are designed to ensure that any shortfall in using renewable fuels is made up quickly.

Calculating the ethanol obligation arising from the RVOs and the 10 percent limit

Obligated parties must meet their annual RVOs by using the renewable fuel that is produced and available in the market. Ethanol and biomass-based diesel (both biodiesel and renewable diesel) are the most common types of renewable fuel available. For this study, the relative amount of available ethanol and biomass-based diesel RINs used for compliance is approximated by examining EPA data on

the annual generation of RINs by type of biofuel produced.[7] **Nearly all D6 RINs and a large majority of D5 RINs generated from 2010 to 2015 represent ethanol production, which must be blended into the gasoline supply**; ethanol is not blended into diesel fuel. There are deviations from this general trend. For instance, in 2015 nearly 3 percent of D6 RINs were assigned to fuels other than ethanol. And in 2010, nearly 86 percent of D5 RINs generated were for biomass-based diesel.

Both gasoline and diesel are obligated fuels under the RFS. The actual obligated fuel volumes reported by obligated parties are shown in Table 1. **The volume of obligated gasoline use is approximately 70 percent of the reported volumes each year.** EIA reports minor variations in the balance of gasoline and diesel consumption each year, so these relative annual percentages are applied to the reported obligated volumes to estimate obligated gasoline volume. The assumed ethanol blending limit is estimated as 10 percent of annual obligated gasoline volumes.

Table 1: Assumed Blend Wall Limit for RFS Renewable Volume Obligations, 2010-2015 (million gallons)

	2010	2011	2012	2013	2014	2015
Obligated fuel volume	153,191	169,402	166,590	172,985	177,080	180,243
Gasoline ratio of obligated fuel	0.7	0.69	0.7	0.7	0.69	0.7
Estimated obligated gasoline volume	107,988	117,609	116,414	121,453	122,865	126,323
Estimated 10% ethanol blending limit	10,799	11,761	11,641	12,145	12,287	12,632

[7] U.S. EPA. (2016) Renewable Identification Number (RIN) Data for Renewable Fuel Standard Program. https://www.epa.gov/renewable-fuel-standard-program/renewable-identification-number-rin-data-renewable-fuel-standard.

The actual obligated fuel volumes reported by EPA are substantially different from the volumes of gasoline and diesel consumption reported by EIA, highlighting the fact that **small refiners and small refineries (even those owned by large refiners) were exempted from the RFS program through 2012.** In setting the 2010 RVOs, EPA reduced EIA's estimate of U.S. fuel production by 13.5 percent, while providing 59 small refineries (processing less than 75,000 barrels of crude per day) and small refiners (employing 1,500 or fewer people) exemption from the obligations.[8,9] In 2011, EPA ended the exemption for small refiners, but granted hardship exemptions to three small refineries that petitioned the agency.[10] Then in 2012, in response to a Department of Energy study ordered by Congress, EPA reinstated the exemption for 21 small U.S. refineries and retroactively applied it to the 2011 RVOs, prior to compliance deadlines. EPA adjusted the EIA estimates of fuel use for those years by approximately 3.6 percent of the gasoline pool and 4.5 percent of the diesel pool.[11] EPA granted a single exemption to a small refinery in 2013.[12] EPA recently published aggregate volumes of gasoline and diesel produced by small refineries that are exempt from the program for each year 2011 - 2015.[13]

Final annual RVOs are calculated as both a percentage of the current year's obligated volumes plus any deficit carryforward volume from prior years. Obligated parties used the deficit carryforward provision most heavily in 2010, indicating relative difficulty as the updated rules and higher volume requirements came into effect. They carried forward approximately 13.5 percent of the 2010 BBD RVO and 24.6 percent of the advanced RVO as a deficit and added these volumes to the 2011 RVO. By comparison, they carried forward less than 1.3 percent of the 2010 overall RVO as a deficit. **Obligated parties have used the deficit carryforward**

[8] 72 Fed. Reg. (23911), Tuesday, May 1, 2007.
[9] 75 Fed. Reg. (14735-14737), Friday, March 26, 2010.
[10] 75 Fed. Reg. (76805), Thursday, Dec. 9, 2010.
[11] 77 Fed. Reg. (1223, 1340), Monday, Jan. 9, 2012. Cf. "Small Refinery Exemption Study: An Investigation into Disproportionate Economic Hardship," U.S. Department of Energy, March 2011.
[12] 78 Fed. Reg. (49825), Thursday, Aug. 15, 2013.
[13] Korotney, D. "Comparison of availability of RINs and standards for previous years." Memorandum to EPA Air Docket EPA-HQ-OAR-2016-0004-3746, Nov. 18, 2016 (posted Dec. 12, 2016, https://www.regulations.gov/document?D=EPA-HQ-OAR-2016-0004-3746).

provision sparingly each year since, suggesting relative ease in meeting the annual RVOs. In 2011, they carried forward about 3.4 percent of the BBD RVO and added that volume to the 2012 RVO. They carried forward less than 2.7 percent of the advanced RVO and less than 0.5 percent of the overall RVO in that same year. Since 2011, obligated parties have carried forward less than 1 percent of each annual RVO as a deficit.

Table 2: Calculation of Annual RVOs Considering Deficit Carryforwards

	2010	2011	2012	2013	2014	2015
Annual overall RVO	12,638,293,110	13,576,733,859	15,380,846,391	16,847,826,477	16,274,578,876	17,159,129,553
Annual advanced RVO	934,467,733	1,322,078,953	2,016,340,643	2,802,157,305	2,674,060,294	2,919,935,911
Annual BBD RVO	1,685,124,090	1,169,542,497	1,516,421,475	1,954,598,102	2,496,970,208	2,685,620,067
Annual cellulosic RVO	6,182,591			864,865	33,647,116	124,367,641
Overall deficit carryforward	163,353,609	71,361,964	78,064,351	59,843,695	160,091,803	12,724,461
Advanced deficit carryforward	229,693,190	39,793,950	23,212,163	18,717,611	14,852,674	9,600,652
BBD deficit carryforward	227,120,812	44,899,618	22,891,875	15,671,598	13,234,484	9,429,196
Cellulosic deficit carryforward	31,453			31	7,722	0
Final overall RVO	12,474,939,501	13,668,725,504	15,374,144,004	16,866,047,133	16,174,330,768	17,306,496,895
Final advanced RVO	704,774,543	1,511,978,193	2,032,922,430	2,806,651,857	2,677,925,231	2,925,187,933
Final BBD RVO	1,458,003,278	1,351,763,691	1,538,429,218	1,961,818,379	2,499,407,322	2,689,425,355
Final cellulosic RVO	6,151,048			864,834	33,639,425	124,375,363
Percent ethanol in conventional biofuel	99.7	100	100	98.1	97.7	96.9
Percent ethanol in advanced biofuel	14.1	85.3	96.7	86.7	86.0	92.4
"Ethanol RVO"	11,734,217,271	12,287,824,563	13,818,144,012	14,527,157,027	13,332,980,194	14,160,363,837

Percent of obligated gasoline	10.9	10.4	11.9	12	10.9	11.2

The total annual RVOs for 2010 – 2015 are shown in Table 2 above. The final RVOs are calculated by subtracting each RVO deficit from the current year and adding it to the appropriate RVO in the following year. Note that the statute adopted by Congress included 2009 obligations for the biomass-based diesel and advanced RVOs; however, EPA did not finalize the regulations until 2010. EPA therefore set a BBD RVO in 2010 that included the 2009 obligation. Cellulosic RVOs for 2011 and 2012 were set to zero, so the cellulosic RVOs for 2011 remains zero despite the deficit carryforward from 2010.

The amount of the annual RVOs required to be met with available ethanol – the "ethanol RVO" – is estimated in Table 2 by adding the conventional, non-advanced biofuel portion of the overall RVO and the portion of the undifferentiated advanced RVO that is not biomass-based diesel. The formula for calculating this "ethanol RVO" is represented in Figure 1.

Figure 1: "Ethanol RVO" equation

		Portion of non-advanced overall RVO met with ethanol						Portion of undifferentiated advanced RVO met by ethanol				
"Ethanol RVO"	=	((Final overall RVO	-	Final advanced RVO)	x	Percent ethanol in conventional biofuel)	+	((Final advanced RVO	-	Final BBD RVO)	x	Percent ethanol in advanced biofuel)

Comparing the "ethanol RVO" in Table 2 to the estimated blend wall in Table 1 illustrates the fact that **the amount of ethanol obligated parties were required to blend into the gasoline they produced was already above 10 percent by 2010**. In 2012 and 2013 the "ethanol RVO" was close to 12 percent. The straightforward economic theory put forward by the FAPRI authors predicted that a requirement to use ethanol above the 10 blending limit would result in a shortage of RINs, which would cause prices to rise. **The data shows that the "ethanol RVO" was no more difficult for obligated parties to meet in 2013 than in**

2012, since the relative percentages were nearly identical. This accounting dispels the post hoc supposition that the spot market RIN price spikes in 2013 signaled that the blend wall had arrived. It also becomes clear that EPA's rulemaking delays in 2014 and 2015 and its eventual changes to the program had no impact on reducing the "ethanol RVO" below the theoretical 10 percent blending limit; the "ethanol RVO" remains at approximately 11 percent for each of those years.[14]

Did refiners use carryover RINs to avoid hitting the blend wall?

The FAPRI authors also tested a hypothesis that obligated parties could use carryover RINs to limit blending of ethanol in any current year and thereby delay arrival of the blend wall. Under this hypothesis, obligated parties would use as many carryover RINs as possible, up to the allowable 20 percent, to meet each annual RVO and thereby keep actual ethanol blending below 10 percent. **The FAPRI authors concluded that this strategy could only be effective for a few years, potentially delaying arrival of the blend wall until 2015.**

The data recently released by EPA demonstrate that obligated parties did not employ this strategy – in fact, their use of carryforward deficits from 2010 to 2011 prevented the strategy. Table 3 below presents the numbers of 2010 – 2014 RINs carried over and retired to meet the 2011 – 2015 final RVOs, calculated in Table 2. The percentage of the annual RVOs that obligated refiners and importers met with carryover RINs and the numbers of prior year RINs that expired unused, after the annual final RVO was met, are also presented.

EPA does not provide data on carryover RINs in 2010, because these RINs were generated under the RFS program established by law in 2005 (RFS1). RFS1 was in effect through June 2010, when the updated regulations and schedule of volumes

[14] As made clear in the newly provided data from EPA, fuel exporters incur a separate RVO if they export RIN-bearing biofuels. The current year and carryover RINs retired by exporters are excluded from the current analysis, because they are not relevant to the blend wall, which is a purported structural limit on U.S. fuel supplies. Deficit carryforwards are not permitted for export RVOs under the RFS rules (at CFR §80.1427(c)).

from the 2007 law came into effect. Because the reported 2010 BBD RVO also included 2009 volumes, EPA established additional options for obligated parties to meet it, including use of RFS1 RINs. Obligated parties met less than 5 percent of the 2011 BBD and advanced RVOs with carryover 2010 RINs. Comparatively, they met nearly 17 percent of the overall 2011 RVO with carryover 2010 RINs. Obligated refiners and importers apparently met a small portion of the 2011 RVOs with 2010 vintage RFS1 RINs.

Table 3: Carryover RINs Retired by Obligated Refiners and Importers, 2011-2015

	2011	2012	2013	2014	2015
D6 RINs carried over	2,241,455,041	3,169,954,134	2,087,485,067	1,072,234,550	1,344,958,404
D5 RINs carried over	3,580,101	50,801,949	165,030,837	42,792,927	54,592,739
D4 RINs carried over	57,368,904	277,937,240	248,305,050	495,434,195	385,161,902
Percent of final overall RVO met with carryover RINs.	16.8	22.8	14.8	10	10.4
Percent of final advanced RVO met with carryover RINs	4	16.2	14.7	20.1	15.4
Percent of final BBD RVO met with carryover RINs	4.2	18.1	12.7	19.8	14.3
Prior year D6 RINs expired unused	426,649,448	469,306,771	11,935,021	4,119,459	7,470,105
Prior year D5 RINs expired unused	56,433	2,688,287	1,407,742	284,326	803,328
Prior year D4 RINs expired unused	2,755,307	23,115,151	2,514,278	2,051,990	6,288,064

Obligated refiners and importers did not use the maximum allowable number of carryover RINs to meet any RVO prior to 2014, with the singular exception of the overall RVO in 2012. The data shows that obligated parties met 22.8 percent of the 2012 overall RVO with carryover RINs.[15] At the same time, nearly a half billion 2011 vintage RINs expired unused. In fact, the number of 2011 vintage D6 RINs that expired unused in 2012 is considerable in comparison to the numbers carried over to meet the overall RVO (a ratio of approximately 15 percent).

Further, even as obligated parties employed the deficit carryforward provision in 2010, nearly a half billion available 2010 vintage RINs expired unused. Most of the expired unused RINs were D6 RINs from ethanol – more than 6 percent of D6 RINs generated in 2010 and nearly 3.5 percent of D6 RINs generated in 2011 expired unused.

Obligated parties may have belatedly used the carryover RIN provision to maximum effect in 2012, but it did not delay arrival of the so-called blend wall. In 2012, obligated parties met 18 percent of the BBD RVO and 16.1 percent of the advanced RVO with carryover RINs. A relatively significant number of potential 2011 carryover RINs still expired unused, and obligated parties carried forward deficits into 2013. In 2013, use of carryover RINs declined as a percentage of the annual RVOs from 2012. Obligated parties met less than 15 percent of each annual 2013 RVO with carryover RINs. At the same time, very few 2012 vintage RINs expired unused, but deficit carryforwards decreased in that year.

Use of carryover RINs for the 2014 BBD and advanced RVOs increased to the maximum allowable, but use for the overall RVO continued to decline in 2014. In 2014, refiners and importers used the maximum allowable 20 percent carryover RINs in both the advanced RVO and the biomass-based diesel RVO; however, they met the overall RVO with only 10 percent carryover RINs, while at the same time carrying forward a larger deficit than in 2013. The 2014 deficit was 0.9 percent of the overall obligation, compared to 0.5 percent in 2013. A small number of available 2013 vintage carryover RINs expired unused. And in 2015, refiners and

[15] See also, Appendix Table A2.

importers met approximately 15 percent of each annual RVO with carryover RINs from 2014. Concurrently, there was a slight increase in the numbers of 2014 RINs expiring unused; but only small deficit carryforwards – less than a tenth of 1 percent for the overall RVO – have been reported for 2015.

It is clear that obligated parties did not employ an active strategy to use carryover RINs to delay the blend wall, at least at an aggregate, multiyear level. At the same time, there was no shortage of RINs during 2013 that could explain the spikes in RIN prices. The relatively small numbers of 2012 and 2013 RINs expiring unused and the declining use of carryover RINs in 2013 and 2014 RVOs – information not available to the market until recently – would not have signaled a shortage to the market for several reasons. They were impacted by deficits carried forward during those years and because the aggregate availability of RINs for 2013 and 2014 would not have become apparent until 2016, since EPA delayed all compliance deadlines for years after 2012.

Did obligated parties encounter a shortage of RINs?

The FAPRI authors theorized that refiners' and importers' inability to blend ethanol into obligated gasoline volumes beyond the theoretical 10 percent limit would cause a shortage of RINs, leading to increased RIN prices. **EPA's newly released data reveals that the amount of ethanol blended into obligated volumes of gasoline clearly exceeded 10 percent by 2011.**

RINs separated in any given year (whether retired, expired or carried over to the following year) represent biofuel blended into transportation fuel. Table 4 below presents a calculation of all D6 and D5 RINs separated from ethanol each year that were eventually retired, carried over, or expired unused. The ratio of RINs generated from ethanol gallons is applied to those retired, carried over and expired unused.[16]

[16] It could be the case that all D5 and D6 RINs that expired unused were separated from ethanol (and conversely, it could be the case that those RINs retired were from biomass-based diesel). Regardless, RINs that expired unused still represent ethanol blended into the

Table 4: Ethanol RINs Used 2010-2015[17]

Current Year RINs	2010	2011	2012	2013	2014	2015
D6 RINs retired	3,838,694,623	9,184,154,593	10,555,225,166	11,923,667,579	12,338,731,449	13,017,455,991
D6 RINs carried over	2,241,455,041	3,169,954,134	2,087,485,067	1,072,234,550	1,344,958,404	
D6 RINs expired unused	426,649,448	469,306,771	11,935,021	4,119,459	7,470,105	
D5 RINs retired	24,808,442	170,668,757	430,685,359	507,813,089	87,981,874	46,685,808
D5 RINs carried over	3,580,101	50,801,949	165,030,837	42,792,927	54,592,739	
D5 RINs expired unused	56,433	2,688,287	1,407,742	284,326	803,328	
Percent ethanol in D5 RINs	14.1	85.3	96.7	86.7	86.0	92.4
Total ethanol RINs used	6,492,838,486	13,008,731,909	13,230,849,241	13,232,833,443	13,834,537,899	13,064,141,799
Percent ethanol in obligated gasoline volumes	6	11.1	11.4	10.9	11.3	10.3

Some of the ethanol used during 2010, 2011 and 2012 (and through 2015) was almost certainly blended into gasoline produced by small refiners and small refineries that were exempt from RFS2 obligations. Splash blending ethanol into the unobligated volumes of gasoline therefore could have provided obligated refiners and importers some relief from the assumed blend wall. Small refiners and small

transportation fuel supply. Further, eliminating expired unused RINs from the calculation would lower the rate of ethanol blended by only a few tenths of a percent, remaining above the 10 percent level.

[17] The number of ethanol RINs retired, carried over or expired unused in 2010 appears to be below the assumed blend wall limit because the data is incomplete. EPA does not provide RIN data from the RFS1 program, which was in effect through June 2010. But only gasoline volumes were obligated under RFS1; therefore, it is more likely that the RINs carried over from RFS1 to meet 2010 RVOs represented ethanol instead of biodiesel. And therefore the proportion of ethanol used to satisfy fuel obligations likely exceeded 10 percent as early as 2010.

refineries were allowed to separate RINs from renewable fuels under CFR §80.1429(b)(8).

However, remaining obligated parties still would have had to purchase the separated RINs, if they were unable to blend more than 10 percent ethanol into the fuels they produced. This path of relief from the assumed 10 percent limit would therefore have presented a potential cost for obligated parties in meeting obligations between 2010 and 2012. **Although the aggregate volumes of gasoline and diesel produced by small refiners and refineries exempted from the program are considerable, they are not sufficient to lower the "ethanol RVO" or ethanol usage below 10 percent of the gasoline supply in any year.** Table 5 below presents the aggregate volumes of exempt fuel reported by EPA, a recalculated blend wall number, and the percent of obligated gasoline plus exempt gasoline required to be ethanol, with the "ethanol RVO" calculation from Table 1 unchanged. The "ethanol RVO" reaches well above 11 percent by 2012.

Table 5: Recalculated Assumed Blend Wall and "Ethanol RVO", Considering Exempt Gasoline Available for Blending

	2011	2012	2013	2014	2015
Exempt volume of gasoline and diesel	8,610,000,000	8,498,000,000	1,278,000,000	650,000,000	539,000,000
Estimated 10% blend wall	12,358,616,320	12,235,229,803	12,235,065,946	12,331,598,283	12,670,057,529
"Ethanol RVO" as percent of obligated and exempt gasoline	9.9	11.3	11.9	10.8	11.2

Under the economic theory put forward by FAPRI, a shortage of RINs should have raised prices. **Given that there is little difference between the percentages of ethanol mixed into the gasoline supply from 2011 to 2013, why RIN prices spiked in 2013 rather than earlier remains unexplained.**

EPA delayed issuing the 2013 RVOs until August of that year as it considered the rise in RIN prices, which the agency assumed signaled arrival of the blend wall, and

the potential difficulty for refiners to meet annual RVOs that year. The agency eventually finalized 2013 RVOs at the full statutory volume while delaying the compliance deadline for the year.[18] **The relative ease or difficulty for obligated parties to meet RVOs in 2012 and 2013 was thereby obscured until 2016.** In 2013 the amount of ethanol blended into obligated gasoline volumes remained well above 10 percent.

EPA also delayed issuing the 2014 and 2015 RVOs as it addressed controversy "about how the volumes should be set in light of lower gasoline consumption than had been forecast" in 2007 when Congress initially set the statutory volumes of biofuel. In tying RVO volume-setting to gasoline consumption numbers, EPA was implicitly relying on the blend wall concept.[19] The agency eventually established RVOs for 2014, 2015 and 2016 in a single rule made public in November 2015. In the rule, EPA waived significant volumes from the congressionally set schedule of biofuel production and use for 2014, 2015 and 2016. The agency further argued that it needed to preserve a "bank" of carryover RINs to ensure compliance flexibility for obligated parties.

The numbers of 2014 RINs carried over to meet the 2015 RVOs increased slightly from the preceding year, except for D4 RINs. Obligated parties met 10 percent of their overall 2015 obligation and approximately 15 percent of both the advanced and biomass-based diesel obligations with carryover RINs. The numbers of RINs expected to expire unused also increased slightly. At the same time, **the volume of ethanol blended into obligated volumes of gasoline in 2014 and 2015 once again exceeded 10 percent**, as indicated solely by the numbers of current year RINs retired for 2015 RVO compliance. EPA's data indicates that more than 1.6 billion 2015 vintage RINs remain available.[20] Within those available RINs, a minimum of 1.16 billion represent ethanol blended into the fuel supply, which would exceed 10.3 percent of obligated volumes of gasoline during 2015. The "ethanol

[18] 79 Fed. Reg. (34242), Monday June 16, 2014; 79 Fed. Reg. (46353), Friday, Aug. 8, 2014.
[19] 79 Fed. Reg. (73007), Tuesday, Dec. 9, 2014.
[20] https://www.epa.gov/fuels-registration-reporting-and-compliance-help/2014-renewable-fuel-standard-data. Oct. 20, 2016.

RVO" calculated in Table 2 estimates the requirement at 11.2 percent for 2015. That gap remains consistent even if exempt gasoline volumes are included, as in Table 5.

EPA delayed establishing 2014 and 2015 RVOs until near the end of 2015. When it did finalize the 2014 RVOs, it set them "based on actual production levels in 2014, possibly suggesting that the 2014 standards we are finalizing are what would have happened in the marketplace absent a rulemaking."[21] Obligated parties blended ethanol into the gasoline supply during 2014 at levels exceeding the assumed 10 percent blending limit ***even without formally set percentage RVOs*** – an outcome that is impossible to reconcile with the theory that the so-called blend wall is a fixed limit that the RFS program cannot overcome except at great cost and lengthy lead times. The 10 percent blending limit was exceeded even when there was a significant pool of non-obligated gasoline volumes produced by small refiners. **It follows that the 10 percent blending level does not present an insurmountable obstacle to U.S. refiners and importers; the so-called blend wall has not created shortages of RINs at any point.**

Implications for Policy

The compliance data made available by EPA refute the assumption that price spikes in spot trading of RINs in 2013 signaled arrival of the so-called blend wall. Aside from the post hoc nature of such an argument, the evidence indicates that the 10 percent blend wall threshold was hit as early as 2010. **Whether looking at the so-called "ethanol RVO" or the number of ethanol RINs used for compliance in any given year, the 10 percent ethanol blending limit was definitively surpassed by 2012.** The requirements for ethanol even potentially eased slightly in 2013, before rising again in 2014. Yet there was no correlated impact on RIN supplies or prices. The so-called blend wall cannot serve as an

[21] 80 Fed. Reg. (77487), Monday, Dec. 14, 2015.

explanation of the 2013 RIN price spikes, since its arrival should have caused RIN shortages and associated price spikes well before then.

The 2013 price spikes in spot market RIN trading remain unexplained. Further research into the actual cause of RIN price spikes is hampered by lack of data on the volumes of RINs traded and actual prices paid for RIN transfers outside the spot market. Publicly available data on RIN volumes traded along with aggregate prices would better inform spot market participants "and may help them to anticipate and avoid market disruptions" or price spikes.[22]

EPA's delays in setting RVOs for 2013, 2014 and 2015 - combined with its changes in the RFS program in the final rule for 2014–2016 - were unwarranted. The agency was incorrect to waive substantial parts of the 2014-2016 statutorily established volume obligations. Moreover, **the agency cannot effectively maintain a "bank" of carryover RINs**, since availability of carryover RINs is impacted by other compliance options available to obligated parties – such as deficit carryforwards – and annually increasing renewable fuel requirements. The FAPRI researchers were careful to point out in their seminal paper that "changing RIN stocks or the volumes of various mandate components might only delay, not prevent the blend wall." Finally, the changes to the rules cannot ease refiners past the blend wall, since they surpassed that imagined limit years ago. The changes also cannot ease RIN prices, since the price spikes remain unexplained.

More recently, a group of merchant refiners petitioned EPA to once again exempt them from the RFS program by changing the definition of "obligated party."[23] The petition rests on the demonstrably incorrect assumption that the 2013 RIN price spike was caused by arrival of the blend wall. In November 2016, the agency proposed to deny this petition and opened a public comment period.[24] The agency

[22] 75 Fed. Reg. (14708), Friday, March 26, 2010.
[23] *Oversight of the Renewable Fuel Standard, Hearing before the Sen. Comm. On Env't and Public Works*, 114th Cong. 10 (Feb. 24, 2016). Written Testimony of Ronald E. Minsk. http://www.epw.senate.gov/public/_cache/files/a4545f2f-52df-4f3f-8a08-e5802950d8e5/rem-rfs-written-testimony.pdf. Also, Minsk, R.E., Letter to Janet McCabe, Acting Assistant Administrator for Air and Radiation, EPA, July 24, 2015.
[24] 81 Fed. Reg. (83776), Tuesday, Nov. 22, 2016.

would be correct to deny the petition, based on the evidence that the blend wall is neither an insurmountable problem nor the cause of RIN shortages or price spikes.

In November 2016, EPA finalized Renewable Fuel Standards for 2017 and biomass-based diesel volume for 2018. The agency abandoned its legally flawed reliance on general waiver authority as a basis for departing from statutory RVOs, appearing to put the program back on track. As such, EPA has sent a strong signal that it will support the biofuels industry and grow advanced and cellulosic biofuel production. The rule adheres to Congress's intent in enacting the RFS statute and ends several years of instability in the RFS program. The agency should continue to set RVOs that ensure the congressionally set volumes of renewable fuel production and use are achieved.

Appendix

EPA reports annual RIN generation and biofuel production by fuel type in its public data for the Renewable Fuel Standard. The ratio of RINs generated for ethanol to those generated for biomass-based diesel during the 2010- 2013 time period is presented below in Appendix Table A1. Other types of fuel that generate RINs available to satisfy the RFS – such as naphtha or compressed and liquefied natural gas – are not counted since they are not blended into the obligated volumes of gasoline and diesel.

Table A1: Calculation of Ethanol RINs from RINs Generated

	2010	2011	2012	2013	2014	2015
D6 biomass-based diesel RINs	18,779,478	6,258,577	1,118,519	251,525,451	337,143,096	452,583,073
D6 ethanol RINs	6,777,308,371	13,609,057,120	12,986,723,082	13,098,970,936	14,021,921,395	14,378,038,529
Ratio of ethanol	99.7	100	100	98.1	97.7	96.9
D5 biomass-based diesel RINs	24,568,615	33,385,319	20,728,997	70,172,481	14,742,412	9,312,772
D5 ethanol RINs	4,043,017	193,748,805	603,461,683	458,250,657	90,298,203	113,785,284
Ratio of ethanol	14.1	85.3	96.7	86.7	86.0	92.4

The aggregate use of carryover RINs beyond the 20 percent cap in 2012 is clearly demonstrated in the data posted by EPA for obligated refiners, recreated in Table A2 below. Obligated refiners used more than 3.378 billion 2011 vintage RINs out of a total 15.139 billion RINs retired to meet their overall 2012 RVO, equal to 22.3 percent. The final column in the table presents a sum of all carryover RINs retired by obligated refiners to meet the annual RVO above a sum of all RINs (both current year and carryover) retired. While there is a 20 percent cap on use of rollover RINs, the cap applies to individual obligated parties. The data here represents an aggregate use of RINs. There is no indication from EPA that any individual refiner violated the cap.

Table A2: RINs Used for Compliance by Obligated Refiners, Including Carryover RINs, 2010-2015

	RIN Year	D4 RINs	D5 RINs	D6 RINs	Total Carryover and RINs retired to meet overall RVO
2010 Compliance Year[1]		N/A	N/A	N/A	
	2010	166,232,179	23,720,991	3,441,123,591	3,631,076,761
2011 Compliance Year[1]	**2010**	49,966,029	2,669,842	1,920,351,778	1,972,987,649
	2011	1,027,143,577	152,386,595	7,769,788,969	10,922,306,790
2012 Compliance Year	**2011**	268,961,057	49,103,786	3,060,020,326	3,378,085,169
	2012	1,254,882,608	415,495,440	10,090,718,261	15,139,181,478
2013 Compliance Year	**2012**	244,478,487	156,284,147	2,040,007,535	2,440,770,169
	2013	1,939,160,352	485,169,551	11,476,873,108	16,341,973,180
2014 Compliance Year	**2013**	479,063,252	41,608,028	1,041,444,423	1,562,115,703
	2014	2,033,114,324	84,336,799	11,953,210,826	15,632,777,652
2015 Compliance Year	**2014**	373,366,345	53,966,409	1,284,546,979	1,711,879,733
	2015	2,286,481,195	44,854,280	12,673,720,820	16,716,936,028