Food and Agricultural
Policy Research Institute
FAPRI
University of Missouri

December 2012

A Question Worth Billions: Why Isn't the Conventional RIN Price Higher?

FAPRI-MU Report #12-12

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Published by the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri (MU), 101 Park DeVille Drive, Suite E; Columbia, MO 65203. FAPRI–MU is part of the College of Agriculture, Food and Natural Resources (CAFNR).

http://www.fapri.missouri.edu

This material is based upon work supported by the U.S. Department of Agriculture, under Agreement No. 58-0111-9-002, and the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2008-38420-18747.

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The Renewable Fuel Standard (RFS) sets minimum domestic use mandates for different biofuels. Renewable Identification Numbers (RINs) are certificates fuel blenders use to prove mandate compliance. Fuel blenders can buy or sell RINs. The conventional RIN price indicates how difficult it is for fuel blenders to meet the overall mandate. U.S. biofuel use mandates grow in the future, likely leading to more ethanol use.

The blend wall is expected to constrain further expansion of domestic ethanol use. Expanding ethanol use in the future could require more E15 and E85 sales. More E15 or E85 could require costly infrastructure development and the prices of these fuels might have to be discounted to coax consumers to buy them. Based on this understanding of the fuel market, pushing more ethanol through the system would be increasingly difficult for fuel blenders, meaning that conventional RIN prices could rise in the future.

If the mandates will become more difficult to meet as they force ethanol use to exceed the blend wall, then RIN prices could rise in the future. RINs can be stored, up to a point, so current RINs might reflect expectations about future RIN prices. However, the price of conventional RINs generated in 2012 is less than $0.05 per gallon – 1-2% of the current wholesale price of ethanol – as of November 2012.

What do RIN buyers and sellers know or take into account that simply comparing future mandates and the blend wall does not? What expectations about market conditions or policy explain the current conventional RIN price?

Here, we use accounting relationships to assess whether using ethanol within the blend wall and depleting existing RIN stocks could provide fuel blenders with enough RINs to comply with the mandate in each year to 2015. Considering only the accounting to balance mandate compliance with a combination of RIN stocks and RIN generation, not economics or price effects, ethanol use must expand beyond the blend wall by 2015 under a variety of assumptions considered here.

There are reasons why the conventional RIN price would remain low despite the looming blend wall.

1. The blend wall could be less of a constraint than expected if ethanol expansion is easy, drop-in biofuels become commercially viable, or more biofuel is used other than as in motor fuels.
2. RIN stocks in the future are expected to exceed the maximum permitted amount, although 2012 market data about biofuel disposition cast some doubt on this explanation in the short run.
3. RIN buyers and sellers could expect that the EPA would waive the broad mandates in the future in the event that the associated RIN prices rise sharply, but this question goes well beyond our analysis.

Many other possible outcomes suggest a higher conventional RIN price in the future. For example, this expectation could persist despite various assumptions about biodiesel use, cellulosic biofuel production, or RIN stock rules. The elements of the mandate met so far using ethanol are set by the RFS to rise to a level that exceeds the blend wall before 2015 means that changing RIN stocks or the volumes of various mandate components might only delay, not prevent the blend wall.

The price of conventional RINs generated in 2012 is less than $0.05, as of November 2012. Unless RIN stocks are expected to reach the maximum permitted level again, it is possible for fuel blenders to buy RINs now at today's price with a view to roll them forward to a time when the RINs have more value. *Under certain conditions, future conventional RIN prices will be higher and those higher prices will affect current conventional RIN prices.*

If expectations of future RIN prices cause higher RIN prices for all 13.2 b.g. of conventional RINs required for compliance in 2012, then the mandate compliance cost increase would amount to billions of dollars.

Introduction

Recent FAPRI-MU baselines project high conventional RIN prices under certain assumptions, including about the nature of the blend wall and EPA waiver decisions in the future. Current market data – specifically conventional RIN prices – indicate that RIN buyers and sellers have different assumptions. Here, Renewable Identification Number (RIN) markets are calculated on a calendar year basis and linked to ethanol use in order to consider how growing mandates, available RIN stocks, and the ethanol blend wall might interact in the medium-term future. The goal is to see if RIN stocks help to reconcile the price of conventional RINs generated in 2012, $0.03-0.04 as of mid-November 2012, with expectations that rapid expansion at the blend wall could lead to higher ethanol-related RIN prices.

The starting assumptions include binding mandates in each year and maximum permitted RIN stocks at the start 2012. The blend wall is approximated as 10% of domestic motor fuel use. Assumptions about motor fuel use and cellulosic biofuel are also critically important.

These calculations do not replace economic analysis. Prices of RINs and ethanol shift to balance these markets, but are not included explicitly in this assessment. This note supplements other FAPRI-MU analysis based on economic models of RIN and biofuel markets, as well as feedstock markets, that take into account price signals and policies. An accounting exercise is a tool to add up RINs and match them to ethanol use, but omits important features of RIN, biofuel, and agricultural markets.

The first scenario shows that the using the RIN stocks on hand at start 2012 to hold ethanol use to no more than 10% of motor fuel can work for only another year or so. *Assuming that the growing mandates are strictly binding, ethanol use must eventually rise to generate RINs. RIN stocks can delay growth in ethanol use until 2014, in this scenario, but then ethanol use rises above 10% of fuel very quickly to keep up with the mandates when RIN stocks are depleted.*

The second scenario emphasizes the part RIN stocks play. *Without the RIN stocks available at start 2012, ethanol use would have to exceed 10% even sooner, according to these assumptions.* This scenario converges to the first scenario (ignoring price effects) because scenario 1 requires biofuel use to generate RINs for compliance once stored RINs are used up, just like scenario two.

The third scenario illustrates the implications if the blend wall shifts outward over time (from 10% in 2012 to 13% in 2015 representing increased E15 or E85 use). *The combination of expanding blend wall and availability of RIN stocks at the start of 2012 appear consistent with rising mandates at least until 2015. However, this begs the question of the necessary price signals – including RIN prices – to cause an expansion in ethanol use.*

Reconciling growing mandates, RIN stock-holding, and the blend wall are an important question. FAPRI-MU baselines projected in the past that the conventional RIN prices could rise to the $0.30-0.60 per gallon range, depending on other conditions, if ethanol use is required by the mandate to push through the blend wall, although there is great uncertainty about how low ethanol must be priced relative to gasoline and for how long to it must be at such prices in order to bring about more E15 or E85 use. Suppose that markets expect that there is equal probability of this range of prices as there is of almost a zero price because it proves easy to expand the blend wall or the mandate is waived. With these possibilities, and discounting, the expected value of a conventional RIN to roll forward for future years is about $0.20, as compared to $0.03-0.04 today for 2012 vintage RINs. Multiplying a difference of $0.15 times the 13.2 b.g. conventional RINs likely to be used for compliance this year equals about $2 billion dollars. Differences in expectations about the difficulty of passing through the looming blend wall or the probability of a waiver have implications for the market value of RINs measured in billions of dollars.

Method

The calculations are used to consider how calendar year RIN markets could balance within the limits of a blend wall through 2015. The blend wall is fixed at 10% of total fuel. This number represents the amount of ethanol sold if all fuel is E10. Using 10% overstates the actual potential of E10, but it excludes the potential for E15 and E85 expansion, as well as renewable biofuels used for purposes other than motor fuel. Significant expansion beyond 10% is expected to require discounting the prices of fuels with more ethanol, like E15 and E85, and developing the infrastructure to deliver these fuels to consumers.

Summarizing, the method for calculating the RIN market numbers and ethanol use in 2012-15 are:

1. Assume binding EISA mandates. Assume cellulosic ethanol production below the mandated level and assume this one mandate is waived, but leave all other mandates unchanged.
2. Choose some amount of rollover stock change in each year. Starting from EPA's EMTS data and the implementing regulations, we estimate that about 3 billion RIN-gallons of overall RIN stocks are available at start 2012. We choose the amount of stock released in each year in order to keep total ethanol use in the limits of E10 - less than or equal to 10% of use – for as long as possible.
3. EISA mandated volumes minus the chosen stock change equals the amount of RINs that must be generated in each year. RIN generation for the advanced gap is calculated as the advanced mandate less assumed cellulosic biofuel production and biodiesel mandate. RIN generation for the conventional gap is calculated as the overall mandate less the advanced mandate.
4. Domestic ethanol use is determined from the necessary RIN generation. Conventional use equals RINs generated for the conventional gap. Advanced ethanol use equals RINs generated for the advanced gap. Cellulosic ethanol use equals assumed production. The sum of conventional, advanced, and cellulosic ethanol equals total ethanol use.
5. The share of ethanol in motor fuel equals total ethanol use divided by assumed motor fuel use.

More on data sources and assumptions

Mandate volumes for the overall, advanced, and biodiesel mandates are from the Energy Independence and Security Act (EISA). The biodiesel mandate is converted to RIN-gallons using a 1.5 equivalence value. The cellulosic biofuel mandate is assumed to be waived, and equal to assumed cellulosic ethanol production that rises to 0.15 b.g. in 2015. The conventional gap is calculated as the difference between the overall RFS and the advanced mandate. The advanced gap is calculated as the advanced mandate less cellulosic and biodiesel sub-mandates.

RINs used for compliance in 2011 are calculated from historical data. The amount of RINs retired in the EPA's EMTS are understood to include exported RINs. So the amount used for compliance is estimated as the amount retired less the exports of the associated biofuel. EIA data are used for 2011 biofuel exports. We assume that only conventional ethanol is exported, not advanced. We assume that all biodiesel exports would normally meet the biodiesel mandate, although there is a small number of conventional biodiesel RINs reported in the EMTS data. RINs used for compliance from 2012 on are derived from mandates and rollover assumptions, as described in the section on method.

RIN generation, less exports, in 2011 is also intended to adjust EMTS RIN data to calculate domestically available volumes. The same assumptions are required to associate biofuel exports and RINs as in the calculations of RINs used for compliance.

RIN stocks at end 2011 are calculated as the difference between the amount used for compliance and the amount generated, excluding exports. As we understand the EMTS reporting methods, the 2011 data

reflect the disposition of 2011 vintage RINs, not RIN activity in the calendar year of 2011. By making this calculation using EMTS data of middle October 2012, between 2011 and 2012 reporting dates, we believe that this calculation reflects the number of 2011 RINs generated for domestic use that were not used for 2011 compliance. Because 2011 RINs can only be used in 2011 or 2012, these RINs will be used for 2012 compliance or expire. This number exceeds the rollover limit, which is 20% of the 2012 overall mandate or 3.04 b.g. (20% of 15.2 b.g.), so we expect some of the conventional RINs will expire unused. This expectation is supported by the very low price of 2011 conventional RINs, which are less than $0.01 at the time of writing. The number of conventional RIN rollover shown here is less than the number of 2011 RINs that appear to remain available, according to EMTS data.

RIN stock changes in 2012-15 are chosen to keep ethanol use at no more than 10% of the total motor fuel use for as long as stocks are available. RIN stock changes are distributed proportionally by type, although biodiesel mandate and use would presumably drive biodiesel stocks. Assuming binding mandates, RIN generation for domestic use equals RINs used for mandate compliance minus the change in RIN stocks.

Total ethanol use in 2011 is the sum of the components. Cellulosic ethanol production is from EMTS data. Advanced ethanol use is the sum of domestically produced advanced ethanol taken from EMTS RIN generation data and ethanol imports from EIA data. Conventional ethanol domestic use is the difference between EIA ethanol production, calculated as total ethanol production less advanced and cellulosic ethanol, and ethanol exports. In 2012-15, domestic use of ethanol by type is determined by RIN generation for domestic use. Ethanol stocks are ignored.

Motor fuel use is assumed to be 133.5 b.g. in 2012 and 134 b.g. in 2013, based in part on the EIA short-term outlook (table 4a) of November 6, 2012, and to grow by 1 b.g. in each of the two subsequent years.

All RIN price data given in the text are from Oil Price Information Service (OPIS).

Biofuel exports and production

Biofuel exports and production are ignored in the accounting exercises for 2012-15. While they important for determining price effects and agricultural commodity market impacts, they are believed to be irrelevant to these RIN accounting relationships and domestic ethanol use. Biofuel exports are not blended for domestic use, and the RINs associated with exported biofuels are already removed from these data because they cannot be used for mandate compliance.

We expect that conventional ethanol exports are influenced by imports of advanced ethanol. However, a policy or market response that reduces conventional ethanol exports might have no effect on domestic ethanol use if the mandates are binding.

Caveats

This accounting exercise is not complete economic analysis. Changes in RIN and ethanol prices cause these markets to balance, but the key mechanism is ignored here. For example, FAPRI-MU analysis has simulated various options for handling cellulosic biofuel waivers, as this part of the mandate becomes larger, and found that price impacts play an important role (FAPRI-MU #04-12).

A change in assumptions can change the results. Binding mandates, EPA cellulosic waiver options, EPA decisions about the biodiesel mandate, and motor fuel use are all critically important assumptions. The nature of the blend wall is better characterized as an inelastic segment of ethanol demand in economic analysis rather than a fixed share that is somehow targeted via RIN stock changes.

Scenario 1: Base case, with rollover RIN stocks depleted to postpone blend wall.

As noted in the section about method, these calculations assume that mandates are binding. An amount of cellulosic ethanol is assumed to be produced each year. The cellulosic biofuel mandate is assumed to be waived down to this amount, without any reduction in broader mandates. Mandates determine RINs used for compliance.

For example, if mandates are assumed to be binding in 2012, then overall RFS compliance requires 15.2 b.g. RINs, advanced mandate compliance requires 2.0 b.g., and the biodiesel mandate requires 1.5 b.g. in ethanol equivalent (equal to 1 b.g. of biodiesel times 1.5 equivalence value). Cellulosic RIN generation equals cellulosic ethanol production, which is assumed to be 0.01 b.g. in 2012.

Rollover RIN stocks are reduced at whatever pace is required to keep ethanol use no greater than the blend wall, defined here as 10% of motor fuel, for as long as possible. Total rollover stock releases in 2012-15 cannot exceed 3 b.g., which is the amount of usable rollover stocks at start 2012. There is no scope to add to RIN stocks in this period because all generated RINs are used for compliance in each year.

For example, in 2012, RIN stocks are reduced by 0.4 b.g. Total RINs generated for domestic use, 14.8 b.g., equals the amount required for mandate compliance, 15.2 b.g., less the chosen change in RIN stocks. RIN stock changes are allocated by type proportionately, although rates of change would vary in reality. RINs generated equals compliance requirement less RIN stock change for each biofuel, as well as for gaps.

In 2012, the total amount of RINs generated, excluding exports, associated with ethanol includes 12.84 b.g. conventional RINs (excluding an assumed small amount of conventional RINs from biodiesel), 0.48 b.g. other advanced RINs, and 0.01 b.g. of cellulosic ethanol. All these RINs are generated from domestic use of ethanol, so each of these numbers are repeated under ethanol use. Total ethanol use is 10% of the assumed 133.5 b.g. of total motor fuel use in 2012, so it does not breach the assumed blend wall target.

RIN stocks are reduced by 1.35 b.g. in 2013. The greater stock reduction is necessary because the mandates are rising, with the overall mandate set by law at 16.55 b.g. Total motor fuel is assumed to rise by only 0.5 b.g. so ethanol use can only rise only slightly within the supposed 10% blend wall limit.

RIN stocks are depleted during 2014. The overall mandate is 18.15 b.g. in this year, 20% greater than the 2012 mandate. Remaining RIN stocks are released to limit ethanol blending, but more RINs are required to meet the mandate. Ethanol use rises to over 11% of total use as mandates require additional RIN generation from domestic ethanol use.

Without any RIN stocks to draw down, ethanol use in 2015 rises to 13.7%. RIN compliance requirements from this point are set by the mandates, with the overall mandate at 20.50 b.g. Much of this requirement must be met through RIN generated in this year under the assumptions of this exercise. Ethanol use in 2015 is over one-fifth higher than in 2014 in order to meet the mandate in the absence of any RIN stocks.

Motor fuel use is assumed to rise 1.4% from 2011 to 2015, despite an initial reduction in 2012, based in part on EIA projections. Rising motor fuel use is a reversal of the moderation after a pre-recession peak in 2007. If motor fuel use continued to decline or remained flat, then the blend wall would be lower and RIN stock depletion would occur more rapidly in these accounting balances.

Table 1. Base case, with rollover RIN stocks depleted to postpone blend wall.

	Actual	Scenario			
	2011	2012	2013	2014	2015
	(billion RIN-gallons)				
Mandates, cellulosic waived					
Overall	13.95	15.20	16.55	18.15	20.50
Advanced	1.35	2.00	2.75	3.75	5.50
Biodiesel	1.20	1.50	1.92	1.92	1.92
Cellulosic	0.00	0.01	0.04	0.08	0.15
Conventional gap	12.60	13.20	13.80	14.40	15.00
Advanced gap	0.15	0.49	0.79	1.76	3.43
RIN markets					
Used for compliance	10.43	15.20	16.55	18.15	20.50
Conventional	8.90	13.20	13.80	14.40	15.00
Advanced	1.52	2.00	2.75	3.75	5.50
Cellulosic	0.00	0.01	0.04	0.08	0.15
Biodiesel	1.35	1.50	1.92	1.92	1.92
Other advanced	0.17	0.49	0.79	1.76	3.43
Generation, less exports	14.26	14.80	15.20	16.86	20.50
Conventional	12.39	12.85	12.60	13.26	15.00
of which, ethanol	12.39	12.84	12.60	13.25	15.00
Advanced	1.87	1.95	2.60	3.60	5.50
Cellulosic	0.00	0.01	0.04	0.08	0.15
Biodiesel	1.65	1.46	1.79	1.80	1.92
Other advanced	0.22	0.48	0.77	1.73	3.43
Change in stocks		-0.40	-1.35	-1.29	0.00
Conventional		-0.35	-1.20	-1.14	0.00
Advanced		-0.05	-0.15	-0.15	0.00
Cellulosic		0.00	0.00	0.00	0.00
Biodiesel		-0.04	-0.13	-0.12	0.00
Other advanced		-0.01	-0.02	-0.02	0.00
Eligible ending stocks	3.04	2.64	1.29	0.00	0.00
Conventional	2.69	2.34	1.14	0.00	0.00
Advanced	0.35	0.30	0.15	0.00	0.00
Cellulosic	0.00	0.00	0.00	0.00	0.00
Biodiesel	0.29	0.25	0.12	0.00	0.00
Other advanced	0.06	0.05	0.02	0.00	0.00
Ethanol use		(billion gallons)			
Use	12.88	13.34	13.41	15.06	18.58
Conventional	12.70	12.84	12.60	13.25	15.00
Other advanced	0.19	0.48	0.77	1.73	3.43
Cellulosic	0.00	0.01	0.04	0.08	0.15
Ethanol use/ fuel (volume)	9.6%	10.0%	10.0%	11.2%	13.7%

Scenario 2: No rollover RIN stock reductions.

The only difference between this scenario to illustrate the importance of RIN stocks and the base case, Scenario 1, is that RIN stock reductions are assumed to be zero; all changes in RIN stocks after 2011 are set to zero in this scenario. Without using stored RINs, all RINs used for compliance in each year must be generated from domestic biofuel use in the same year.

In 2012, for example, 15.20 b.g. RINs must be generated for compliance. Assuming all mandates are binding, 13.20 b.g. of conventional ethanol, 0.50 b.g. of advanced ethanol, and a small amount of cellulosic ethanol are used for compliance in this scenario. The total use is 13.70 b.g. of ethanol, or 10.3% of total motor fuel.

Ethanol use must rise with the mandates in this scenario. In 2013, ethanol use amounts to 10.9% of motor fuel and in 2014 it is 12.0%.

The share of ethanol in total use is the same in this case as in the base case. In the base case, RIN stocks were depleted during 2014, so they have no effect on 2015. Of course, these accounting relationships do not take into account price effects.

Comparing this scenario to the base case illustrates the importance of RIN stocks in the assessment of how the mandates can interact with ethanol markets as regards the timing of the blend wall. If the existing RIN stocks are at the maximum permitted amount, as implied by EPA EMTS data, then gradually drawing them down in coming years can keep ethanol use below the 10% mark. If the RIN stocks prove to be smaller, if they are drawn down more quickly, or if the blend wall is lower, then the delay before hitting the blend wall could be shorter than indicated in the base case.

Table 2. No rollover RIN stock reductions.

	Actual	Scenario			
	2011	2012	2013	2014	2015
	(billion RIN-gallons)				
Mandates, cellulosic waived					
Overall	13.95	15.20	16.55	18.15	20.50
Advanced	1.35	2.00	2.75	3.75	5.50
Biodiesel	1.20	1.50	1.92	1.92	1.92
Cellulosic	0.00	0.01	0.04	0.08	0.15
Conventional gap	12.60	13.20	13.80	14.40	15.00
Advanced gap	0.15	0.49	0.79	1.76	3.43
RIN markets					
Used for compliance	10.43	15.20	16.55	18.15	20.50
Conventional	8.90	13.20	13.80	14.40	15.00
Advanced	1.52	2.00	2.75	3.75	5.50
Cellulosic	0.00	0.01	0.04	0.08	0.15
Biodiesel	1.35	1.50	1.92	1.92	1.92
Other advanced	0.17	0.49	0.79	1.76	3.43
Generation, less exports	14.26	15.20	16.55	18.15	20.50
Conventional	12.39	13.20	13.80	14.40	15.00
of which, ethanol	12.39	13.20	13.80	14.40	15.00
Advanced	1.87	2.00	2.75	3.75	5.50
Cellulosic	0.00	0.01	0.04	0.08	0.15
Biodiesel	1.65	1.50	1.92	1.92	1.92
Other advanced	0.22	0.49	0.79	1.76	3.43
Change in stocks		0	0	0	0
Conventional		0	0	0	0
Advanced		0	0	0	0
Cellulosic		0	0	0	0
Biodiesel		0	0	0	0
Other advanced		0	0	0	0
Eligible ending stocks					
Conventional					
Advanced	*All RIN stocks assumed to be zero in this scenario.*				
Cellulosic					
Biodiesel					
Other advanced					
Ethanol use	(billion gallons)				
Use	12.88	13.70	14.63	16.23	18.58
Conventional	12.70	13.20	13.80	14.40	15.00
Other advanced	0.19	0.49	0.79	1.76	3.43
Cellulosic	0.00	0.01	0.04	0.08	0.15
Ethanol use/ fuel (volume)	9.6%	10.3%	10.9%	12.0%	13.7%

Scenario 3: A gradually expanding blend wall.

The only difference between this scenario and the base case, Scenario 1, is that the blend wall is assumed to be 1% greater each year. The target share of ethanol in total motor fuel is 11% in 2013, 12% in 2014, and 13% in 2015. This scenario attempts to demonstrate how expanding E15 or E85 use could affect the calculations.

For example, suppose E15 use expands in this scenario. If only E10 and E15 are used, then 60% of fuel would have to be E15 in 2015 for the share of average ethanol in motor fuel to be 13%. If ethanol expansion occurred in E85 use, and E85 is assumed to average 75% ethanol content, then 5% of total motor fuel use would have to take the form of E85, if the rest is E10. As in previous calculations, there is no adjustment to the total motor fuel use caused by changing ethanol amounts. In reality, a greater share of lower-energy ethanol would imply that consumers are using the same volume of motor fuel but receive less energy, so motor fuel use might tend to rise, in volume terms, if ethanol represents a greater share.

In 2013, the change in RIN stocks is positive in this scenario. The higher blend wall allows more ethanol to be used domestically before hitting the limit. Blending at this limit allows more RINs to be stored against future years of a higher mandate, and blenders are assumed to do so. Again, the price signals necessary to bring this result about are not considered. (The amount of stored RINs is less than the limit: 20% of the 2014 overall mandate equals 3.63 b.g., and accumulated RIN stocks at end 2013 are about 0.90 b.g. below that level in this scenario.)

There is no change in RIN stocks in 2014 in this scenario. Blending ethanol to 12% of motor fuel use results in a total ethanol use that approximately equals the mandate.

RIN stocks start to be released in 2015. The reduction of 1.00 b.g. holds ethanol use to 13% of total motor fuel use. We do not speculate about how these accounting relationships might evolve after 2015. For this scenario, and the preceding scenarios as well, a key question would be the assumption about cellulosic biofuel production and EPA waiver decisions in the event that cellulosic biofuel production is below the EISA mandate.

This expansion in ethanol use is simply assumed to occur. There are no prices in these accounting relationships, and no way to guess the infrastructure costs or the consumer prices that explain this expansion. To the extent that it is costly to develop infrastructure or to discount fuels with more ethanol in order to increase ethanol use each year, we would expect the RIN prices related to domestic ethanol use to rise. In other words, this scenario represents an ethanol use expansion path beyond 10% of fuel use that would be gradual, as compared to the sudden increases implied in the base case, but it does not mean that this more gradual path is necessarily easy or low cost.

Table 3. A gradually expanding blend wall.

	Actual	Scenario			
	2011	2012	2013	2014	2015
	(billion RIN-gallons)				
Mandates, cellulosic waived					
Overall	13.95	15.20	16.55	18.15	20.50
Advanced	1.35	2.00	2.75	3.75	5.50
Biodiesel	1.20	1.50	1.92	1.92	1.92
Cellulosic	0.00	0.01	0.04	0.08	0.15
Conventional gap	12.60	13.20	13.80	14.40	15.00
Advanced gap	0.15	0.49	0.79	1.76	3.43
RIN markets					
Used for compliance	10.43	15.20	16.55	18.15	20.50
Conventional	8.90	13.20	13.80	14.40	15.00
Advanced	1.52	2.00	2.75	3.75	5.50
Cellulosic	0.00	0.01	0.04	0.08	0.15
Biodiesel	1.35	1.50	1.92	1.92	1.92
Other advanced	0.17	0.49	0.79	1.76	3.43
Generation, less exports	14.26	14.80	16.65	18.15	19.50
Conventional	12.39	12.85	13.89	14.40	14.11
of which, ethanol	12.39	12.84	13.88	14.40	14.11
Advanced	1.87	1.95	2.76	3.75	5.39
Cellulosic	0.00	0.01	0.04	0.08	0.15
Biodiesel	1.65	1.46	1.93	1.92	1.82
Other advanced	0.22	0.48	0.79	1.76	3.41
Change in stocks		-0.40	0.10	0.00	-1.00
Conventional		-0.35	0.09	0.00	-0.89
Advanced		-0.05	0.01	0.00	-0.11
Cellulosic		0.00	0.00	0.00	0.00
Biodiesel		-0.04	0.01	0.00	-0.10
Other advanced		-0.01	0.00	0.00	-0.02
Eligible ending stocks	3.04	2.64	2.74	2.74	1.74
Conventional	2.69	2.34	2.43	2.43	1.54
Advanced	0.35	0.30	0.31	0.31	0.20
Cellulosic	0.00	0.00	0.00	0.00	0.00
Biodiesel	0.29	0.25	0.26	0.26	0.17
Other advanced	0.06	0.05	0.05	0.05	0.03
Ethanol use		(billion gallons)			
Use	12.88	13.34	14.72	16.23	17.67
Conventional	12.70	12.84	13.88	14.40	14.11
Other advanced	0.19	0.48	0.79	1.76	3.41
Cellulosic	0.00	0.01	0.04	0.08	0.15
Ethanol use/ fuel (volume)	9.6%	10.0%	11.0%	12.0%	13.0%

Other assumptions

Forward looking assessment of RIN markets and ethanol use can be based on any number of alternative assumptions. We choose only a few to highlight some key questions, but there is no reason to believe that either the base case or a gradual blend wall expansion is more likely than certain other assumptions. More to the point, buyers and sellers of RINs presumably base price expectations on assumptions that lead them to conclude that the going conventional RIN price is appropriate.

RIN stock rule changes might not matter if the blend wall is already almost binding. For example, if there were no drought that reduced 2012/13 corn production, domestic ethanol use might still be constrained by the blend wall. In that case, although ethanol production could be higher, domestic ethanol use in 2012 and 2013 might not be much greater than currently expected over this period if the blend wall represented a serious obstacle to expansion. The RIN stocks would presumably not be drawn down as quickly as in the base case presented above, but eventually ethanol use would have to rise above the blend wall if the mandates were met with 15 b.g. of conventional ethanol plus billions of gallons of advanced and cellulosic ethanol by 2015.

Deficits might affect the timing, but only within certain limits. A blender can attempt to declare itself in deficit relative to its obligated volumes of biofuels. However, even if successful in one year, then the blender in deficit must make good its full mandate requirement plus the shortfall during the next year. We are under the impression that the obstacles to declaring deficit might prevent blenders using this option to postpone their blend wall constraints on an individual basis and, in any case, it seems that deficit provisions cannot be used to avoid complying with the mandate for long.

Cellulosic biofuel production is uncertain, but alternative assumptions might not delay the blend wall. The level of cellulosic ethanol production assumed in these calculations will almost certainly prove to be wrong. For example, biofuel production technology could expand quickly, leading to much greater production than assumed here. If the alternative assumption is that there will be more cellulosic ethanol, however, then the story would not change. The reason is because of the hierarchy of mandates and assumptions about implementation. In these calculations, the broader mandates are not changed even though the cellulosic production is low and the EPA is assumed to reduce this sub-mandate. The hierarchy of the mandates can require that any shortfall in cellulosic biofuel is made up by an increase in other advanced biofuels, as assumed here, consistent with recent EPA decisions. With the broader mandates unwaived as in the recent past, a higher or lower level of cellulosic ethanol production can be assumed and the changes are offset by changes in advanced ethanol use.

If the alternative assumption is that there is more cellulosic biofuel, but it is biodiesel, then the growth in ethanol imports could be slower and the blend wall might be pushed back. The greater cellulosic biodiesel production would displace advanced ethanol as far as mandate compliance is concerned, under the assumed method of cellulosic mandate waiver. More cellulosic biodiesel can lead to less advanced ethanol, delaying the blend wall. We do not know the likelihood of this outcome and the price of cellulosic biodiesel RINs of this case.

Alternative assumptions about the cellulosic biofuel waiver implementation could change ethanol use, but was already shown to introduce important price impacts. Previous economic analysis (FAPRI-MU report #04-12) estimates the market impacts of alternative EPA options for treating other mandates in the event that the cellulosic mandate continues to be waived.

The blend wall could be delayed if biodiesel use exceeds the assumed 1.28 b.g. (1.92 b.g. ethanol equivalent), but perhaps at a high cost given the relative RIN prices. Because biodiesel is a sub-mandate of the advanced and overall mandates, more biodiesel can displace ethanol in meeting these mandates. Suppose biodiesel use increased, either because the EPA raises the mandate or due to market forces, to 1.5 b.g. in 2013, 2.4 b.g. in 2014, and 4.0 b.g. in 2015. Put in ethanol terms for RIN generation, this growth path would result in 6 b.g. of RINs from biodiesel use in 2015. However, such a biodiesel expansion, to the point that biodiesel displaces corn starch ethanol, would still have to be supplemented with RIN stock depletion in order to delay the blend wall until 2015, if no other assumption is changed.

This hypothetical increase to roughly four times 2012 biodiesel use in 2015, combined with the depletion of the 3 b.g. RIN stocks on hand at start 2012, could push the blend wall back to 2015, based on the accounting relationships alone. The biodiesel RIN price is currently over $0.50 per gallon – and has been much higher in the past – as compared to less than $0.05 for a 2012 vintage conventional RIN at the time of writing, so this alternative could be associated with high costs. Arguments that biodiesel displaces enough ethanol to prevent the blend wall could imply that the conventional RIN price rises to the level of the biodiesel RIN price in the future, potentially representing an increase in conventional RIN price by a factor of ten or more.

The price effects of such a change in biodiesel use could be important. Previous economic analysis has also studied some options open to the EPA as regards the biodiesel mandate (FAPRI-MU report #04-12).

Comparison to the EPA waiver decision of November 2012

The EPA ruled not to waive broader mandates in response to the drought of 2012. As of mid-November, 2012, preliminary text of the ruling is available.

The accounting balances represented here are intended to assess how RIN stocks, growing mandates, and the blend wall interact on a calendar year basis. The only direct comparisons between this assessment and the EPA ruling relates to the treatment of RIN stocks going forward.

These accounting balances, like previous FAPRI-MU reports, highlight the importance of rollover stocks. Whereas the EPA's recent decision to decline to waive the mandates partly rests on the availability of RINs at start 2012, RIN stocks going forward also matter. For example, FAPRI-MU models estimated that the largest market impacts of a 2012/13 mandate waiver in analysis using these models was delayed until 2013/14 (FAPRI-MU Report #11-12). The reason was that the waiver allowed maximum RIN rollover stocks at end 2012/13, and these stocks helped to meet the growing, more binding mandate that pushed ethanol use into the blend wall after the waiver. In its assessment of a 2012/13 waiver, EPA judges that there is a low probability that mandates will be binding in the marketing year. It is not clear how the desire to hold RIN stocks at the end of the year fit into this assessment. If analysis assumes that all RINs available at the start of the year are available to be used for compliance in 2012/13, then it makes sense also to include the demand for RINs to carry forward into future years. Demand for RINs to carry forward might lead blenders to use more ethanol strictly required in 2012/13 based on the mandate less initial RIN stocks.

By way of comparison, suppose that the numbers of the first scenario presented earlier were changed so that all RIN stocks were sold in 2012. Using simple accounting balances, that would imply that much less ethanol is needed in 2012, but ethanol use would have to be higher in 2013 and 2014 to meet the mandates in those years. This pattern results in a quicker expansion in ethanol use in 2013 and 2014, making the mandate more binding in those years relative to the base case of scenario 1. Using all RINs in 2012 might

not be realistic if blenders foresee a more difficult mandate and consequently pay more for 2012 RINs in order to help to meet the more binding future mandates when RINs are expected to have a higher value.

That said, this analysis is motivated by the difference in expectations about the future blend wall and, in particular, the difficulty of reconciling the potential for much higher conventional RIN prices in the future with RIN prices of mid-November 2012. The low current conventional RIN price was noted by the EPA and FAPRI-MU in other work as a critically important fact demonstrating that the overall mandate is not extremely difficult to meet at present, and is not expected to become extremely difficult to meet.

Two recent FAPRI-MU reports provide economic estimates of market impacts of different EPA waiver options. FAPRI-MU Report #11-12 analyses of 2012/13 waiver options in response to the drought. FAPRI-MU Report #04-12 focuses on cellulosic mandate waiver options available to the EPA.

Implications

The calculations are used to consider how calendar year RIN markets could balance within the limits of a blend wall in the medium term. Results suggest that it is not possible to use stored RINs to reduce blending below 10% of motor fuel use through 2014, let alone 2015, if mandates are binding, ethanol is used to meet conventional and advanced gaps, and motor fuel use rises slowly. In contrast, if the blend wall is assumed to expand steadily, then it is possible for the combination of growing ethanol use at the blend wall and RIN stock management to meet the mandate to 2015.

There are several possible outcomes.

1. RIN prices rise when ethanol use must grow to meet the mandate, but ethanol expansion must pass through the blend wall. This is the assumed case of recent FAPRI-MU baseline reports, in which the conventional RIN price rises to $0.30-0.60 per gallon, or more, depending on other assumptions such as how low E15 or E85 prices must go and for how long they must stay low to encourage consumer adoption, as well as the infrastructure costs to distribute these fuels.

This possible outcome might not be supported by current market data. If RIN buyers and sellers expected that an increase in price of this order of magnitude were probable, then the conventional RIN price could be higher. Suppose the conventional RIN price is expected to rise to $0.45 in 2014. Then a trader would be willing to pay $0.45 less interest expense for a 2013 conventional RIN that can be rolled over or sold in 2014. If 2013 RIN prices are driven by this expectation, then 2012 RIN stock decisions will reflect expected 2013 prices. The implication is that the 2012 conventional RIN price might equal the discounted expected $0.45 price of 2014.

The sequence of RIN storage decisions depends on a first-in-first-out strategy for stock decisions so that stored RINs do not expire unused (within the rollover limit). RINs generated last year are all used first, and current vintage RINs are stored as rollover for the next year.

The exception is if rollover RINs at end 2012 exceed the rollover limit. If traders expect 2012 RIN rollover to exceed 20% of the next year's mandate, then extra RINs beyond that point will expire. The traders would have exhausted all possibility to store RINs for the future while leaving extra RINs on the table, in this case. The value of a RIN, net transaction costs, is set by the marginal use, so the RIN price would be low in this case even though traders covet every RIN within that 20% limit. For this exception to hold, overall RIN stocks would increase from 3.04 b.g. at start 2012 to 3.31 b.g. (20% of 16.55 b.g.) at end 2012.

This exception requires that RIN stock holding increases in 2012 up to the limit, meaning that RIN generation in 2012 must increase by more than the mandate does. Such an increase in RIN generation would require an increase in biofuel use that would presumably be evident in some combination of greater production, more imports, or less exports. EIA data indicate that January through October 2012 ethanol production is lower by about 3% lower than the same period in 2011, and about 9% lower in July through October. Higher imports and lower exports so far in 2012 as compared to 2011 (also EIA data), however, could lend some support to the ethanol consumption is generating enough RINs so that rollover stocks are at the maximum permitted level. Ethanol stocks might end the year lower, as well. However, the possibility that this exception holds is reduced given that the overall mandate increases by 1.25 b.g. (from 13.95 b.g. in 2011 to 15.2 b.g. in 2012), so that many more RINs will be needed for compliance this year than in 2011.

In any case, if end 2012 RIN stocks are at the maximum permitted, then 2013 RIN prices might sell at a premium to 2012 RINs.

2. The blend wall could be easy to meet, so the conventional RIN price would not rise in the future. If fuels with more ethanol can be distributed easily and consumers will adopt readily these fuels without discounting their prices relative to E10, then the blend wall is no obstacle.

If renewable fuels are increasingly used for other purposes, like heating oil, then motor fuel inclusion rates are less relevant. Qualifying renewable fuels used domestically for heating oil also generate RINs. If ethanol use continues at the limits of E10 inclusion and an increasing amount of biofuel is consumed for heating oil, then the blend wall could be postponed.

"Drop-in" biofuels have been discussed as one way to delay or avoid the blend wall, even though they are not in commercial production at this time. Drop-in biofuels can be used as motor fuel without blending, in theory, so they substitute for gasoline more easily. If RIN prices rise in the future then there will be greater incentive to develop these technologies and they are more likely to be commercially viable. Initially, at least, the blend wall might be avoided with a fairly modest amount of drop-in biofuel that is sufficient to keep ethanol use at or near the limits of E10 use.

3. Biodiesel has been suggested as an alternative. Biodiesel adoption suffers no similar blend wall constraint at 10% of use. However, biodiesel RIN prices as of mid-November 2012 are in the $0.50-0.60 range – more than ten times the conventional RIN price – and have been higher. If biodiesel is used because the conventional RIN price rises to this level, then this outcome might be identical to outcome 1, above. If the biodiesel mandate is expanded to displace other advanced biofuel, such as imported sugar cane ethanol, then previous FAPRI-MU economic analysis suggests that price impacts can play a role.

4. Waivers in the context of the cellulosic mandate waiver or associated with rising compliance costs could also lead to lower ethanol use. The FAPRI-MU baselines have typically assumed some reduction in broader mandates associated with the cellulosic mandate waiver, but RIN market traders could expect larger reductions. Traders might speculate about mandate waivers if the conventional RIN price rises sharply.

RIN buyers and sellers presumably base their expectations at least in part on EPA's reasoning for declining waiver requests in the past. In the draft text describing its decision not to waive the mandates during the drought of 2012, the EPA writes, in part (p 70-72):

> In establishing the RFS program, Congress created a framework to increase the amount of renewable fuel used in the domestic transportation sector over time. It gradually increases from 4.0 billion gallons in 2006 to 36.0 billion gallons in 2022. Congress charged EPA with

> implementation of the program, and directed the Agency to assign the obligation to use renewable fuels to "refineries, blenders, distributors and importers as appropriate" to ensure that the annual national statutory volumes were met. EPA subsequently promulgated the implementing regulations for the RFS program first in 2007 in response to the Energy Policy Act of 2005 and then again in 2010 in response to the Energy Independence and Security Act. Under these regulations refiners and importers are required to ensure that the volumes of renewable fuel required under the Act are actually consumed.
>
> …
>
> Ethanol has been the dominant domestic renewable fuel for several years, and during development of the law and regulations stakeholders in the fuel sector reasonably expected that ethanol would play a significant role in fulfilling the RFS volume requirements. As pointed out by commenters, E10 is approaching the point at which it saturates the gasoline market. As a result, if obligated parties choose to achieve their required RFS volumes using ethanol they should work with their partners in the vehicle and fuel market to overcome any market limitations on increasing the volume of ethanol that is used. Stakeholders in the refining sector have been aware of the E10 blendwall since passage of EISA in December of 2007.
>
> As the market has approached the E10 blendwall, the ethanol industry has worked to support the introduction of E15 into the market, and domestic auto manufacturers have increased production of vehicles capable of running on even higher ethanol blends. Over ten million flex-fuel vehicles (FFVs) are now in the existing fleet. FFVs currently consume E85 only about 0.4% of the time, but were they to be regularly fueled on E85, such vehicles would be capable of consuming billions of additional gallons of ethanol. The affected industries have had and continue to have the ability to achieve widespread adoption of E85 through working with partners in the retail and terminal infrastructure sectors to increase the number of stations that offer E85 or other intermediate ethanol blends and improve the pricing structure relative to E10…..

It is beyond the scope of this study to assess the probability of future EPA waiver decisions. However, RIN buyers and sellers presumably assign some probability to future regulatory decisions.

The accounting relationships we use to assess RIN balances and ethanol use in the short run are vastly less complicated than the assessment RIN market participants must make every trading day. Our calculations are intended only to outline the challenge of reconciling the growing mandates and looming blend wall, on the one hand, with current conventional RIN prices. Our fundamental intention is to address the discrepancy between FAPRI-MU RIN price projections that suggest sharply higher prices in the future under certain assumptions, with current conventional RIN prices in the market that appear to rest on some very different assumptions about RINs or ethanol use.