Outlook for Ethanol and Conventional Biofuel RINs in 2013 and 2014

by Bruce A. Babcock

Executive Summary

The US ethanol industry faces numerous challenges over the next two years. The 2012 drought sharply increased corn prices, so profit margins will be low until least the 2013 corn crops are harvested. A saturated ethanol market means that ethanol mandates that are scheduled to be implemented in the next two years can possibly be met only if ethanol prices are heavily discounted. Thus, profit margins will continue to be low even if production costs fall after the next crop is harvested. In addition, buyers of ethanol can draw on blending credits they have accumulated over the last few years in lieu of ethanol to meet their obligations under the Renewable Fuel Standard (RFS). These banked credits are called RINs (Renewable Identification Numbers) and allow the Environmental Protection Agency (EPA) track how much renewable fuels are being used. When domestic consumption of ethanol exceeds mandated levels, the surplus RINs can be banked to meet future mandates.

This policy brief provides insights into how the next two years will unfold in the ethanol market by focusing on whether the supply of banked RINs will be used in 2013 to help offset current high production costs or in 2014 to help offset low ethanol prices. The guiding principle of the analysis is that owners of banked RINs will use them when they have the greatest value. This principle implies that RINs will be used in 2013 until their 2013 value is equal to their expected value in 2014. The analysis indicates that because of the E10 blend wall and high ethanol production costs, a significant portion of banked RINs will be used in 2013. If, as seems likely, imported sugarcane ethanol is used to meet the portion of the advanced biofuels mandate that is not met by biodiesel meeting its own mandate, then almost all the banked RINs should be used in 2013. This result assumes that corn yields return to trend-line levels in 2014. If sugarcane ethanol is not imported to meet the advanced mandate, then fewer banked RINs will be needed in 2013 to offset heavily discounted ethanol prices. Whether sugarcane ethanol is used or not, the fundamental market forces indicate that RIN prices will be low in both 2013 and 2014.

The ability to use banked RINs increases the feasibility of meeting the 2013 and 2014 mandates and is what keeps expected RIN prices low in both years. Low future prices are why conventional biofuel RIN prices are so low today. This result, though, depends on the assumption that heavily discounted ethanol will incentivize significant amounts of additional ethanol consumption from owners of flex fuel vehicles or by an unexpectedly large and rapid movement to use of E15. If this additional consumption does not materialize, then it seems that EPA will have no choice but to waive conventional ethanol mandates in 2014 because mandated consumption will exceed the ability of consumers to use ethanol as a fuel. Such a waiver, were it to occur, would also validate current low RIN prices.

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Domestic ethanol use exceeded mandated use by approximately 3.6 billion gallons from 2007 to 2011 according to Paulson and Meyer.[1] Paulson estimates that approximately 1.9 billion gallons of this excess use is currently "banked" and can be used to help meet future mandates. [2] What is banked are actually Renewable Identification Numbers (RINs) that are created when ethanol is produced. RINs are turned into the Environmental Protection Agency (EPA) by gasoline producers and importers who use them to demonstrate that they have met their obligation to use biofuels under the Renewable Fuels Standard (RFS). When these obligated parties use more ethanol than they need to under the RFS then they can sell their excess RINs or bank them to help meet their obligations in the future.

The severe drought that impacted the 2012 corn crop and drove corn prices sharply higher has focused attention on these banked RINs. If these RINs are used in 2013, then the amount of corn used to produce ethanol will be reduced, and the impact of the 13.8 billion gallon ethanol mandate on corn prices in 2013 will be lower. In an earlier study, I estimated that corn prices would increase to an average of $9.73 per bushel if the full 2013 mandate had to be met.[3] However, if the banked RINs were used to meet a portion of the mandate, then the price of corn would instead be $7.82 per bushel. With no mandate, I estimated that the price of corn would be $7.24 per bushel. Thus, use of banked RINs reduces the impact of the mandate from $2.49 to $0.58 per bushel.

Banked RINs that are used in 2013, however, cannot be used in 2014. If the expected value of a RIN saved for use in 2014 is greater than the value of a RIN used in 2013, then the RIN will stay in the bank. If the value in 2013 is greater than the expected value in 2014, then the RIN will be used. Thus, to answer the question of when the banked RINs will be used requires knowledge of their value in 2013 and 2014. The purpose of this paper is to identify the main drivers of RIN value and to discuss how these drivers will influence the value of RINs over the next two years.

What Determines RIN Values?

RINs have value only if an obligated party would rather buy a RIN than a gallon of ethanol. This can only occur when the value of using a gallon of ethanol is less than the cost of that gallon. If ethanol is sold in a free market the value of a gallon of ethanol will always be at least as great as the cost of that gallon, otherwise the gallon would not be purchased. However, because of growing mandates, obligated parties will likely soon face the reality that they will need to buy gallons of ethanol that generate less value than the purchase price of ethanol. That is, when the ethanol mandate itself forces ethanol

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[1] "An Update of RIN Stocks and Implications for Meeting the RFS2 Mandates with Corn Ethanol." Nick Paulson and Seth Meyer August 1, 2012.
http://www.farmdocdaily.illinois.edu/2012/08/an_update_on_rin_stocks_and_im.html.
[2] "RIN Stock Update: Implications of the 2012 Drought." Nick Paulson December 14, 2012.
http://farmdocdaily.illinois.edu/2012/12/rin-stock-update.html
[3] "Updated Assessment of the Drought's Impacts on Crop Prices and Biofuel Production." Bruce A. Babcock. CARD Policy Brief 12-PB 8 August 2012.

consumption to increase, then the use value of ethanol will be less than the cost of the ethanol. When the use value of ethanol is lower than the purchase price of ethanol, obligated parties will consider using banked or purchased RINs to meet their obligations rather than RINs generated by buying and using ethanol. If the cost of using a banked or purchased RIN is less than the value lost by buying ethanol, then the obligated party will choose RINs over ethanol. The value lost by using ethanol is exactly the difference between the purchase price of ethanol and the use value of ethanol, which is only positive when mandates increase consumption. A simpler way of saying this is that RINs have value when the ethanol mandate is binding.

When the cost of using a banked or purchased RIN is less than the value lost from buying ethanol, obligated parties will start using RINs to meet their obligations rather than buying ethanol. This act has two effects on the market. The first is a decline in the use of ethanol. If enough obligated parties start using RINs this decline in use will eventually lower the purchase price of ethanol and increase the use value of ethanol. That is, the value lost from using a gallon of ethanol will begin to decline. The second effect is that increase use of RINs will increase their price. These forces will continue to work until the price of RINs increases enough, and the value loss from using ethanol decreases enough, so that an obligated party is indifferent between buying a gallon of ethanol or using a purchased or banked RIN to meet their obligation. Figure 1 shows graphically in a supply and demand diagram that this indifference point occurs when the price of RINs is exactly equal to the difference between the supply price of ethanol (the price that ethanol plants need to cover the cost of producing enough ethanol to meet the mandate) and the demand price of ethanol (the use value of the last gallon of ethanol that is needed to meet the mandate). In Figure 1 the mandate forces an increase in ethanol consumption above Q*, which is the level that would be consumed without the mandate. The cost of producing this increased amount of ethanol rises primarily because the price of corn increases. Thus, ethanol plants need a higher ethanol price to entice them to produce the extra ethanol. The extra ethanol consumption offers lower value to ethanol buyers, so a wedge forms between the cost of production and the market value. The RIN price closes this wedge as shown.
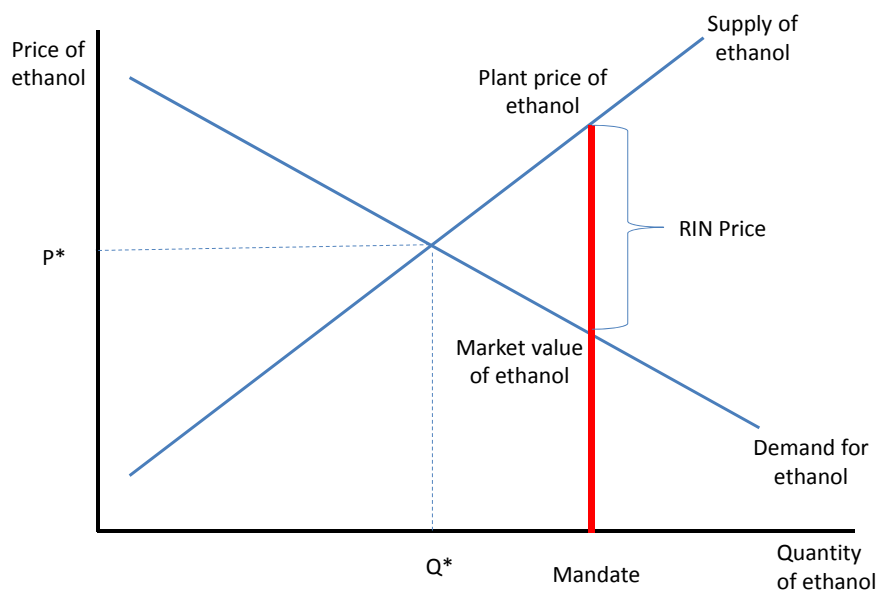

Figure 1. Determination of the RIN price

From Figure 1 it is easy to see that the key factors determining RIN price are the position of the supply and demand curves of ethanol and the level of the mandate. If the mandate is binding, then a shift up in the supply curve caused by, for example, a short corn crop, will increase the price of RINs. A shift up in the demand curve for ethanol by, for example, an increase in the price of gasoline, will decrease RIN prices. In addition, Figure 1 clearly shows that an increase in the mandate will increase RIN prices. The next section presents estimates of the likely positions of the ethanol supply and demand curves in 2013 and 2014 to provide insight into the future value of ethanol and ethanol RINs.

Supply of Ethanol in 2013 and 2014
The cost of producing corn ethanol in the United States is primarily a function of the price of corn. The 2012 drought dramatically increased the price of corn, and hence the cost of producing ethanol for most of 2013. Farmers making planting decisions for the 2013 crop are seeing relatively high corn prices, so it is likely that they will plant a similar amount of corn in 2013 as they did in 2012. Unless another drought occurs, a repeat of 2012's planted acreage will mean substantially lower corn prices and lower ethanol production costs. Figure 2 below shows the 2013 ethanol supply curve and the effect of the 2013 corn yield on the 2014 ethanol supply curve.[4] The 2013 supply curve corresponds to the actual 2012 yield of 122.3 bushels per acre.

As shown, higher yields from the 2013 crop shift the 2014 ethanol supply curve to the right, which simply means that the cost of producing a given quantity of ethanol is lower if corn is plentiful. If the probability of adverse growing conditions in 2013 follows historical probabilities, then the expected corn yield in 2013 is just shy of 160 bushels per acre. At that yield, the cost of producing the 14th billion gallon of ethanol of ethanol would be about $1.60 per gallon (the corn price is about $5.00 per bushel). This is in contrast to the current cost of production of approximately $2.40 per gallon at a quantity of 13 billion gallons. It is apparent from Figure 2 that if corn yields in 2013 are close to trend-line levels, then the outlook for corn ethanol is much different than it is today.[5] To get a good picture about what lower ethanol production costs imply about RIN values in 2013 and 2014 requires an exploration of the future demand for ethanol.

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[4] The key assumptions behind the 2014 supply curves are: (*a*) corn supply in the 2014 marketing year equals 650 million bushels plus the product of 87.7 million harvested acres and the indicated yield level; (*b*) 2.75 gallons of ethanol per bushel of corn; (*c*) DDGS are valued at 90 percent of the price of corn; (*d*) feed, food, and export corn demand are linear and calibrated to the latest USDA WASDE projections; (*e*) stock demand is nonlinear to account for the possibility of stock-out conditions; and, (*f*) non-corn ethanol production costs vary by 40 cents per gallon across ethanol plants, and follow a uniform distribution. For simplicity, differences between crop years and calendar years are not accounted for. The 2012 crop, which was harvested in the fall of 2012, corresponds to the 2013 supply curve. The 2013 crop, which will be harvested in the fall of 2013, corresponds to the 2014 supply curves. In reality, a crop is consumed across two calendar years.
[5]The 2013 trend-line yield using data from 1980 to 2012 is 157.1 bushels per acre. If the very low yield in 2012 is eliminated from estimation, or a weather-adjusted trend is calculated, then the 2013 trend-line yield is 161 bushels per acre.
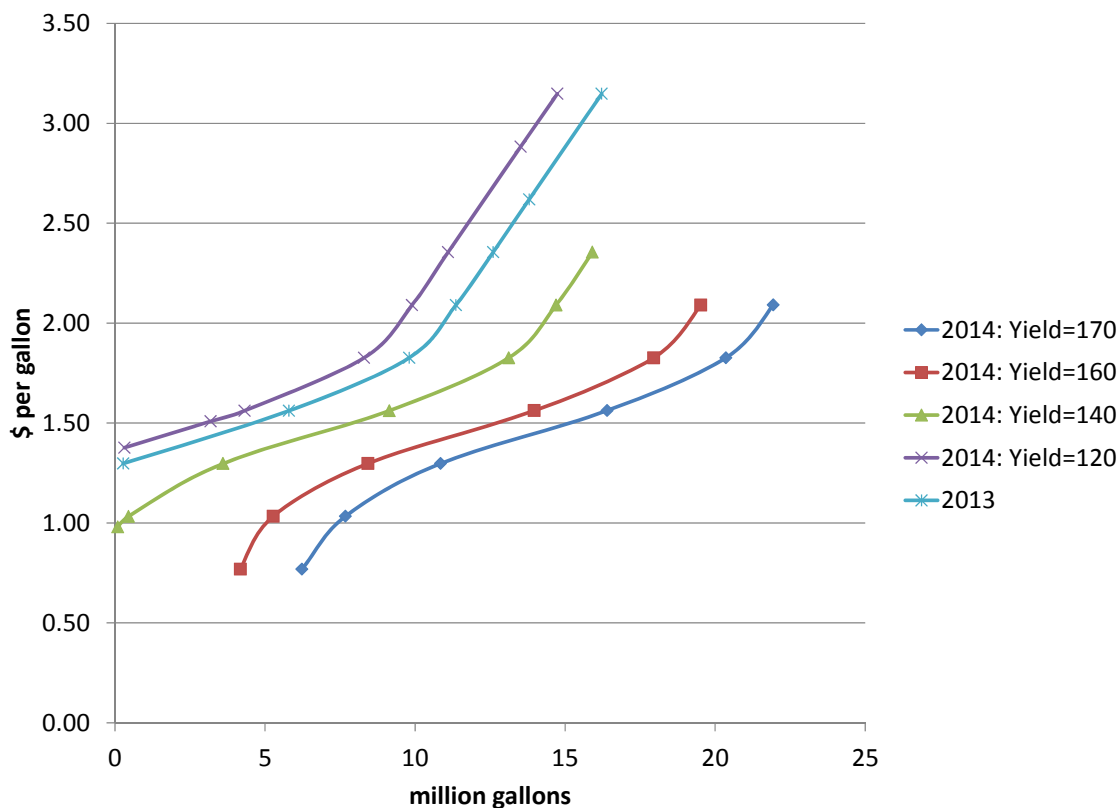
Figure 2. US corn ethanol supply curves in 2013 and 2014

Demand for Ethanol in 2013 and 2014

It seems likely that the ability to consume ethanol in the United States in both 2013 and 2014 will be severely constrained by the E10 blend wall. Approximately 135 billion gallons of finished motor gasoline is expected to be consumed, which means that if ethanol blends are limited to 10 percent, then the maximum amount of ethanol that can be consumed is about 13.5 billion gallons.

Gasoline producers have configured their refineries to produce gasoline blend stock that minimizes their costs (or maximizes ethanol's value) of using required amounts of ethanol. Because it takes time and money to reconfigure refineries, the demand for ethanol is largely fixed at a quantity approximately equal to 10 percent of US finished motor gasoline consumption. A fixed demand implies that the quantity of ethanol consumed is quite insensitive to the price of ethanol.

The EPA denied a request to waive the 2013 mandate because it concluded that doing so would not materially affect the price of corn. The primary reason for EPA reaching this conclusion is given by the demand curve (Figure 3) EPA used to analyze the impact of waiving the mandate—this demand curve was given to EPA by analysts at the US Department of Energy.[6] The vertical axis of the EPA/DOE demand curve is the ratio of ethanol to gasoline price. This demand curve shows that the quantity demanded of

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[6] The Department of Energy's explanation for this demand curve is provided in a memo that is included in the EPA's docket of material at http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2012-0632-2544. Note of disclosure: I conducted analysis that was used by EPA in their waiver analysis.

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ethanol is quite insensitive to the price of ethanol until the ethanol price exceeds the wholesale price of gasoline, which currently is projected to be about $2.70 per gallon. As shown in Figure 2, the 2013 supply curve of ethanol will intersect this demand curve at a price of less than $2.70 per gallon. This demonstrates that waiving the mandate with this demand curve would have little or no effect on the quantity of ethanol demanded in the marketplace, which implies that waiving the mandate would have little or no effect on corn prices.

One implication of this demand curve is that if it gives an accurate portrayal of ethanol demand through 2013 and 2014, then the 2013 and 2014 mandates cannot be met because there is no price at which either 14.6 billion gallons (in 2013) or 16.2 billion gallons of ethanol can be consumed in the United States.[7] If this were the case, then one would think that EPA would be forced to lower mandated ethanol consumption.

However, there are at least two alternatives ways of meeting the existing mandates in 2013 and 2014 without a waiver. These alternatives have implications on the use of banked RINs so each will need to be explored. The first is that sugarcane ethanol will not be used to meet the advanced mandate that is in excess of a 1.28 billion gallon biodiesel mandate. This would lower ethanol mandates from approximately 14.6 to 13.8 billion gallons in 2013, and from 16.2 to 14.4 billion gallons in 2014. The second alternative is that this demand curve is not an accurate reflection of what will happen to the quantity demanded of ethanol if the price of ethanol drops enough. If a low ethanol price stimulates enough demand by owners of flex fuel vehicles to seek out high ethanol blends and incentivizes gasoline station owners to invest in new pumps, then additional ethanol can be consumed.
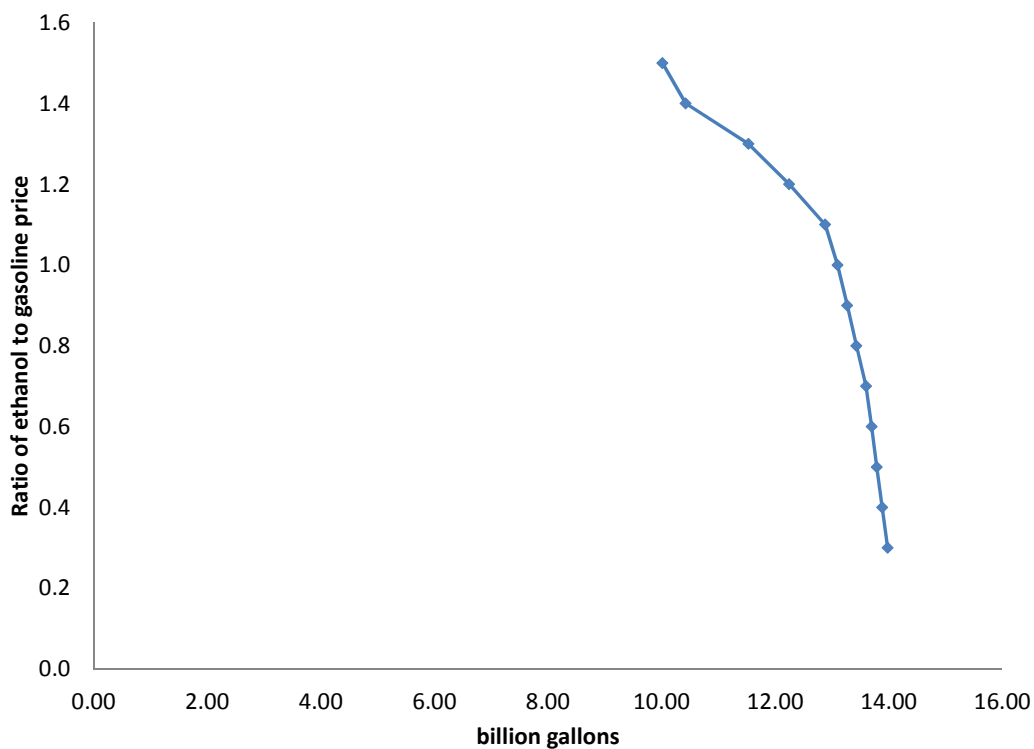

Figure 3. Ethanol demand curve used by EPA in waiver analysis

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[7] These quantities of ethanol assume that the portion of the advanced mandate not met by mandated biodiesel will be met by imported sugarcane ethanol from Brazil.

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A third alternative that is not considered here is that regulatory and legal hurdles are quickly overcome to allow the E10 blend wall to be exceeded through expanded sales of E15. These hurdles include liability issues if owners of pre-2001 model year cars choose to consume E15 and problems result. If these hurdles are overcome, then it is likely that ethanol will need to be low enough in price to incentivize consumers to buy E15 and station owners to invest in E15 pumps, which makes this alternative similar to the FFV alternative considered below.

If ethanol demand in 2013 and 2014 is to be met by expanded use of E85 (or higher than 10 percent blends), then clearly the demand curve in Figure 3 is not correct. However, it is quite likely that to stimulate demand the price of ethanol relative to gasoline will have to be heavily discounted to induce ethanol consumption beyond 13.5 billion gallons. Figure 4 provides an alternative demand curve that reflects greater ability to use higher volumes of ethanol than assumed by the Figure 3 demand curve. The demand curve in Figure 4 is highly speculative because no data exists to estimate ethanol demand beyond the blend wall. This demand curve, however, is sufficient to illustrate the ramifications of forcing consumption beyond 14 billion gallons.[8]
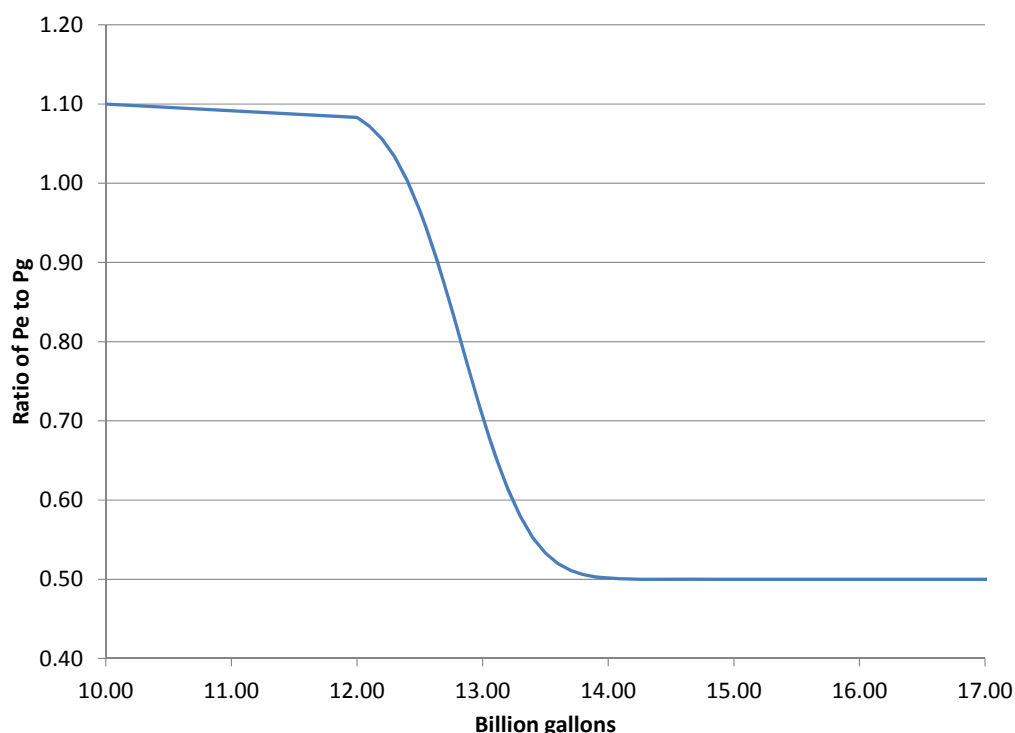

Figure 4. Hypothesized ethanol demand in 2013 and 2014

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[8] It is at least plausible that E85 consumption can increase significantly. There should be approximately 12 million FFVs in the US vehicle fleet in 2014. If each vehicle consumes 500 gallons of fuel per year and 50 percent of the 12 million FFVs use ethanol, then this represents about 2.2 billion gallons of ethanol consumption per year. To achieve this level of consumption would be difficult, however, and would require substantial investment in E85 pumps and an advertising campaign targeted at owners of FFVs.

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RIN Price Dynamics and Market Outlook
Whether banked RINs will be used in 2013 or 2014 depends on when they will be most valuable. We can gain insight into the fundamental value of RINs in both 2013 and 2014 by using the demand curve in Figure 4 along with the corn-ethanol supply curves in Figure 2, and by making two assumptions about how much sugarcane ethanol will be used to meet the advanced mandate. First, if we assume that no sugarcane ethanol will be used to meet the advanced mandate, then the total ethanol mandate will equal 13.8 billion gallons in 2013 and 14.4 billion gallons in 2014. Second, if we assume that the biodiesel mandate is capped at 1.28 billion gallons, then total ethanol mandates will equal 14.6 billion gallons in 2013 and 16.2 billion gallons in 2014 because imported sugarcane ethanol will be used instead of biodiesel to meet the advanced mandate. The amount of actual ethanol consumption will depend on how many of the banked RINs will be used to help meet the conventional ethanol mandate.

Meeting the Advanced Mandate with Biodiesel
To begin, Figure 5 shows some relevant supply and demand curves and the mandates. The 2014 supply curve shown is the supply curve from Figure 2, which corresponds to a 2013 corn yield of 160 bushels per acre. If each year's mandate had to be met by production in that year, then the RIN value for each year would be the vertical distance between each year's supply curve and the demand curve at each year's mandate. To get a better view of this vertical distance, Figure 6 provides a close-up view of the relevant portions and the corresponding RIN values. As shown, if ethanol production equals mandate ethanol consumption, then 2013 RIN prices will be approximately $1.20 per gallon and 2014 RIN prices will be only $0.20 per gallon. Clearly, holders of banked RIN have a large incentive to use their banked RINs in 2013, not in 2014. Why would anybody bank a RIN when it will likely lose most of its value?
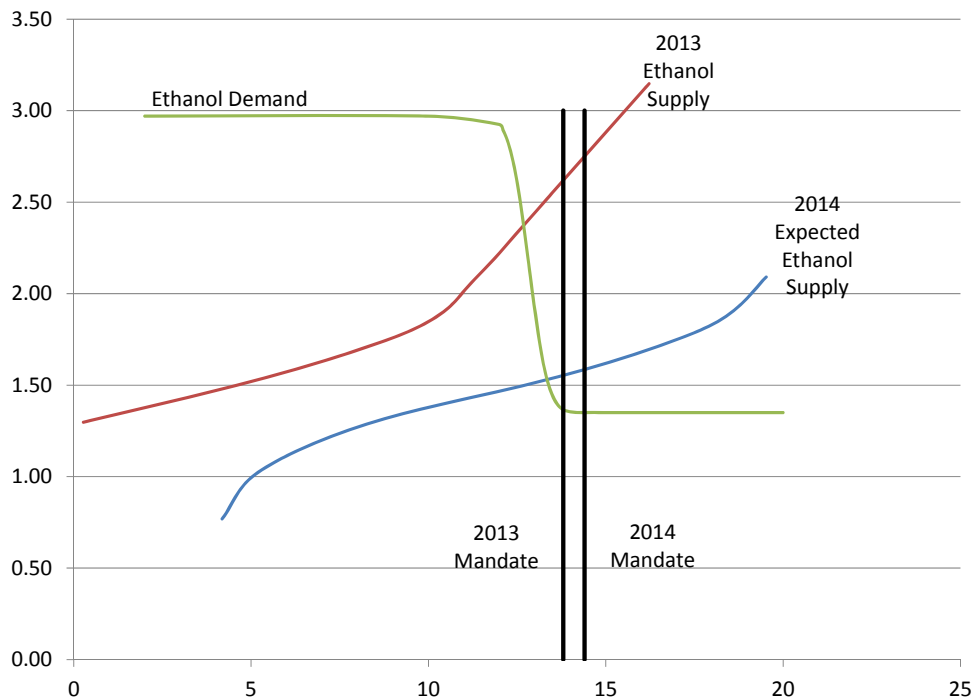

Figure 5. Supply and demand for ethanol in 2013 and 2014 with no sugarcane ethanol and a $2.70 per gallon gasoline price
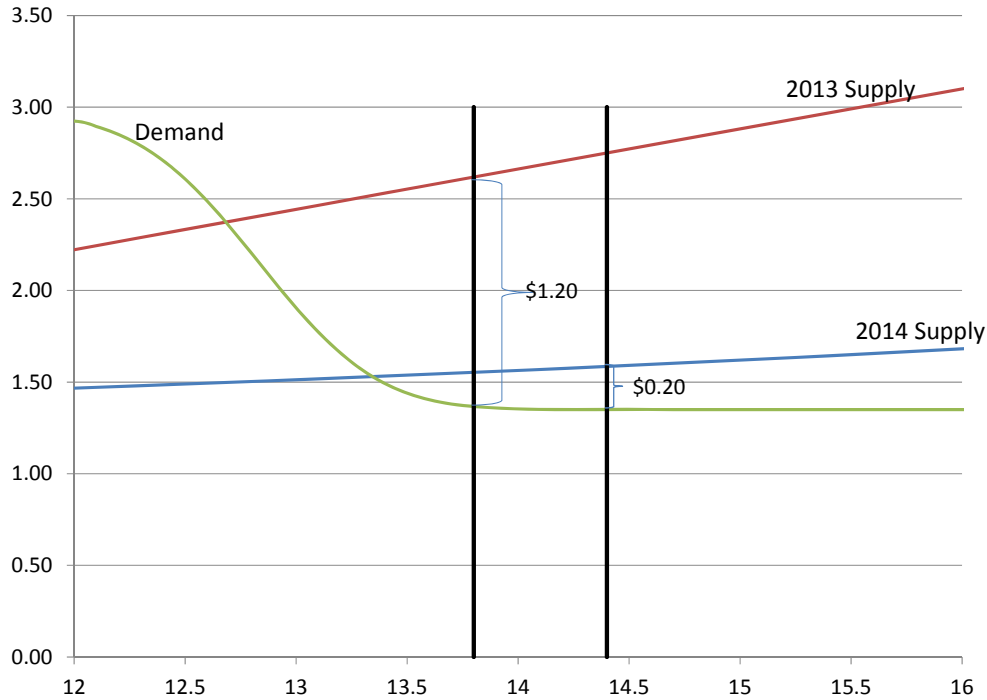
Figure 6. Determination of RIN prices in 2013 and 2014 without use of banked RINs

Note that the ethanol demand curve in Figure 6 intersects the 2013 ethanol supply curve at about 12.7 billion gallons. This means that if 1.1 billion banked RINs were used in 2013 to help meet the mandate, then the RIN price would fall to zero and there would still be 800 million banked RINs available to meet the 2014 mandate. Were 800 million banked RINs to be used in 2014, then the 2014 RIN price would fall to nearly zero because the 2014 ethanol supply curve intersects the ethanol demand curve at about 13.4 billion gallons. Thus, if sugarcane ethanol is not imported to meet a portion of the advanced mandate, then the current amount of banked RINs along with ethanol are likely sufficient to meet the ethanol mandates in 2013 and 2014. In this situation, one would not expect conventional ethanol RIN prices to be quite low.

Meeting the Advanced Mandate with Sugarcane Ethanol and Biodiesel
It is doubtful, however, that biodiesel will out-compete sugarcane ethanol for the portion of the advanced mandate that is not met by the biomass-based diesel mandate. If biodiesel just meets its own mandate, then an additional 800 million gallons of sugarcane ethanol will need to be consumed in 2013, and an additional 1.8 billion gallons in 2014. This situation is depicted in Figure 7.

The demand prices in Figure 7 are determined by the total ethanol consumed. The supply prices are determined by the amount of domestic ethanol produced. If no banked RINs are used, then the RIN price in each year is the vertical distance between the supply price and the demand price, which is $1.25 in 2013 and $0.20 in 2014. As before, there is an incentive to use banked RINs in 2013 because they are more valuable than in 2014.
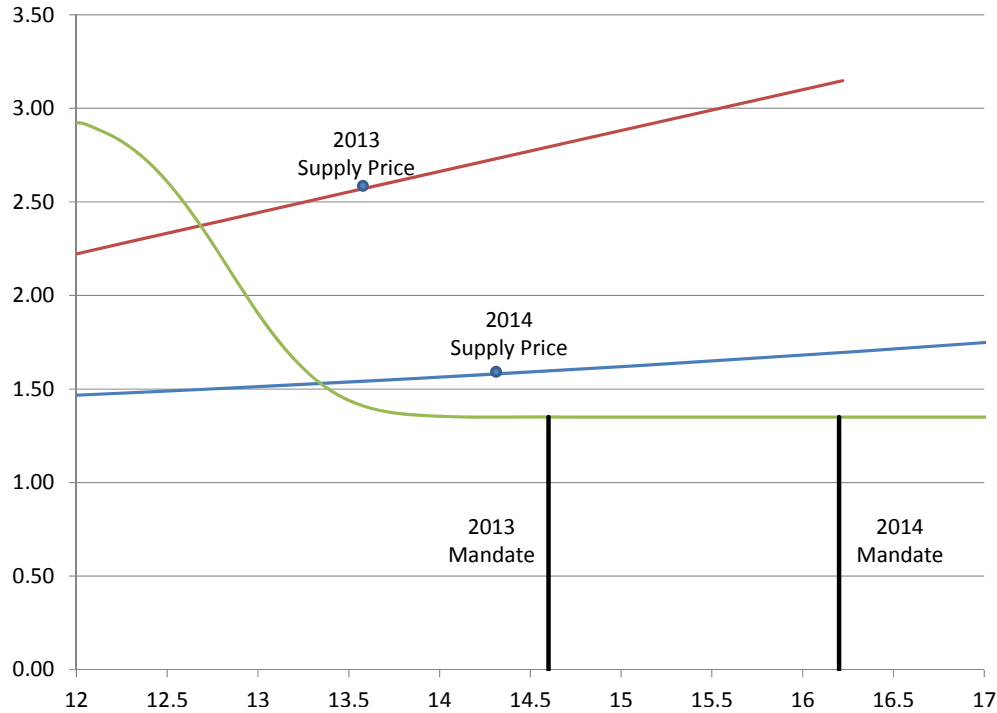
Figure 7. RIN price determination with imported sugarcane ethanol and no use of banked RINs

However, use of 1.1 billion banked RINs in 2013 is insufficient to bring the price of RINs down to zero because total ethanol consumption would still be equal to the blend wall at 13.6 billion gallons. Thus, RIN prices in 2013 would remain high at about $1.00 per gallon. Use of 1.5 billion banked RINs would lower the RIN price to approximately $0.25 per gallon in 2013, which is still lower than the RIN price in 2014. A $0.20 RIN price could be achieved if 1.8 billion banked RINs are used in 2013, leaving only 100 million RINs for 2014. Thus, a much greater proportion of banked RINs will be used in 2013 if sugarcane meets the portion of the advanced mandate that is not met by the biodiesel mandate.

Whether sugarcane ethanol is used or not, this analysis helps explain why current RIN prices are so low. Simply put, there are enough banked RINs to use in 2013 and 2014 in combination with ethanol production to dramatically lessen the impact of the conventional and advanced mandates. How robust these results are is discussed next.

Some Caveats and a Look Beyond 2014
As with all economic analysis, some simplifying assumptions were made to obtain key insights into the question of when banked RINs would be used. As shown in Figure 2, the 2013 corn yield will have a major influence on the cost of producing ethanol in 2014. If corn yields turn out to be much lower than 160 bushels per acre, then the RIN value in 2014 will be much higher than suggested by Figure 6. A higher RIN value in 2014 would tend to reduce the amount of banked RINs used in 2013, and hence RIN prices in 2013 would in turn increase. In addition, if gasoline prices turn out to be much lower than $2.70 per gallon, then RIN prices would tend to be higher than assumed here.

Another possibly important factor that is not accounted for in this study is the level of US ethanol exports. Increased exports increase the supply price of ethanol, which increases the RIN price. Canada will likely continue to import US-produced corn ethanol, and any Brazilian exports that are used to meet the advance mandate will cause Brazilian demand for imports to rise. If 2013 corn yields rebound significantly, then the impacts of exports on RIN values will be modest.

There likely is not a great deal of uncertainty regarding corn acreage in 2013 because futures markets are signaling farmers to plant a lot of corn in 2013. Part of the reason why current futures prices are so high is that if farmers do not plant a lot of corn, and if weather does not cooperate, then the price of corn could rise well above current levels. If, instead, corn yields return to trend-line levels, then corn prices will drop significantly in 2014 to between $4.00 and $5.00 per bushel depending on how much ethanol is needed to meet the 2014 mandate.

Perhaps the most important caveat concerns the ethanol price discount needed to incentivize owners of gasoline stations to supply enough E85 at a low enough price to induce owners of FFVs to use E85. If the discount is much more than the 50 percent discount assumed here, then perhaps it is not realistic to expect EPA to implement the RFS mandates as scheduled.

Interestingly, the current low RIN prices for conventional ethanol are consistent with both a future in which EPA does not implement the mandates because there is no pathway beyond the E10 blend wall, and with a future in which EPA fully implements the mandates because a combination of banked RINs and E85 (or perhaps E15) provides a viable pathway through the blend wall.

If EPA does not implement the mandates as scheduled, then what happens beyond 2014 is that corn prices and corn acreage will drop, and ethanol production will likely stay at about 13 billion gallons plus some amount that is exported.

If a way through the ethanol blend wall is found then the big decision facing EPA will be whether to fully implement the advanced mandate, substituting non-cellulosic advanced biofuels for a lack of cellulosic biofuels, or to reduce the total advanced mandate. In either case, Brazil will have to significantly expand sugarcane production to meet domestic and export demand for ethanol, and US corn ethanol will level out at 15 billion gallons. If the way through the blend wall is with expanded use of E85, then demand for FFVs will grow as will E85 availability. If the Brazilian experience is any guide, we should then see the wholesale price of ethanol low enough to induce FFV owners to use enough ethanol to meet the large and growing mandates.

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