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Implied RIN Prices for E85 Expansion and the Effects of a Steeper Blend Wall

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Any remaining errors are those of the authors.

Summary

The FAPRI-MU baseline projections for biofuel and agricultural markets are built on a series of assumptions about how the Renewable Fuel Standard (RFS) will be implemented and how market participants will respond to changing market circumstances. One key question is what will happen when the RFS requires greater levels of biofuel use than can be achieved with 10 percent ethanol blends and mandated levels of biodiesel use.

The baseline assumes that domestic ethanol use will exceed the 10-percent "blend wall" if the effective cost of ethanol to blenders and fuel consumers drops low enough, long enough to encourage the use of higher-level blends such as E85 and E15. The question is just how low the price must go for how long. The baseline assumes that use of these higher-level blends will only increase significantly if the consumer-level cost of these fuels is at a slight discount to conventional fuels, even after taking into account the lower energy value of ethanol-blended fuels.

Others have suggested that the blend wall may be steeper than assumed in the FAPRI-MU baseline. In other words, it may take a steeper discount to encourage widespread use of higher-level blends, or that it may be almost impossible to encourage broad use of E85 or E15, at least in the near term.

Recent increases in the prices of Renewable Identification Numbers (RINs) can be attributed in part to concerns about how the blend wall and future RFS requirements will interact, as suggested in an earlier FAPRI-MU report. Higher RIN prices increase the incentives to produce and use higher-level ethanol blends.

This report looks at these questions from different perspectives using alternative assumptions about the implementation of the RFS and the behavior of biofuel market participants:

1) The first section calculates hypothetical RIN prices that would cover costs and discounts necessary to encourage expanded use of E85. Under one set of assumptions, the implied RIN values are very close to those recently observed in the market, but plausible changes in assumptions yield estimates that range from $0.28 to $2.34 per gallon.

2) The second section examines a scenario that assumes ethanol-blended fuel must sell at a deeper discount to conventional gasoline to encourage use of high-level blends—a somewhat steeper blend wall. This scenario results in less ethanol use than in the baseline, higher RIN prices, and increased use of biodiesel. However, the changes in quantities produced and consumed are fairly modest, so long as there remains a price that can encourage increased use of higher-level blends.

3) The third section explores the implications of alternative RFS implementation strategies and how they interact with alternative assumptions about the steepness of the blend wall. All else equal, the greater the total and advanced biofuel mandates, the greater the value of RINs and the greater the use of biodiesel. A steeper blend wall also results in greater RIN values and biodiesel use. Several different scenarios result in fairly similar levels of use of corn ethanol in 2013/14, provided that mandates are enforced.

4) The final section explores an extreme scenario where there is no price that will induce the use of higher-level ethanol blends. If the RFS remains in place, such a scenario would require large increases in biodiesel use that would require very high RIN prices and result in large increases in vegetable oil prices. Such RIN and biodiesel prices could induce new renewable fuels or trade patterns, and might be inconsistent with the view that ethanol expansion is impossible.

An example based on prices at the end of April 2013

One hypothesis regarding the blend wall is that expansion of ethanol consumption into high-level blends, such as E85, would occur when those fuels are sold on an energy equivalent basis with gasoline and a normal margin that covers distribution costs. The following calculations show what that hypothesis implies for the RIN price.

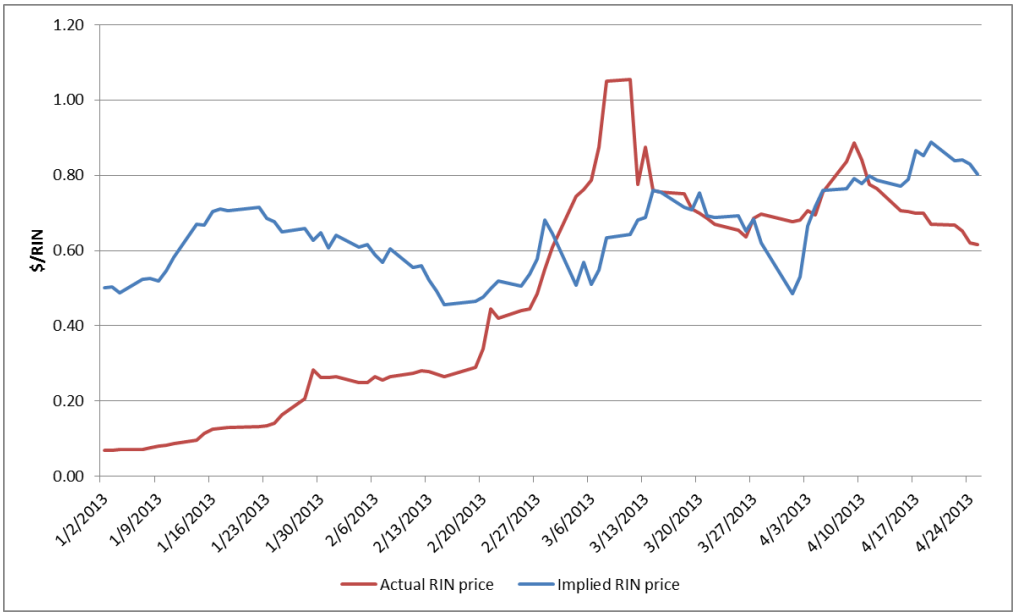
We view the result as a minimum conventional RIN price to allow profitable sales of E85. If the assumptions were correct and the RIN price was substantially higher, then there would be an arbitrage opportunity: selling more E85 would generate sales and RIN revenues that exceed the costs of input fuels and delivery. Conversely, if the assumptions are correct and the RIN price is below the price calculated below, then the costs of input fuel and delivery costs of E85 exceed the revenues from fuel and RIN sales. The calculations assume the average gallon of E85 is 75 percent ethanol and 25 percent gasoline. (Blend rates for E85 often vary seasonally, but must contain between 51 and 83 percent undenatured ethanol, by volume.)

Table 1. Calculate a RIN price that might maintain blender profitability of E85 sales.

Price data from OPIS Ethanol & Biodiesel Information Service, April 25, 2013				
Ethanol spot price, Chicago				$2.488
Front-month RBOB, NYMEX				$2.812
Conventional RIN price				$0.615
Implied gasoline retail price with assumed margin				
Wholesale fuel cost (above)				$2.812
Margin (assumed)			+	$0.60
Retail price			=	$3.41
Possible willingness to pay for E85 at energy equivalence				
Gasoline price (above)				$3.41
Energy content relative to gasoline			*	75%
Possible price consumer with FFV would pay for E85			=	$2.57
Implied E85 cost, wholesale				
Ethanol cost (share times price per gallon stated above)	+	75%	*	$2.488
Gasoline cost (share times price per gallon stated above)	+	25%	*	$2.812
Total			=	$2.57
Implied retail E85 price with assumed margin				
Implied E85 wholesale cost (above)				$2.57
Margin (assumed)			+	$0.60
Retail price			=	$3.17
Difference between E85 price and willingness to pay price				
E85 implied retail cost (above)				$3.17
Possible price consumer with FFV would pay for E85 (above)			-	$2.57
Difference			=	$0.60
RIN price necessary to maintain profitability of E85 sales at willingness to pay price				
Difference between E85 implied retail and willingness to pay prices (above)				$0.60
RINs generated per gallon of E85 sold (share of ethanol in fuel)			/	75%
Minimum RIN price necessary to maintain profitability			=	$0.80

Figure 1 shows how the implied and actual conventional RIN prices have evolved from January 1 to April 24, using price data from EIA and OPIS and the cost and discounting assumptions of Table 1. Figure 1 shows that the implied price was higher than the actual price at the start of 2013, suggesting that E85 sales would not be profitable at that time. More recently, the actual and implied prices have been more similar, indicating that E85 sales might be profitable given these basic assumptions.

Figure 1. Conventional RIN price and minimum implied price based on energy equivalent consumer demand and no additional infrastructure cost.



Sources: Energy Information Administration, Oil Price Information Service.

Table 2 shows how the implied conventional RIN price varies under alternative assumptions. If consumers with flex fuel cars hesitate to switch to E85, perhaps because the product is hard to find or they do not want to fill up their vehicles more often, then the price of E85 might have to be discounted below the energy equivalent value. Building the capacity to utilize significant quantities of E85 will be expensive and will take time, as there are currently a limited number of flex fuel vehicles and a limited number of stations selling the product. If infrastructure costs are higher for E85 than for other fuels, at least initially, to establish the marketing channel, then the margin might be larger. In either case, the implied RIN price would be higher.

Table 2. Implied conventional RIN price under alternative assumptions ($/RIN)

	Margins are the same	Margins different (+50% for ethanol)
Energy equivalence	0.80	1.20
Two-thirds energy equivalence	1.94	2.34

In the calculations above, there is some uncertainty related to the decision to use RBOB prices rather than CBOB prices. CBOB prices typically are lower than RBOB prices and, to some extent, may be the more likely blendstock used for E85 production. A price discount relative to RBOB implies a higher conventional RIN price would be needed to maintain the profitability of E85 for fuel blenders. At the time of writing, CBOB was running a premium relative to RBOB, which would imply a lower RIN price necessary to maintain the profitability of E85. If Table 1 used the CBOB price on April 25, 2013, $2.9906/gallon, then the implied RIN price would be $0.68.

Expectations by obligated parties are another source of uncertainty. Through rollover stocks of RINs, current RIN prices might be influenced by the degree to which obligated parties expect future RFS standards to be binding. If RINs are purchased now to rollover to later years, then current RIN prices are bid higher. At the time of writing, the May 2014 futures prices for RBOB and ethanol were $2.71 and $1.89, respectively, suggesting an implied RIN price of $0.28. In other words, a comparison of current RIN prices and those implied by futures prices suggests an opportunity for blenders to identify segments of the potential E85 market that could be developed in the coming year through discounts relative to energy equivalence.

The calculations of this section reflect the view that there is some RIN price at which profit can be made from getting more ethanol to consumers. The exact level depends on costs and consumer demand in the markets that just suffice to generate additional ethanol sales to cover a mandate. The price could be large, but it is presumably finite.

A steeper blend wall

We present the blend wall question as "How low must the price go, and for how long?" For example, at some price of E15 or E85, however low, some consumers would want to increase their use of this fuel. At some conventional RIN price, however high, some blenders would want to blend more ethanol and use revenue from RIN sales to offset additional costs of E15 or E85 sales. In the FAPRI-MU stochastic baseline released in March, 2013, we assumed that ethanol use in higher-blend fuels starts to grow if these fuels are priced at energy equivalence, but use really takes off only if prices fall below that level.

We use the FAPRI-MU stochastic model to test the effect of the blend wall on markets. We compare the average outcomes of 500 stochastic simulations to estimate the impacts of the steeper blend wall over the next two marketing years. First, suppose consumers are willing to expand consumption significantly only if ethanol in blended fuels is valued at two-thirds of its energy equivalence, relative to the smaller discount required in the baseline.

Here, we assume that the cellulosic mandate is waived to a lower amount and broad mandates are also reduced, but only somewhat. The portion of the mandate that ethanol can fill falls in between two alternative extremes: one, there is no broad waiver at all and all the cellulosic mandate shortfall must be made up by extra advanced biofuel and, two, the broader mandates are reduced as much as the cellulosic mandate so no extra ethanol is eligible beyond conventional and advanced gaps. The reduction in RINs generated under this assumption as compared to the case that broader mandates are not waived average about 0.75 and 1.75 billion RIN-gallons in 2013/14 and 2014/15, respectively, in stochastic simulations.

The effects of a steeper blend wall alternative assumption are summarized in Table 3. The interactions of policies and markets introduce some possibly unexpected results of a steeper blend wall:

1. Less E15 and E85 use means more E10 use as overall miles travelled changes only slightly.
2. As biodiesel use expands to displace restricted ethanol use, there is an order based on the mandate hierarchy. Biodiesel displaces sugar-cane ethanol imports that help to meet the advanced mandate before it displaces conventional ethanol.
3. Less sugar-cane ethanol can leave open the possibility for conventional ethanol use to continue to fill the E10 market, and whatever higher-blend fuel use remains.
4. RIN stocks might be depleted more quickly if the blend wall is steeper. A steeper blend wall drives up RIN prices earlier and pushes down RIN stocks faster, in this analysis.
5. The pace of RIN stock depletion can affect the timing of reductions in biofuel use and corresponding RIN generation.

These and other outcomes seen in the averages of stochastic simulations, are discussed below.

Table 3. Preliminary estimates of how a steeper blend wall affects biofuel, RIN, and crop markets.

	Baseline		Scenario		Difference	
	2013/14	2014/15	2013/14	2014/15	2013/14	2014/15
Ethanol market quantities			(billions of gallons)			
Domestic use	14.24	15.62	13.82	15.36	-0.41	-0.25
Low-blend fuels	12.85	12.44	13.21	12.98	0.36	0.54
Higher-blend fuels	1.39	3.18	0.62	2.38	-0.77	-0.79
Exports	0.62	0.56	0.65	0.52	0.03	-0.04
Production	14.62	15.44	14.37	15.44	-0.25	0.00
Imports	0.35	0.78	0.21	0.50	-0.14	-0.28
Biodiesel market quantities			(billions of gallons)			
Domestic use	1.27	1.36	1.38	1.57	0.11	0.21
Net exports	0.07	0.06	0.06	0.05	0.00	-0.01
Production	1.34	1.42	1.44	1.62	0.11	0.20
Biofuel and RIN prices			(dollars per gallon or per RIN-gallon)			
Conventional ethanol	2.04	2.02	2.00	2.03	-0.05	0.00
Advanced ethanol	2.46	2.51	2.21	2.37	-0.25	-0.14
Wholesale biodiesel	4.78	4.69	4.98	5.05	0.20	0.37
Conventional RIN	0.69	0.80	1.28	1.51	0.58	0.71
Advanced RIN	1.11	1.28	1.49	1.85	0.38	0.56
Biodiesel RIN	1.33	1.54	1.51	1.87	0.18	0.33
Crop market prices						
Corn price, dollars per bushel	5.18	4.69	5.11	4.73	-0.06	0.04
Soybean price, dollars per bushel	11.49	11.26	11.63	11.38	0.14	0.12
Soybean oil price, cents per pound	53.67	52.14	55.78	56.05	2.12	3.91

Ethanol use in higher-blend fuels, namely E15 and E85, is lower by about 750-800 million gallons in the scenario with a steeper blend wall. If there is less E15 and E85 use, then there is likely to be a partly offsetting increase in E10 because total motor gasoline demand does not change by a large amount.

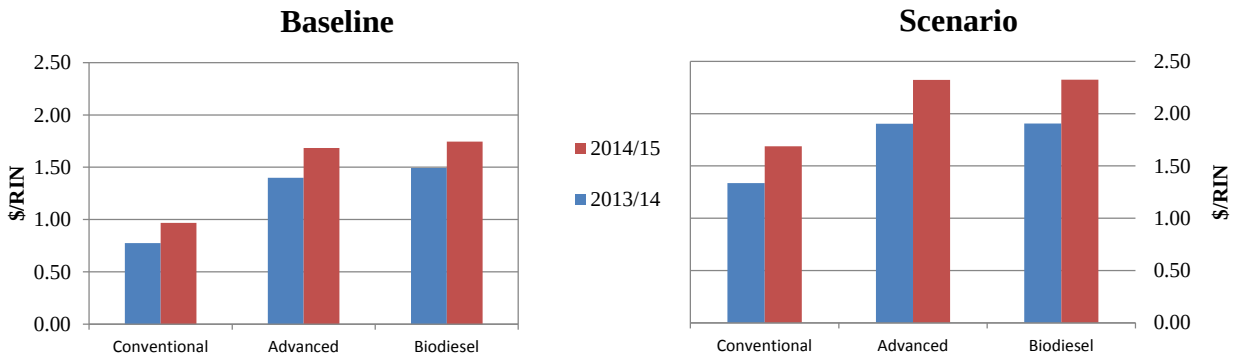
Biodiesel use expands as ethanol use is reduced in order to meet the mandates. Ethanol imports are lower because biodiesel displaces sugar-cane ethanol in meeting the advanced mandate. Biodiesel RINs used beyond the biodiesel mandate are expected always to displace advanced RINs before conventional RINs.

Ethanol production is lower in the first year, and almost unchanged in the second year. This result follows from biodiesel displacing imported advanced ethanol first, but also because of earlier RIN stock depletion. In the baseline, RIN stocks are still decreasing in 2014/15, so some of the mandate is met with RINs generated in the previous year. However, in the scenario the RIN stocks are depleted by the end of 2013/14 so all the 2014/15 mandate must be met using RINs generated in that year.

The conventional and advanced RIN prices increase enough for blenders to cover the additional costs of marketing high-blend ethanol or buy more biodiesel in order to meet the mandates (Figure 2). In 2013/14, the baseline advanced RIN price averages less than the biodiesel RIN price, indicating that biodiesel RINs are not being demoted to help meet the broader advanced mandate in all simulations. In the scenario with the steeper blend wall, the advanced RIN price and biodiesel RIN price are almost equal in 2013/14 and 2014/15, indicating that biodiesel is typically used beyond its mandate to help meet the advanced mandate, displacing sugar-cane ethanol.

The steeper blend wall has little impact on wholesale ethanol prices, as most of the blend wall impacts are bid into RIN prices. Falling U.S. imports puts downward pressure on Brazilian ethanol prices so, even though there is somewhat less demand for conventional ethanol domestically there is also more competition in export markets. The average net effect on exports in these simulations is small.

Figure 2. RIN prices with the baseline and steeper blend wall.



More biodiesel RINs are used to meet a larger share of broader mandates than required if the blend wall is steeper, so the biodiesel RIN price is bid higher. This increase translates into a higher wholesale price of biodiesel as blenders compete to buy more of this biofuel.

The greater demand for biodiesel results in higher biodiesel feedstock prices, as is shown by the increase in soybean oil price. This increase helps to draw the soybean price higher. Because of the net effects on corn-starch ethanol production in the second year and also corn area impacts owing to the first-year price effects, corn price rises slightly in the second year. A steeper blend wall or a longer period of analysis could have different implications for the corn price impact.

Alternative scenarios: higher RFS requirement or steeper blend wall

We use the FAPRI-MU stochastic model to test different assumptions about the blend wall and the mandate waiver.

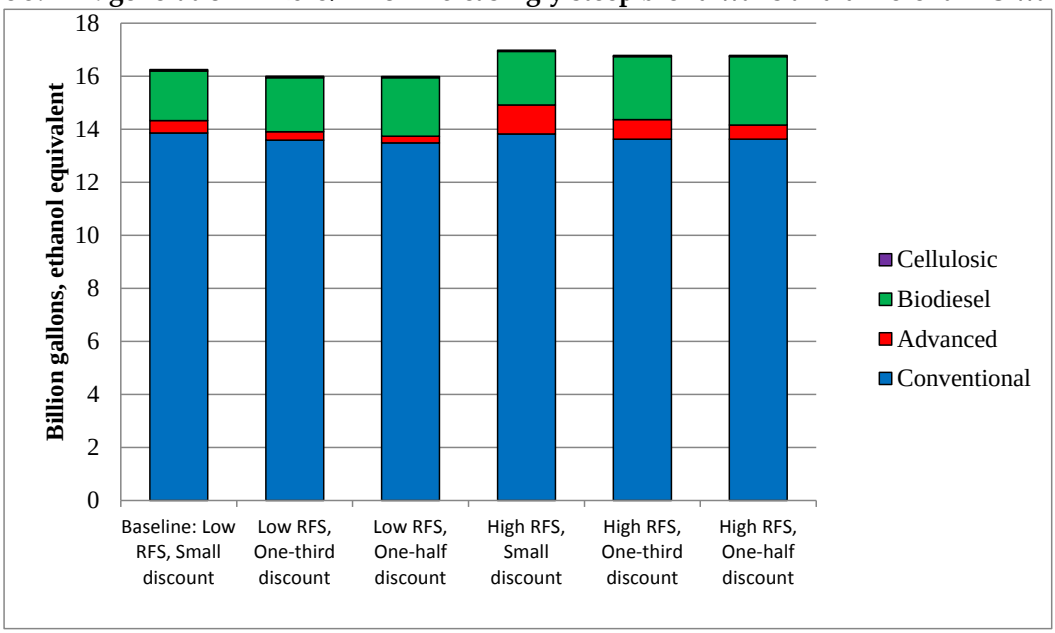
Assuming that cellulosic biofuel will fall short of the RFS target for this type of biofuel, there remains the question of whether broader mandates are partly reduced in the future. If cellulosic biofuel production continues to lag as the cellulosic mandate grows, it is uncertain whether broader mandates will also be reduced somewhat, as assumed above, by as much as the cellulosic mandate is reduced, or not at all.

The infrastructure costs and retail price discount necessary to sell more ethanol in higher-blend fuels is also uncertain. Whereas the baseline assumed that the quantities of these fuels sold would increase fairly quickly as the price fell below energy equivalence, perhaps with a small further discount, the scenario above tested the implication of a one-third discount on the value of ethanol in these fuels relative to its energy equivalence. We also test the case that the value of ethanol in these fuels, taking infrastructure costs and retail discounts into account, must be one-half its energy equivalence before these fuels can be sold.

Comparing simulation results shows how RIN generation is estimated to change as the blend wall becomes steeper (Figure 3). The baseline case has a low RFS and a small discount. In this case, ethanol sales beyond the blend wall require that the price is discounted only slightly below energy equivalence, but even in this case biodiesel use exceeds its mandate in some simulations. As a steeper blend wall leads

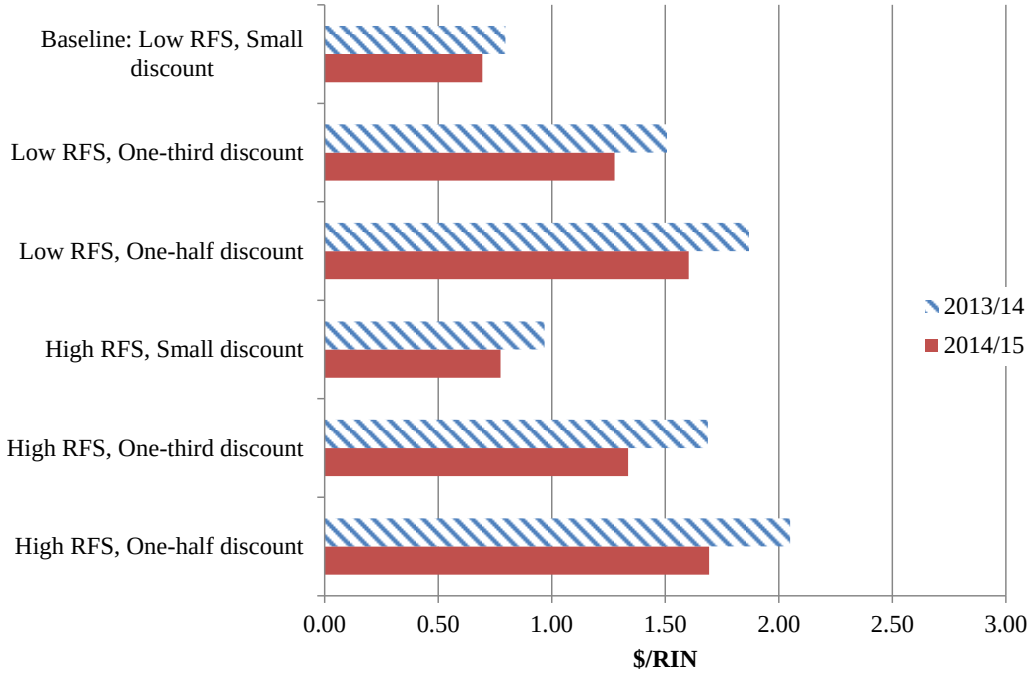
to less ethanol use, fewer RINs are generated from ethanol, and more RINs generated from biodiesel use. As noted earlier, biodiesel replaces other advanced RINs generated from sugar-cane ethanol use before conventional ethanol is replaced because of the RIN hierarchy. As shown in the figure, these changes remain small in 2013/14 relative to total RIN generation, but they are noticeable.

Figure 3. RIN generation in 2013/14 for increasingly steep blend walls and different RFS waivers.



High RFS reflects the case with no broader waivers, so the entire shortfall in cellulosic biofuel is offset by an increase in the advanced gap. Relative to the partial waiver of the baseline, the High RFS cases imply that more ethanol can be used to help to meet the larger advanced and conventional mandate. Relative to the low RFS cases, even more RINs are generated from biodiesel, although ethanol use is also greater.

Figure 4. Conventional RIN prices (dollars per RIN) under different RFS and blend wall assumptions.



The baseline has a low RFS, reflecting the assumption that broader mandates are partly waived when the cellulosic mandate is waived, and the only a modest discount necessary to induce E15 and E85 use. This case has the lowest conventional RIN prices (Figure 4). However, the baseline averages of $0.69 in 2013/14 and $0.80 in 2014/15 easily exceed all peak values before the run up in price in early 2013.

The other low RFS cases correspond to other scenarios with partly waived overall and advanced RFS mandates. However, the blend wall is assumed to be steeper in each case. The case where E15 and E85 expand only when the value of ethanol in retail fuels is priced at two-thirds energy equivalence corresponds to the scenario discussed in some detail above. If the blend wall requires a discount in the value of ethanol down to one-half of energy equivalence before use in E15 or E85 expand, then conventional RIN price is more than twice as high as the baseline price.

The three high RFS cases correspond to no reduction in the overall or advanced mandates. Any shortfall in cellulosic biofuel production relative to its mandate must be offset by greater advanced biofuel use. This assumption implies more biofuel is needed for the RFS, and allows more ethanol to be used to help meet the mandates. RIN prices are higher even given the assumption that E15 and E85 use expand if the value of ethanol in these fuels is discounted only slightly below its energy equivalence. The two scenarios with a high RFS and a steeper blend wall lead to higher RIN prices in order either to cover the costs of E15 or E85 distribution and discounting, or else to yield for more biodiesel use. At some point, higher RIN prices raise questions about biodiesel imports and other means of meeting the RFS.

An extreme case: no E15 or E85, and no broad mandate reduction

This characterization of the blend wall is based on strong assumptions. Stating adamantly that no E15 or E85 will be sold no matter the RIN and biofuel prices might lead to some rather odd outcomes, such as distributors and consumers who could not be paid to take, sell, and use these fuels. If, in addition, the

cellulosic waiver is assumed not to lead to broader mandates reductions, then the pair of extreme assumptions, absolute limit on ethanol use and maximum biofuel use requirement, set the stage for large possible impacts.

In this case, the following biofuel and RIN market pressures would be manifested in the next few years.

- Domestic ethanol use is restricted to E10 blending. Ethanol use remains below 14 billion gallons.
- Blenders cannot use more ethanol to meet growing overall and advanced mandates in this case, conventional and advanced RIN prices rise.
- Biodiesel is the only biofuel that is in commercial production at substantial volumes today that can be used to meet the overall and advanced mandates beyond the volume of ethanol used in E10. Biodiesel use might expand to account for some or most of the additional volume required in the next few years.
- Initially, advanced and biodiesel RIN prices would tend toward equality, and be bid higher in order to draw in more biodiesel. Biodiesel would displace other advanced ethanol, namely sugar-cane imports from Brazil.
- With this extreme assumption, use of ethanol in E10 would not meet the conventional gap as it continues to grow through 2015. Even more biodiesel might be used in order to displace conventional ethanol, with conventional RIN price equal to the advanced and biodiesel RIN prices, and all of them bid even higher to draw in more biodiesel.
- Biodiesel use could increase substantially, depending on how quickly domestic biodiesel production can respond or biodiesel can be imported.

  For example, suppose the blend wall limits ethanol use to 13.5 billion gallons in 2014 while the overall mandate RFS rises to 18.15 billion gallons in that year. If biodiesel use makes up the difference between the RFS and ethanol use (at 1.5 equivalence value), then 3.1 billion gallons of biodiesel would be used in 2014.
- Ethanol export impacts are uncertain. Conventional ethanol prices fall because of constrained domestic use, encouraging exports. Lower ethanol imports suggest lower prices of ethanol in Brazil, discouraging exports.

We expect the following *commodity market results* during this period:

- There could be considerable pressure on the prices of vegetable oils and fats that are feedstocks for biodiesel, including soybean oil, if production is increased quickly.
- In the extreme case that ethanol use is restricted to E10 and this volume falls short of the conventional gap, there could be less corn starch ethanol use and lower corn prices.

Key questions that need to be considered are as follows:

- Given the RIN price increases that might result and the usual levels of wholesale ethanol prices, the underlying assumption might be that no more E15 or E85 can be sold no matter the prices.

  The RIN price has some upper limit. At some hypothetical RIN price, people could be paid to buy flex-fuel vehicles and fill them with E85, yet these costs would be more than offset by selling high-price RINs.
- If the higher compliance costs are passed on to fuel consumers in the form of higher retail prices, including E10, then consumers would become increasingly willing to switch to E15 or E85 even as the value of RINs generated from additional ethanol sales rise.
- More biodiesel blended to replace ethanol means substantial pressure on markets for biodiesel and vegetable oils and fats, possibly leading to significant U.S. imports.
- Additional biodiesel use might lead to questions about a biodiesel blend wall at some point.
- The high RIN prices discussed here provide a stronger incentive to produce drop-in fuels that circumvent the blend wall.