A Preliminary Assessment of RIN Market Dynamics, RIN Prices, and Their Effects

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Executive Summary

In 2013 the price of renewable identification numbers (RINs) for renewable fuels generated under the Renewable Fuel Standard (RFS) program increased significantly. This document examines available data in an attempt to describe and explain the factors that caused this increase in the price of one variety of renewable fuel (D6) RINs, and the impact this increase in RIN prices may have had on retail fuel prices. We also examine the impact of high RIN prices on merchant refiners (i.e. refiners who do not blend the majority of the petroleum products they produce with renewable fuels), some of whom argue that they are disadvantaged relative to integrated refiners (i.e. refiners who blend a volume of petroleum products with renewable fuels greater than or equal to the volume of petroleum products they produce) by high RIN prices. For the purposes of this document we have primarily considered available data from 2013, and have assumed constant renewable volume obligations (RVOs). This document does not quantify the total cost of the RFS program to consumers or other parties. We acknowledge, however, that the program is likely to have a cost if the cost of renewable fuels is greater than the petroleum based fuels they replace on an energy equivalent basis and if this cost outweighs the overall decrease in the cost of transportation fuel that results from increased fuel supply.[1]

In examining the available data we found that the rise in D6 RIN prices can largely be explained by the increasing total renewable fuel requirement of the RFS program. For the first time in 2013 this standard was established at a level beyond what could be achieved by the blending of ethanol as E10. This meant that the D6 RIN price was largely driven by the marginal cost of blending and marketing ethanol as E85, or the cost of blending other non-ethanol renewable fuels where available, since nearly all gasoline sold in the United States already contained 10 percent ethanol. The demand price for ethanol sold in an E85 blend is significantly less than the demand price for ethanol sold as an E10 blend, as the lower energy density of the fuel, and therefore lower fuel economy of a vehicle operating on E85, are more noticeable in higher level ethanol blends. Alternative fuel choices to E85, such as E10, are also widely available, giving consumers the opportunity to purchase the lowest cost fuel. With the exception of two brief spikes in the price of D6 RINs, which may be the result of the market adjusting to new supply and demand realities,[2] the D6 RIN

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[1] Several parties have credited the increased availability of renewable fuels with a decrease in the market price of petroleum derived fuels (relative to a scenario with no renewable fuels) as renewable fuels increase the global supply of transportation fuel. While we acknowledge that increasing available volumes of renewable fuels may have had some effect on global petroleum prices, there is much uncertainty surrounding the magnitude of this impact and quantifying it is beyond the scope of this document.

[2] These price spikes, reported by Oil Price Information Service (OPIS), may overstate the average RIN price as many RINs are purchased through long term contracts or acquired when attached to renewable fuels. The prices reported by OPIS are more reflective of the price for separated RINs in the spot market.

prices in 2013 generally reflect what would be expected as the demand price for ethanol shifts from a volumetric relationship with gasoline, as was the case for E10, to an energy equivalent relationship with gasoline, as is expected to be the case for E85. We do not find evidence that the price of D6 RINs was driven by scarcity pricing,[3] as some have suggested.

While RIN prices were significantly higher in 2013 than in previous years, we did not see, nor would we expect to see, a corresponding net increase in the overall retail price of transportation fuels across the entire fuel pool. This is because the RIN price, rather than acting as an additional cost, generally acts as a transfer payment between parties that blend renewable fuels and obligated parties who produce or import petroleum-based fuels and are required to obtain RINs for compliance purposes.[4] RINs are generated by renewable fuel producers and sold attached to volumes of renewable fuels to fuel blenders or obligated parties. When the RINs are separated from the renewable fuel and sold independently, the RIN seller may use the revenue received for the RIN to discount the effective cost of the renewable fuel. In order to recover the cost of purchasing RINs, however, obligated parties are expected to increase the selling price of the petroleum products they produce. If fuel prices are fully flexible, markets are perfectly competitive, and we assume no changes to the price of renewable or petroleum based fuels, these two price impacts, the discounting of renewable fuels enabled by the sale of the RINs and the higher petroleum prices that result from the cost of purchasing RINs, are expected to offset each other, resulting in the RIN price having no net impact across the entire fuel pool.

We note, however, that higher RIN prices are expected to have an impact on the retail price of transportation fuels such as E85, E10, and diesel fuel based on their renewable content. In some cases high RIN prices are expected to decrease the retail price of the fuel, while in others they are expected to result in an increase in the retail price of the fuel. High RIN prices are expected to reduce the price of fuel blends that contain a higher percentage of renewable fuels, such as E85 or B20, while increasing the price of fuels that contain little or no renewable fuels.[5] An increase in D6 RIN prices, as seen in 2013, is expected to result in a significant decrease in the price of E85, a very small decrease in the price of E10, and an increase in the price of diesel fuel. This is because the RIN costs of a gallon of fuel (the price increase of the petroleum blendstock due to the RIN obligations) is proportional to the amount of petroleum blendstock contained in a fuel blend, while the RIN value (the effective price reduction of the renewable fuel content enabled by the sale of the RIN) is proportional to the renewable content of the blend. These price impacts are one of the primary ways the RFS program can incentivize the increased blending and consumption of

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[3] Scarcity pricing occurs when the price of a good increases significantly due to concerns over a limited supply. In this context we use the term scarcity pricing to refer to a situation where the price of D6 RINs rises significantly beyond what would be expected when considering the price of ethanol and the consumer demand price for ethanol when sold as E85.

[4] In some cases the fuel blender and obligated party may be the same company.

[5] This is expected to be true in a competitive market, however many of these expected price reductions may not be realized for fuels such as E85 that at the current time generally face little competition at the wholesale and retail level. As the availability of these fuels increases we anticipate that a higher proportion of the expected price decrease will be realized by consumers.

renewable fuels in the United States. In blends such as E10, RIN prices are expected to have little overall impact as the RIN cost is approximately equal to the RIN value.

Finally, we examined available data to determine if the expected impacts of high RIN prices could be observed. We were able to observe these impacts in several areas, notably in price differences between petroleum-based fuels with and without RIN obligations and in lower wholesale and retail prices for fuel blends containing higher percentages of renewable fuels. RIN prices are not expected to have a significant impact on the wholesale or retail prices of E10, the most widely used transportation fuel in the United States, as the rise in the market price of the petroleum blendstock due to the RIN cost is offset by the lower effective price of the ethanol portion of the blend enabled by the value of the RIN. The higher market prices for petroleum fuels with RIN obligations relative to those without RIN obligations suggest that obligated parties are generally recovering their RIN costs in the price of the petroleum fuels they produce. Merchant refiners, who largely purchase separated RINs to meet their RFS obligations, should not therefore be disadvantaged by higher RIN prices, as they are recovering these costs in the sale price of their products. Were this not the case, merchant refiners could, and we expect would, avail themselves of other compliance strategies such as contractual arrangements and investing in fuel blending and distribution infrastructure, which are available to merchant refiners looking for alternative methods for meeting their RIN obligations.

Each of these conclusions, and the available data that EPA examined to arrive at these conclusions, is presented in further detail below. While the focus of this document is explaining the rise in RIN prices and resulting fuels marketplace impacts in 2013, we expect a similar set of issues and market forces will be at work in future years.

We note that this document examines available data through June 2014. EPA intends to continue to monitor available data and update the assessments contained in this document as time allows and data becomes available. EPA also welcomes feedback and input on our methodology and conclusions.


Background

On March 26, 2010 EPA published changes to the RFS program regulations, as required by the Energy Independence and Security Act of 2007 (EISA), to ensure that transportation fuel sold in the United States contains volumes of renewable fuel that are either specified in the statute or set by EPA pursuant to specified waiver authorities. The EISA amendments increased the volume of renewable fuel required to be blended into transportation fuel to 36 billion gallons by 2022. As a part of the RFS regulations, EPA implemented a system for tracking the production and use of qualifying renewable fuel using Renewable Identification Numbers or RINs. These RINs are generated by renewable fuel producers or importers and are bought and sold "attached" to the renewable fuel until the fuel is purchased by an "obligated party" (a refiner or importer of gasoline or diesel fuel) or blended with a petroleum-based transportation fuel. At that point the RIN is "separated"

from the fuel and may thereafter be independently bought or sold until it is retired to meet an obligated party's renewable volume obligation or for some other reason.

By providing an opportunity for obligated parties to fulfill their obligations under the RFS program by purchasing RINs, the RIN market allows obligated parties the flexibility to choose whether or not to be directly involved in the blending of renewable fuels. Obligated parties may choose to acquire RINs by directly blending renewable fuels, by purchasing renewable fuel, separating the RINs, and selling the renewable fuel without RINs, or by purchasing separated RINs on the spot market or through other contractual arrangements. While most RINs are used for compliance in the year they are generated, up to 20% of an obligated party's renewable volume obligation (RVO) may be satisfied with RINs generated in the previous year. This allows excess RINs to function as an inventory in the RIN trading market and provides compliance flexibility to the obligated parties as excess (or "carry over") RINs can act as a buffer for obligated parties to protect themselves against unforeseen changes in the RIN market. Obligated parties may also defer their RFS obligation, in whole or in part, to the following year, provided that the RIN obligation is satisfied together with the party's next year's RVO.

In 2013 the price for Renewable Fuel RINs (D6) increased substantially, from an average of a few cents per RIN in previous years to over $1.00 per RIN in the summer of 2013 (see Figure 1 below). The swift run up in the RIN price led a variety of stakeholders to conduct analyses looking into the causes and impacts of the increase. This document presents EPA's assessment of the cause of the high RIN prices, the expected impacts on retail fuel prices of high RIN payments, and the impact of high RIN prices on obligated parties. Throughout, this document focuses on D6 RINs; references to RIN prices are to D6 RINs unless otherwise noted.

Figure 1
RIN Prices

All RIN Prices from OPIS Ethanol and Biodiesel Information Service
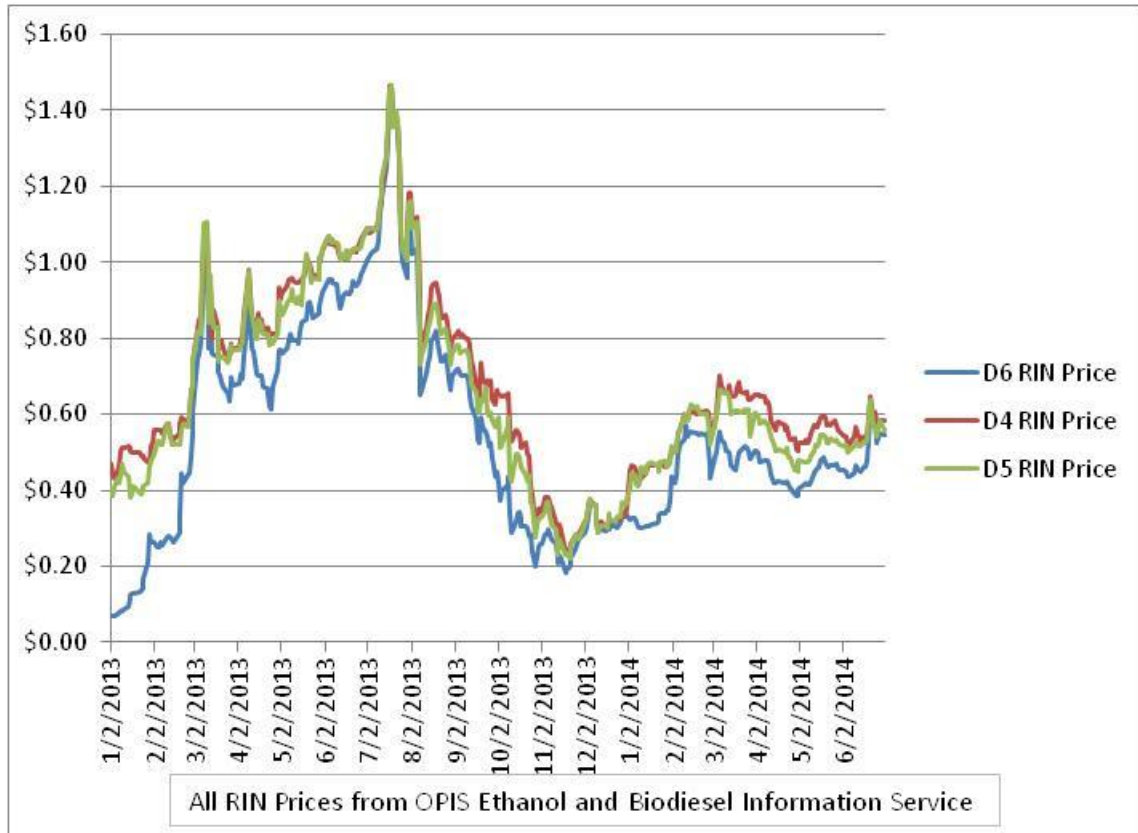
RIN Market Overview

In attempting to describe and explain the many factors that affect RIN prices or the effect of RIN prices on fuel prices and market participants, it is helpful to begin with a look at the roles different RIN market participants play. RINs are generated by renewable fuel producers.[6] RINs may be generated any time after the fuel is produced but before the fuel leaves the custody of the renewable fuel producer. Each RIN is "attached" to a gallon of renewable fuel and must be sold with that gallon of renewable fuel for which it was generated.

After a gallon of renewable fuel is sold, it is generally blended with a petroleum based fuel to produce a transportation fuel such as E10, E85, or B5. When a gallon of renewable fuel with an attached RIN is purchased by an obligated party[7] or blended to create a

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[6] Renewable fuel must be made from "renewable biomass" in accordance with a "pathway" determined by EPA to satisfy lifecycle greenhouse gas reduction requirements (or be grandfathered from such requirements) and be produced for use as transportation fuel, jet fuel or home heating oil. Pathways are a combination of feedstock, finished fuel type, and production process. For a list of currently approved pathways see 40 CFR 80.1426

[7] In the RFS program an obligated party is defined as any refiner that produces gasoline or diesel fuel in the 48 contiguous states or Hawaii, or any importer that imports gasoline or diesel fuel, into the 48 contiguous states or Hawaii

transportation fuel the owner of the fuel may separate the RIN from the renewable fuel. The RIN can then be used by the obligated party to demonstrate compliance with their RFS obligation, or it can be sold to another obligated party seeking RINs to fulfill their renewable volume obligation. Figure 2 presents a basic schematic of the RIN/renewable fuel market.

Figure 2
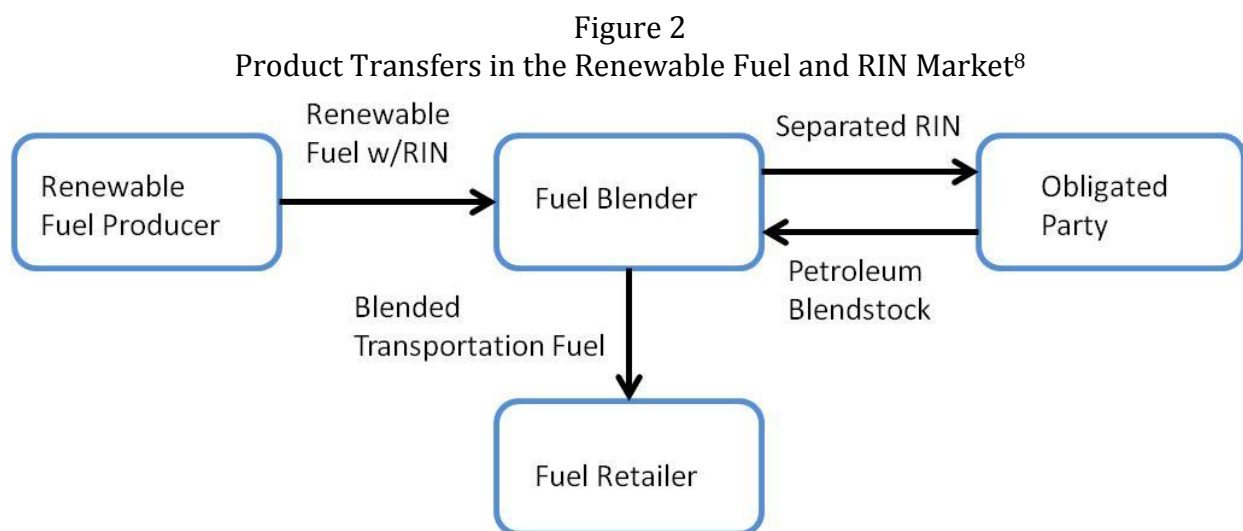Product Transfers in the Renewable Fuel and RIN Market[8]

Figure 2 greatly simplifies the reality of a complex marketplace. For example, many obligated parties also own fuel blending operations, and others may purchase renewable fuel with an attached RIN, retain the RIN, and then sell the renewable fuel without the RIN. In practice several parties may take ownership of a renewable fuel before it is blended with a petroleum blendstock to produce a transportation fuel. Similarly separated RINs may be sold to brokers or aggregators before being sold to obligated parties. Where there are additional parties participating in the marketplace not shown in the graphic above, the commodity price received by one of the depicted parties will not be equal to the purchase price paid by the party who ultimately receives the commodity as the intermediate parties will require a fee for their services. We do not expect these fees to be significant, as the RIN and transportation fuel marketplaces are generally competitive.

There are also cases where a single company may be active in multiple areas of the transportation fuel market place. Examples include an ethanol production facility that blends finished transportation fuel, or a refiner who owns fuel blending terminals. In these cases certain transactions may take place within a single company rather than between two companies. The same fundamental transactions, however, still take place, whether they are internal to one company or external and involve different entities.

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[8] In the graphics in this document we have depicted the renewable fuel producer, fuel blender, obligated party, and fuel retailer as independent entities. In reality two or more of these functions may be conducted by the same company. Traditionally many obligated parties have also functioned as fuel blenders, and increasingly renewable fuel producers are also producing and marketing renewable fuel blends.

Factors Affecting the RIN Price

EPA designed the RIN program with the intention of providing a market-based compliance mechanism that would cause minimal disruption in the transportation fuel marketplace, while also providing EPA with the necessary assurance that the mandated volumes of renewable fuel would be used in the transportation sector. EPA sought to provide flexibility to refiners, importers, and other producers of petroleum-based transportation fuel by allowing obligated parties to purchase RINs and rely on the existing renewable fuel production, distribution, and blending marketplace rather than requiring each obligated party to directly blend a quantity of renewable fuel equal to their renewable volume obligation. If the RIN market is functioning efficiently the RIN price should be approximately equal to the difference between a renewable fuel's supply price and its demand price (the price the market is willing to pay for the renewable fuel as a transportation fuel). The RIN price provides the incentive the renewable fuel producer needs to continue to produce renewable fuel up to the mandated volume even if the demand price for the fuel would not otherwise cover the cost of production of the renewable fuel.

With this in mind, EPA examined available price data to determine if changes in the supply and demand price for renewable fuels explained the rising and variable D6 RIN prices observed in 2013. Determining a supply price was straightforward: EPA used ethanol[9] price data reported weekly by USDA.[10]

Determining the demand price for ethanol, however, is more complicated. Ethanol, in its unblended form, cannot be used as a transportation fuel by vehicles in the United States. It must be blended with gasoline to produce transportation fuels such as E10 (containing 10% ethanol) or higher level blends such as E85 (containing between 51% and 83% ethanol with a national average ethanol content of 74% as reported by the Energy Information Administration (EIA)).

We posit that the demand price for ethanol in a blended transportation fuel varies significantly depending on the ethanol blend level. The vast majority of ethanol sold as transportation fuel in the United States is sold as E10. When ethanol is sold in an E10 blend we believe that the demand price is approximately equal to the price of the gasoline fuel into which it is blended on a volumetric basis, despite the fact that ethanol contains approximately 33% less energy per gallon than gasoline.

There are several reasons we believe this to be the case. Due to the relatively low level of ethanol in E10 the fuel economy reduction of E10 as compared to E0 (gasoline without ethanol) is fairly small (approximately 3%) and not noticeable by most consumers. Customers therefore generally do not seek price discounts for E10 v. E0. Furthermore, for

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[9] Throughout this document all references to ethanol are to denatured ethanol

[10] Data recorded by Agricultural Marketing Resource Center. These prices are for ethanol with attached RINs. Accessed online April 10, 2014 <http://www.agmrc.org/renewable_energy/ethanol/midwest-ethanol-cash-prices-basis-data-and-charts-for-selected-states/>

the relatively few consumers who are aware of the slightly lower energy content (and therefore lower fuel economy) of E10 as compared to E0, options to purchase E0 are very limited as virtually all gasoline sold in the United States now contains 10% ethanol. Where E0 is available, it is generally priced at a significant premium relative to E10, thus negating any potential value it may have offered due to its higher energy content. For a further discussion of the pricing of ethanol as E10 see the 2012 Notice of Decision Regarding Requests for a Waiver of the Renewable Fuel Standard.[11]

If the demand price for ethanol as transportation fuel when blended as E10 is approximately equal to the price of gasoline on a volumetric basis, rather than an energy-equivalent basis, we would expect D6 RIN prices to be very low whenever the ethanol price is below the gasoline price. This is because fuel blenders can generate profit by purchasing ethanol for a lower price than gasoline and sell the blended E10 at a price approximately equal to that of the gasoline blendstock on a per gallon basis despite the lower energy content of the fuel. No RIN value is necessary for the blending of ethanol to be profitable under these conditions. This was the case throughout the history of the RFS program until the early months of 2013. As shown in the graph below, from July 2010, the effective date of the updated RFS regulations, through the end of 2012 ethanol was generally priced below gasoline *on a volumetric basis*, and D6 RIN prices were only a few cents, likely attributable to RIN transaction costs. In 2013 the price of ethanol generally remained below the price of gasoline on a volumetric basis, yet the price of D6 RINs increased substantially. We believe a significant factor in this change in RIN price was a saturation of the E10 pool requiring that any additional volumes of ethanol be blended as E85.

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[11] FRL-9754-4

Figure 3
Ethanol, Gasoline, and D6 RIN Prices (July 2010 – June 2014)
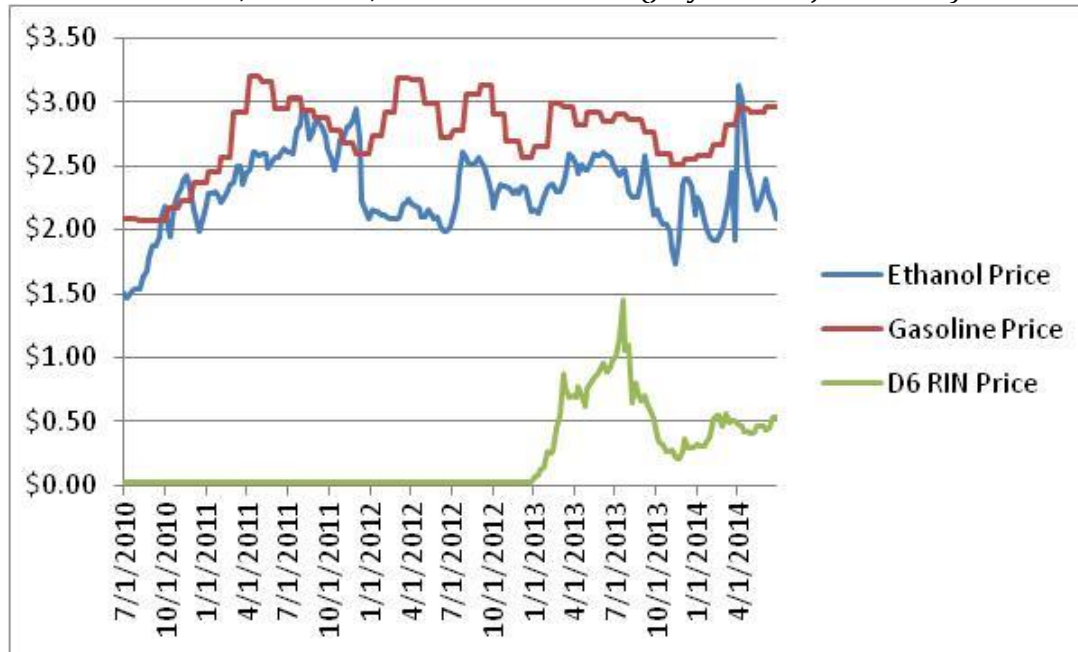
Note: The ethanol blenders tax credit expired on December 31, 2011, likely resulting in the decline in ethanol price in January 2012. The price spike in March/April 2014 was primarily the result of extremely cold winter temperatures leading to rail congestion[12]

When ethanol is sold as an E85 blend available information suggests that the ethanol has a significantly different consumer demand price. E85 blends contain significantly less energy per gallon than E10 (approximately 22% less energy per gallon assuming E85 contains 74% ethanol). This lower energy content results in a decrease in fuel economy of approximately 22% when owners of flexible fuel vehicles (FFVs) operate their vehicles on E85 rather than E10. Not only is the decrease in fuel economy more noticeable to fuel customers, but the fuel customers also have the ability to choose between purchasing E85 or E10, as E10 is available everywhere that E85 is. For E85 to appeal to most customers, therefore, it would need to be priced in a manner that accounts for the fuel economy penalty, as well as any "inconvenience factor" associated with its lack of availability relative to E10 and the need to refuel more frequently.

We argue that the more noticeable decrease in fuel economy and the greater availability of alternative fuel choices has a significant impact on consumer decisions regarding purchases of E85. While some FFV owners, primarily motivated by factors other than minimizing fuel costs[13], may purchase E85 at prices above energy parity, the majority of

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[12] For further information on this issue see "Rail congestion, cold weather raise ethanol spot prices." *Today in Energy*. U.S. Energy Information Administration, April 3, 2014. Web. September 25, 2014 <http://www.eia.gov/todayinenergy/detail.cfm?id=15691>.

[13] Consumers may purchase E85 when priced above energy parity for reasons such as supporting the rural economy, a desire to buy a domestically sourced fuel, E85's perceived environmental attributes, or government fleet mandates. Alternatively some customers may avoid purchasing E85 even when it is

potential E85 customers will likely only purchase E85 if it is priced at a per gallon discount equal to or greater than the difference in energy content between E85 and E10.[14] If this is the case, the demand price for ethanol as a transportation fuel in an E85 blend is proportional to gasoline on an energy-equivalent, rather than a volumetric basis. This means that we would expect the true demand price for ethanol blended as E85 to be approximately 67% of the price of gasoline.[15] We would further expect that in a competitive market the D6 RIN price would be approximately equal to the difference between the price of ethanol relative to the price of gasoline on a volumetric basis (or near zero if ethanol were cheaper) when ethanol was primarily sold as E10, as it was until the end of 2012, and approximately equal to the difference on an energy-equivalent basis (67% of the price of gasoline) when the E10 market is effectively saturated and additional ethanol must be blended as E85, as it was in 2013. The prices of ethanol, gasoline, and an ethanol-equivalent gallon of gasoline (67% of a gallon) for 2012 and 2013 are shown below (Figure 4), followed by a graph that compares the difference between these prices and the observed D6 RIN price in 2012 and 2013 (Figure 5).

Figure 4
Ethanol Price, Gasoline Price and Energy-Equivalent Gasoline Price
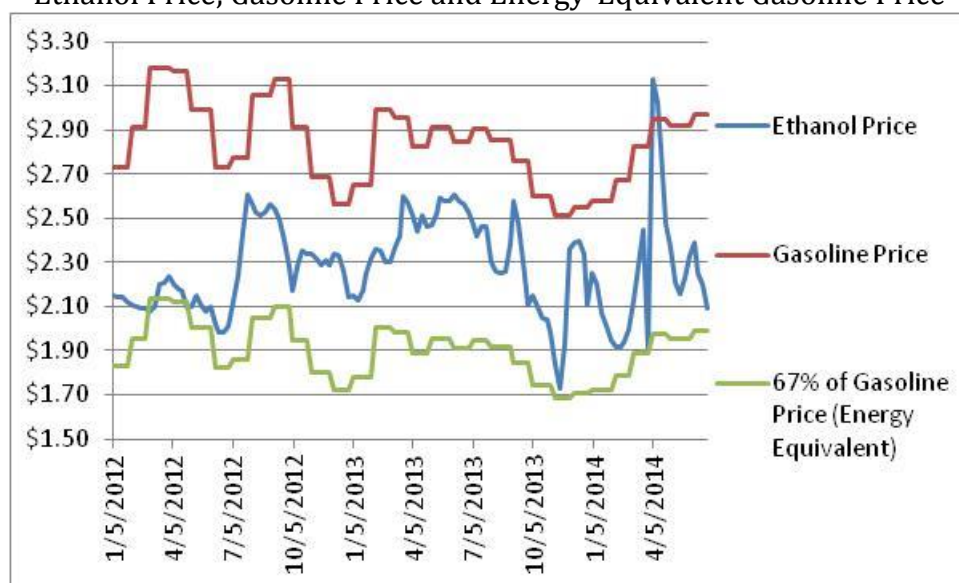

available and priced below energy parity due to concerns about fuel quality, a desire to avoid more frequent refueling, or a lack of knowledge that the fuel is compatible with their vehicle.

[14] Informed customer decisions are often complicated by a lack of information on the precise ethanol content of E85. E85 may contain anywhere from 51% to 83% ethanol. Uncertainty regarding the ethanol content of E85 may hinder a customers ability to effectively choose the lower cost fuel on an energy-equivalent basis.

[15] The energy content of ethanol (77,000 BTU/gallon) is approximately 67% of the energy content of gasoline or E0 (115,000 BTU/gallon).

Figure 5
D6 RIN Price and Difference Between Ethanol and Gasoline Price (Volumetric and Energy-Equivalent)
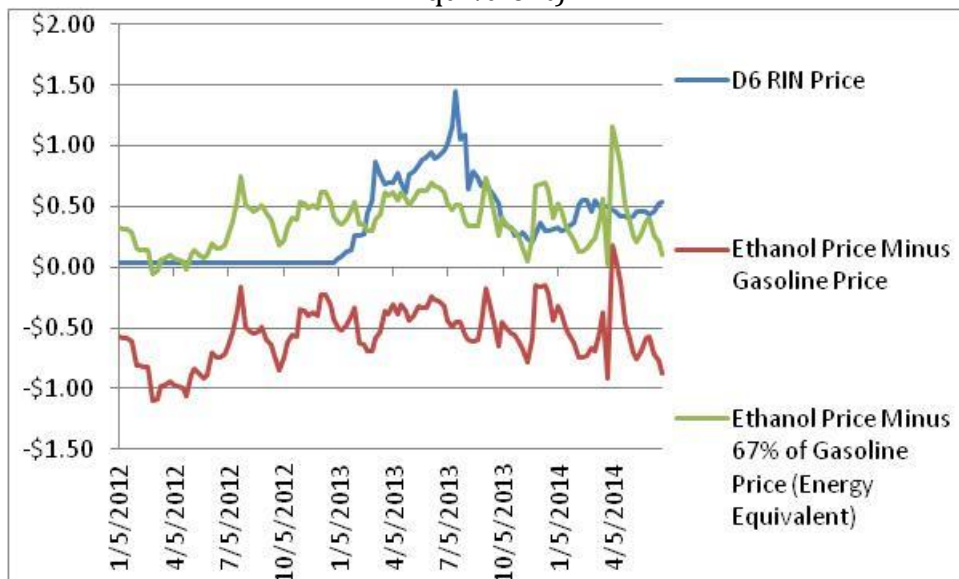
For the first time in 2013, the portion of obligated parties' total renewable volume obligations that could be satisfied with D6 RINs (the total volume obligation for non-advanced biofuels) exceeded the quantity of RINs that could be obtained by blending ethanol with gasoline to create E10. Because the amount of ethanol that could be blended as E10 was effectively capped, obligated parties looked to alternative sources of RINs, such as increased blending of ethanol as E85, the blending of additional non-ethanol biofuels, or the use of carry over RINs (RINs generated in 2012 available to satisfy 2013 obligations). In the ethanol market, we argue that the customer demand price shifted from a price based in part on gasoline on a volumetric basis (as it had been when increased blending of ethanol as E10 had represented the marginal gallon of ethanol), to one based in part on gasoline on an energy-equivalent basis, as increased ethanol blending of ethanol as E85 now represented the marginal gallon of ethanol. Figure 5 illustrates this shift. Throughout the vast majority of the time from January 2012 through June 2014 ethanol was cheaper than gasoline on a volumetric basis. Prior to reaching the E10 blendwall in 2013 the demand price for ethanol was primarily based on that of gasoline on a volumetric basis and D6 RINs were only a few cents, effectively representing transaction costs. After reaching the blendwall the demand price for ethanol shifts to being based primarily on the price of gasoline on an energy-equivalent basis. Because ethanol was more expensive than gasoline on an energy-equivalent basis from January 2013 through June 2014 the D6 RIN prices help offset the difference between the supply price of ethanol and the new demand price when the marginal gallon of ethanol is sold as E85.

This higher D6 RIN value also provided an increased opportunity for the increased blending of non-ethanol fuels, which may not have been profitable to blend into transportation fuel with low D6 RIN prices. In each of these cases, increased blending of ethanol as E85 and increased use of non-ethanol biofuels, the supply price exceeded the

demand price for these renewable fuels when used as a transportation fuel. As a result, RIN prices increased in 2013 as shown in Figure 1. The increasing D6 RIN price provided an incentive not only for increased blending of ethanol as E85, but also for the increased production and import of non-ethanol fuels such as biodiesel and for a draw-down in the bank of carry over RINs.

During the period of high RIN prices in the middle of 2013 some parts of the United States saw growth in E85 sales. This growth was most notable in states, such as Minnesota and Iowa, where the RIN value was most likely to be passed on to the consumer due to competition at both the wholesale and retail level in the E85 market.[16] However, consumption of E85 remained limited despite the high RIN prices due to a variety of factors including a lack of infrastructure for the blending, sale, and consumption of E85, and the lack of competitive markets leading to limited RIN value pass through to consumers in many markets.

Figure 6
Monthly E85 Sales in 2013 for States with Available Information
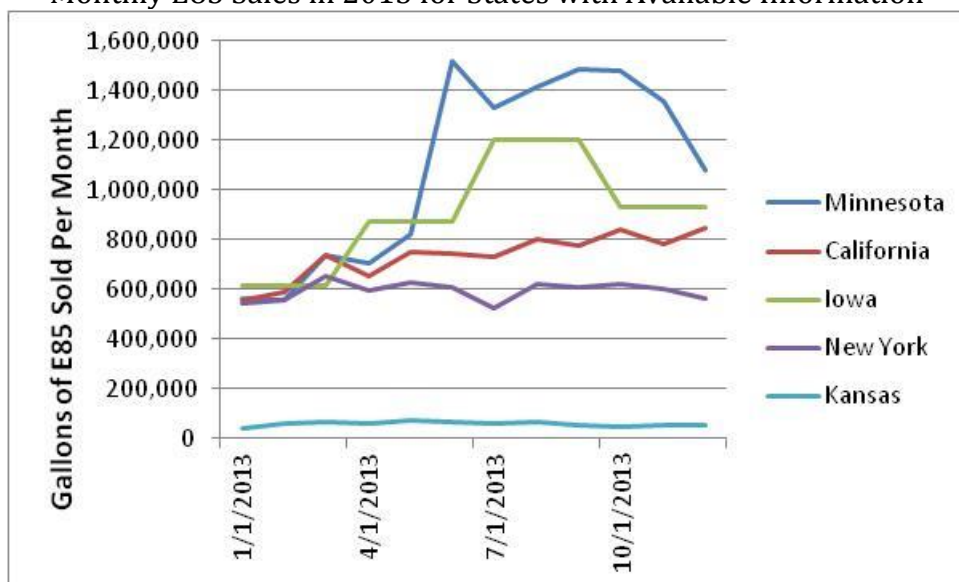
High D6 RIN prices had an even more significant impact on the production and consumption of non-ethanol biofuels such as biodiesel and renewable diesel, which did not face the same infrastructure challenges as ethanol blended as E85. Generation of D6 RINs for biodiesel and renewable diesel increased from approximately 6 million and 1 million in 2011 and 2012 respectively to over 250 million in 2013.[17] Generation of D4 (biomass-based diesel) RINs were also at the highest levels achieved under the RFS program. The increased availability of these fuels, combined with the availability of carry over RINs from excess production in 2012 helped to moderate the price of D6 RINs in 2013 despite the

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[16] According to data from DOE's Alternative Fuels Data Center approximately 20% of all E85 stations in the United States in 2013 were located in Minnesota or Iowa
[17] All RIN production numbers from EMTS

limited ability of RIN prices or volume mandates to increase the consumption of ethanol as E85.

On the basis of the data available to EPA, we believe much of the increase in 2013 D6 RIN can be explained by the arrival of the E10 blendwall in 2013 and the resulting change in demand price for ethanol. These factors alone, however, do not provide a complete explanation of the observed D6 RIN prices. As shown in Figure 5, from May 2013 through August 2013, spot D6 RIN prices were substantially higher than would have been expected based solely on the prices of ethanol and gasoline. This may have been due to a variety of factors, including: limited blending and retail infrastructure for E85, limited ability for RIN prices to affect the retail price of E85, the RIN price needed to incentivize increasing the production or import of non-ethanol fuels, and uncertainty about the final RFS standards for 2013 and 2014. It may also be the case that the reported prices for D6 RINs reflect the price of a relatively small number of RINs traded on the spot market rather than the D6 RINs purchased through long term contracts and are therefore more volatile and not necessarily reflective of the average D6 RIN price. Regardless, these elevated D6 RIN prices increased the incentive for the production, import, and consumption of non-ethanol fuels, notably biodiesel produced from grandfathered facilities,[18] which were eligible to generate D6 RINs and could now compete in the domestic fuels market as a result of their significantly increased RIN value. In other words, renewable fuels that were uneconomic to produce or import to satisfy the D6 RIN obligations when RIN prices were only a few cents became economic to produce or import with substantially increased D6 RIN prices.

It is highly speculative and difficult to predict the future price of D6 RINs, as they are influenced by multiple factors, including the supply and demand prices for ethanol, the price of petroleum, the cost of production of non-ethanol renewable fuels, consumer behavior in the E85 market, and availability of alternative compliance mechanisms. However, given the fact that the required total renewable fuel volume will likely exceed the volume of ethanol that can be blended as E10 in the future, we would not expect D6 RIN prices to return to the prices seen from 2010 to 2012.[19]

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[18] Grandfathered facilities are those that commenced construction on or before December 17, 2007, or any ethanol plant fired by natural gas, biomass, or a combination thereof that commenced construction before December 31, 2009. These facilities are exempt from the 20% GHG reduction requirement for the generation of D6 RINs, however they still must use a feedstock that meets the renewable biomass definition, be intended for use as transportation fuel or other qualifying uses, and meet all other reporting and recordkeeping requirements.

[19] RIN prices could return to historic low levels of a few cents if the price of ethanol or other renewable fuels fell sufficiently below the cost of gasoline on an energy equivalent basis

Figure 7
Generation of Non-Ethanol D6 RINs and D6 RIN Price
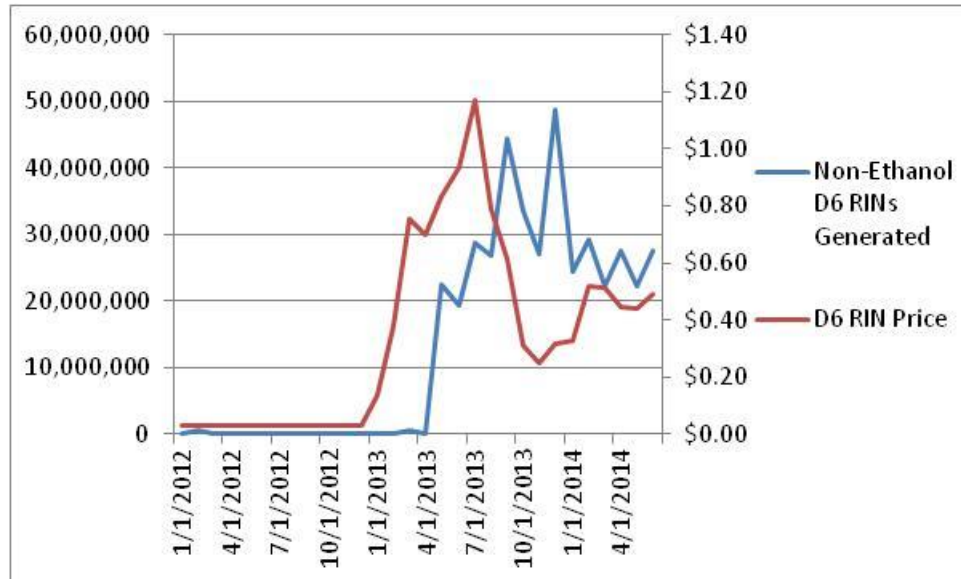
*RIN Prices from OPIS Ethanol and Biodiesel Information Services

RIN Price Impact on Transportation Fuel Prices

The high RIN prices observed in 2013 prompted questions not only regarding the cause of the increase, but also about the impact the RIN prices would have on the retail price of transportation fuel. Some have suggested that higher RIN prices necessarily lead to higher retail prices for all transportation fuels.[20] Our analysis, however, indicates that this is not likely to be the case. In short, this is due to the fact that, rather than being an additional cost, RINs can be viewed as transfer payments from obligated parties to renewable fuel blenders to incentivize the blending of renewable fuels and the sale of fuel blends with higher renewable content. These payments, while having no net impact on the overall cost of transportation fuel, can reduce the price of fuels with high renewable content, such as E85, at the expense of fuels such as diesel that generally contain a small percentage of renewable fuel. This can ultimately increase the demand for renewable fuels by giving the fuel blenders a greater incentive to increase the renewable content of the fuel blends they sell.

If the cost of producing ethanol and gasoline blendstocks (or biodiesel and diesel fuel) remains unchanged, then the overall cost of the blended fuels should not be impacted by RIN prices.[21] This does not mean that there is no cost to increasing the volume of renewable fuels required to be blended into the transportation fuel pool. If renewable fuels cost more on an energy-equivalent basis than the petroleum fuels they displace there is a

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[20] For example see "Gasoline Price Inflated by Ethanol in Oil Boom: Energy Markets" by Mario Parker, published by Bloomberg on March 21, 2013. Available online < http://www.bloomberg.com/news/2013-03-21/gasoline-price-inflated-by-ethanol-in-oil-boom-energy-markets.html>
[21] As stated in the previous paragraph, however, varying RIN prices are expected to impact the relative prices of different fuel types such as E85, E10, E0, B20, B5, etc.

cost to using these renewable fuels; and the higher the required volume of these fuels, the higher the cost will be. As can be seen in examining the available data, however, the sharp rise in D6 RIN prices did not have a measurable impact on the prices of ethanol with attached RINs (see Figure 8). Renewable fuel blenders acquire RINs by purchasing renewable fuels with attached RINs.[22] They sell these RINs to obligated parties, who look to recover the cost of these RINs in the price of the blendstocks they sell to the fuel blenders. Higher blendstock prices are in turn offset by the RIN value captured by blenders when they blend renewable fuels. We expect that higher RIN prices may increase the magnitude of these payments between obligated parties and renewable fuel blenders, as well as the relative pricing of fuel blends containing higher volumes of renewable fuels versus those containing little or no renewable fuel (see Figures 9 and 10 below), but that the net impact of these transfers on the cost of transportation fuel would be minimal.

Figure 8
Ethanol (with attached RIN) and D6 RIN Prices
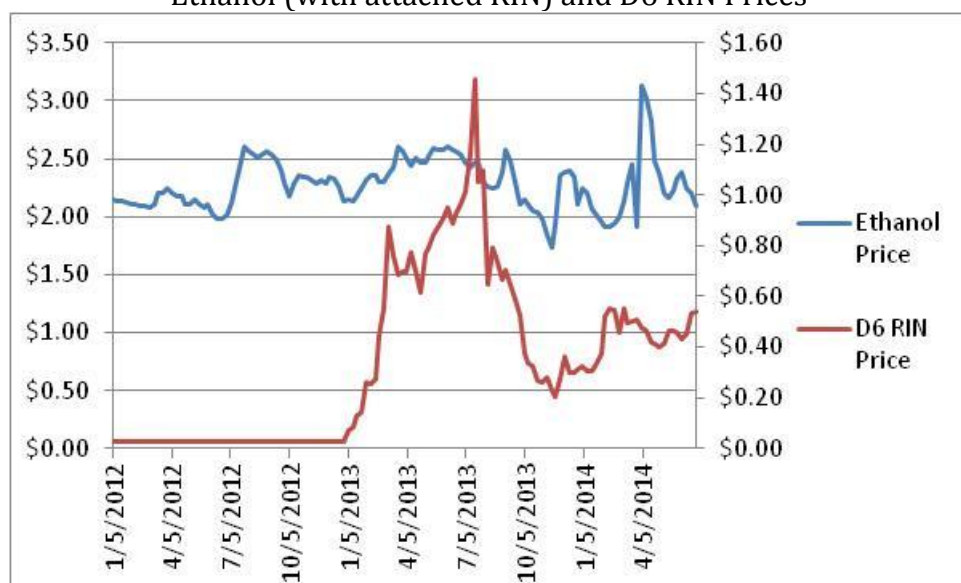
To illustrate this we examined the expected price of fuel supplied to the retailer for both E10 and E85. We did this first assuming a relatively low average RIN price and then again using the average RIN prices in 2013. The prices used for this example are shown in Table 1 below. The RIN obligation percentages are based on the 2013 volume requirements and standards. We note that because the standards are nested, the D6 RIN obligation percentage is equal to the total renewable fuel percentage standard minus the advanced biofuel percentage standard. Similarly, the D5 RIN obligation percentage is equal to the advanced biofuel percentage standard minus the biomass-based diesel percentage standard. For this example we have ignored the very small cellulosic biofuel requirement.

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[22] As noted previously, renewable fuels with attached RINs can be purchased directly by obligated parties, and many obligated parties also blend renewable fuels to produce transportation fuel.

The total RIN cost is calculated by summing the product of the RIN obligation percentages by the corresponding RIN price for each of the RIN types.[23] The structure of the RFS program is such that every gallon of gasoline or diesel fuel produced or imported in the United States has an equal RIN obligation, including cellulosic, biomass-based diesel, advanced, and total renewable RINs. This means that the RIN cost for a gallon of gasoline is impacted by the price of the biomass-based diesel RIN, even though biodiesel cannot be blended into gasoline. Our examples reflect this structure, with identical RIN costs for gasoline and diesel that vary with different RIN prices. For these examples we have ignored transportation, overhead, and profit-taking[24] to simplify our analysis. While these are all factors that will impact the cost paid by retailers for blended fuels, we would not expect them to vary with RIN prices and have therefore not explicitly considered them in our example.

Table 1
Illustrative Commodity Prices for Exploring RIN Price Impacts on Retail Fuel Prices

	Low RIN Prices	High RIN Prices (2013 Average for RIN Prices)
Ethanol (with attached RIN)[25]	$2.25/gallon	$2.25/gallon
Gasoline blendstock (without RIN costs)	$2.75/gallon	$2.75/gallon
Biodiesel (with attached RIN)	$4.00/gallon	$4.00/gallon
Diesel blendstock (without RIN costs)	$3.25/gallon	$3.25/gallon
D6 RIN Price	$0.05	$0.60
D4 RIN Price	$0.50	$0.73
D5 RIN Price	$0.25	$0.71
D6 RIN Obligation	8.12%	8.12%
D4 RIN Obligation	1.13%	1.13%
D5 RIN Obligation	0.49%	0.49%
Total RIN Cost per gallon(All RIN obligations)	$0.01	$0.06

Using these assumptions for commodity prices, and based on our schematic of the RIN and fuel market shown in Figure 2 above, we can follow each of the fuel types through the RIN and fuel market to estimate the impacts on the price paid by retailers for both E10 and E85.
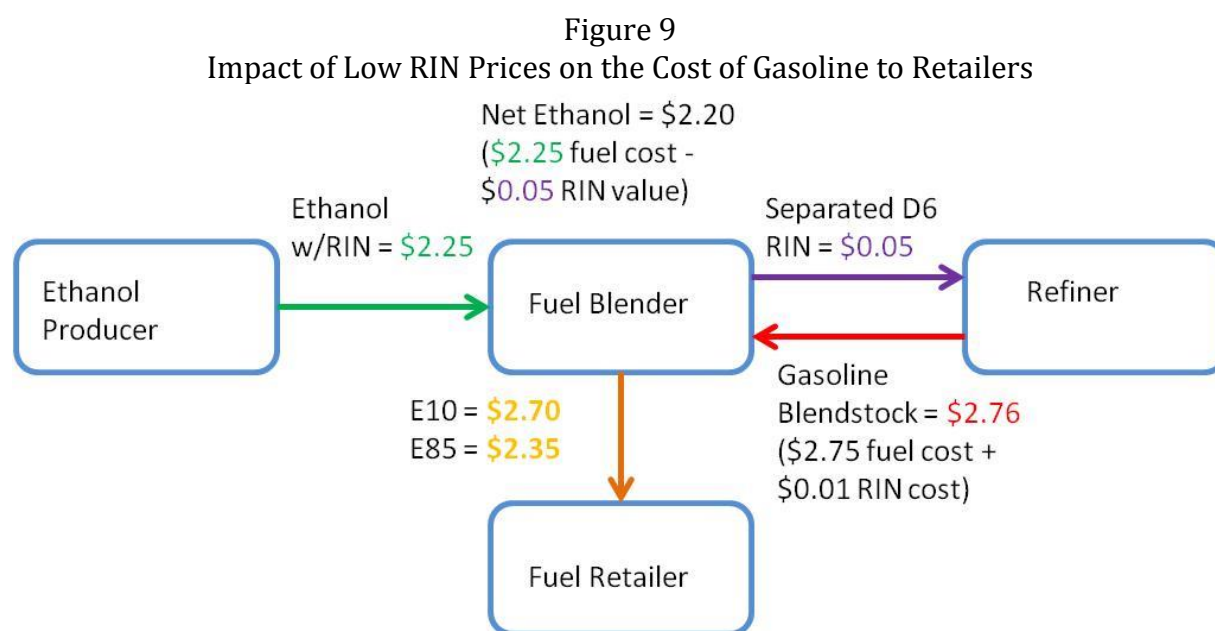
For the low RIN price scenario, we begin with the purchase of ethanol by the fuel blender from the renewable fuel producer. In this transaction the fuel blender receives one gallon

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[23] Per Gallon RIN Cost = D6 RIN Obligation * D6 RIN Price + D5 RIN Obligation * D5 RIN Price + D4 RIN Obligation * D4 RIN Price. This is the RFS "compliance cost" for each gallon of gasoline and diesel produced or imported by an obligated party.

[24] EPA has examined some data that suggests increased profit taking during times of high RIN prices in the E85 market, but believe this will decrease as competition in the E85 marketplace increases.

[25] As shown in Figure 8, data from 2013 strongly suggests that the price of ethanol with an attached RIN is not a function of the RIN price

of ethanol and the corresponding D6 RIN from an ethanol fuel producer for $2.25. After receiving the ethanol from the ethanol producer the fuel blender separates the D6 RIN and sells it to an obligated party for $0.05. The net purchase price for the ethanol without the RIN is therefore $2.20. The fuel blender next purchases gasoline blendstock from a refiner. The price the refiner would charge for one gallon of gasoline blendstock in the absence of the RFS program in this example is assumed to be $2.75 per gallon. Anticipating the need to purchase RINs to satisfy the RIN obligation associated with selling the gallon of gasoline blendstock, the refiner instead charges the fuel blender $2.76 per gallon ($2.75 for the cost of the gasoline blendstock and $0.01 to cover the per gallon cost of the RIN obligations). The fuel blender has effectively paid $2.20 per gallon of ethanol ($2.25 per gallon with attached RIN - $0.05 cost recovered in the sale of the RIN) and $2.76 per gallon of gasoline blendstock ($2.75 for the blendstock + $0.01 RIN recovery cost). The cost of producing blended fuels can be calculated by taking the average of these two fuel component costs weighted by the proportion of each component in the finished fuel blend.[26] The resulting blended fuel costs are $2.70 per gallon for E10 and $2.35 per gallon of E85. The prices and flows of the various commodities are shown in Figure 9 below.

Figure 9
Impact of Low RIN Prices on the Cost of Gasoline to Retailers

A similar scenario can be examined with high RIN prices, such as those observed in 2013. For this scenario, we begin in the same place, with the purchase of ethanol by the fuel blender from the renewable fuel producer. As in the previous scenario, the fuel blender receives one gallon of ethanol and the corresponding D6 RIN from an ethanol fuel producer for $2.25. In this case, however, after being separated from the gallon of ethanol the RIN is sold to an obligated party for $0.60. The net purchase price for the ethanol without the RIN is therefore $1.65 rather than $2.20 in the previous scenario. In response to the higher RIN

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[26] For this example we have assumed E10 contains 10% ethanol and 90% gasoline blendstock and E85 contains 74% ethanol and 26% gasoline blendstock. The equations to calculate the cost are therefore E10 = 0.1*[net ethanol cost] + 0.9*[net gasoline blendstock cost] and E85 = 0.74*[net ethanol cost] + 0.26*[net gasoline blendstock cost].

prices, the refiner must charge more for each gallon of gasoline blendstock sold to cover the cost of purchasing RINs to fulfill their RVO. The refiner now charges the fuel blender $2.81 per gallon of gasoline blendstock ($2.75 for the cost of the gasoline blendstock and $0.06 to cover the cost of the RIN obligations). In this high RIN price scenario, the fuel blender has effectively paid $1.65 per gallon of ethanol ($2.25 per gallon with attached RIN - $0.60 cost recovered in the sale of the RIN) and $2.81 per gallon of gasoline blendstock ($2.75 for the blendstock + $0.06 RIN recovery cost). The resulting blended fuel costs are $2.69 per gallon for E10 and $1.95 per gallon of E85. The prices and flows of the various commodities are shown in Figure 10 below.

Figure 10
Impact of High RIN Prices on the Cost of Gasoline to Retailers
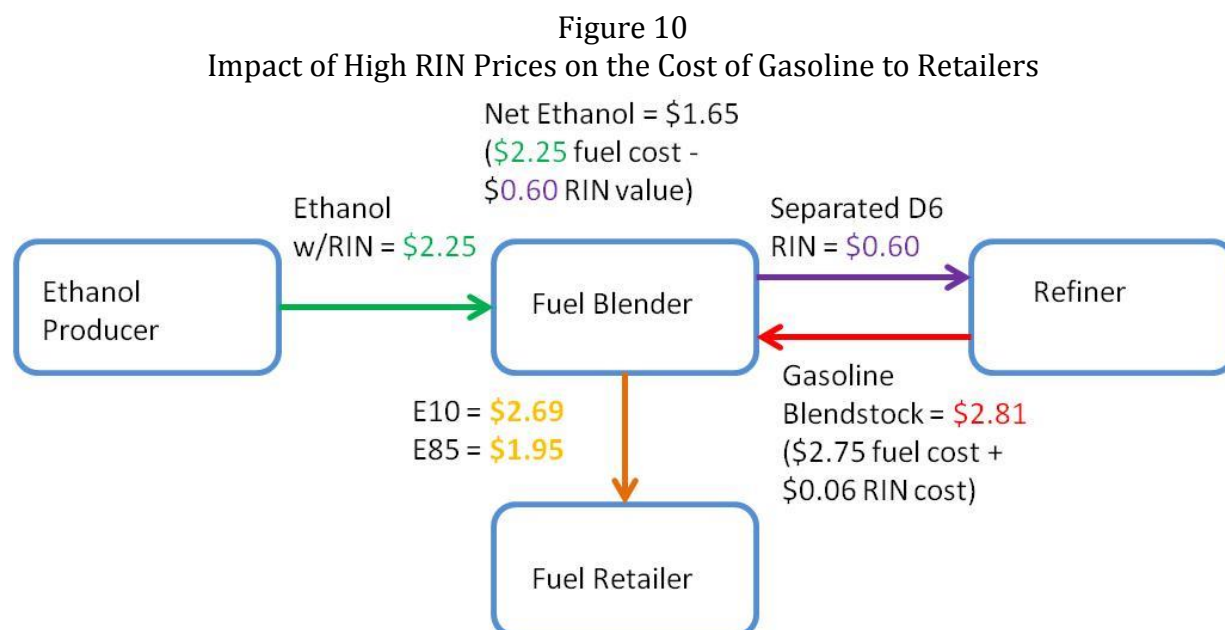
As these two scenarios demonstrate, rising RIN prices alone are not expected to increase the price of transportation fuel to retail station owners, however they have a significant impact on the relative prices of fuels with a relatively high renewable content (E85) as compared to those with a relatively low renewable content (E10). As the cost of acquiring RINs rises, refiners and other obligated parties are expected to respond to this cost by increasing the price of the gasoline blendstock they are selling to recover their increasing RIN costs. While this does increase the market price for the gasoline blendstock, this increase is generally offset by the lower net price paid for the ethanol with which the gasoline blendstock is blended.
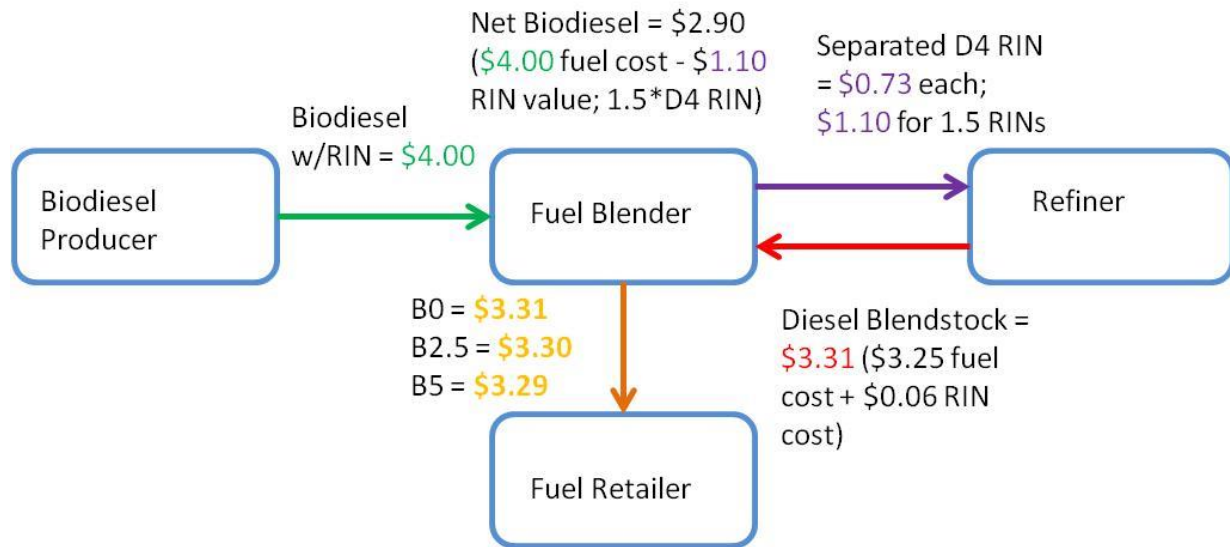
The same market dynamics are at work in the diesel fuel marketplace. When considering the impact of RIN prices on cost of fuel to the retailer, we begin with the purchase of biodiesel by the fuel blender from the renewable fuel producer. The fuel blender receives one gallon of biodiesel and 1.5 D4 RINs from a biodiesel producer for $4.00. Each gallon of biodiesel generates 1.5 RINs due to the higher energy content of biodiesel relative to ethanol. After being separated from the gallon of biodiesel, the RINs are sold to an obligated party for $0.50 each (the blender receives the total RIN value associated with a gallon of biodiesel; $0.75 in the low RIN price scenario). The net purchase price for the

biodiesel without the RIN is therefore $3.25. For the purposes of this example we are not considering the impact of any blenders tax credit on the cost of biodiesel blends to retail stations. To cover the anticipated cost of their RIN obligation, the refiner charges the fuel blender $3.26 per gallon of diesel blendstock ($3.25 for the cost of the diesel blendstock and $0.01 to cover the cost of the RIN obligations). In this scenario, the fuel blender has effectively paid $3.25 per gallon of biodiesel ($4.00 per gallon with attached RIN - $0.75 cost recovered in the sale of the RINs) and $3.26 per gallon of diesel blendstock ($3.25 for the blendstock + $0.01 RIN recovery cost). The resulting blended fuel costs are an identical $3.26 per gallon for B0, B5 and B2.5 (the average blend rate if every gallon of diesel fuel sold contained biodiesel). The prices and flows of the various commodities are shown in Figure 11 below.

Figure 11
Impact of Low RIN Prices on the Cost of Diesel to Retailers
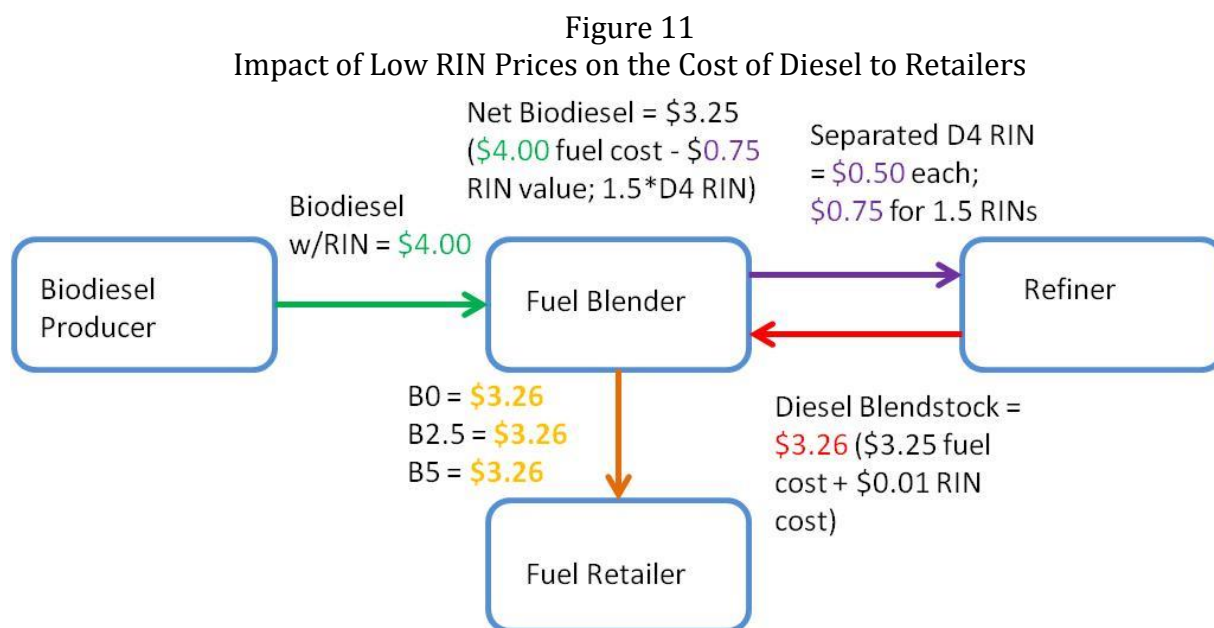
For the high RIN price scenario, the cost of the biodiesel with attached RINs to the fuel blender is the same $4.00 per gallon. The net purchase price for the biodiesel without the RINs is now reduced to $2.90 per gallon ($4.00 per gallon of biodiesel – 1.5 RINs * $0.73 per RIN). In response to the higher RIN prices, the refiner must charge an additional $0.06 for each gallon of diesel blendstock sold, resulting in a per gallon price of $3.31 per gallon for diesel blendstock. In this high RIN price scenario, the fuel blender has effectively paid $2.90 per gallon of biodiesel ($4.00 per gallon with attached RIN - $1.10 cost recovered in the sale of the RINs) and $3.31 per gallon of diesel blendstock ($3.25 for the blendstock + $0.06 RIN recovery cost). The resulting blended fuel costs are $3.31 per gallon for B0, $3.30 per gallon of B2.5, and $3.29 per gallon of B5. The prices and flows of the various commodities are shown in Figure 12 below.

Figure 12
Impact of High RIN Prices on the Cost of Diesel to Retailers

Net Biodiesel = $2.90
($4.00 fuel cost - $1.10
RIN value; 1.5*D4 RIN)

Separated D4 RIN
= $0.73 each;
$1.10 for 1.5 RINs

Biodiesel
w/RIN = $4.00

Biodiesel Producer

Fuel Blender

Refiner

B0 = $3.31
B2.5 = $3.30
B5 = $3.29

Diesel Blendstock =
$3.31 ($3.25 fuel
cost + $0.06 RIN
cost)

Fuel Retailer

When comparing the impact of high versus low RIN prices on the cost of gasoline and diesel fuel blends to retailers we note two key differences. The first is that the price of gasoline and ethanol fuel blends are much more sensitive to high RIN prices than the price of diesel and biodiesel fuel blends (see Table 2 below). This is due to the fact that the renewable content of gasoline is generally much higher than for diesel fuel (almost all gasoline sold in the United States contains 10% ethanol, with limited availability of blends containing up to 85% ethanol; biodiesel is generally sold at blends containing 5% biodiesel or less, with few blends offered that contain more than 20% biodiesel).

Table 2
Impact of High RIN Prices on Retail Fuel Prices

	No RIN Price (No RFS)	Low RIN Prices	High RIN Prices
E0	$2.75	$2.76	$2.81
E10	$2.70	$2.70	$2.69
E85	$2.38	$2.35	$1.95
B0	$3.25	$3.26	$3.31
B2.5	$3.27	$3.26	$3.30
B5	$3.29	$3.26	$3.29

The second difference that can be observed is that increasing D6 RIN prices are expected to cause a slight decrease in gasoline prices and an increase in diesel prices. In the example above, which is designed to be reflective of a perfectly competitive market, any cost decreases that result from lower prices of gasoline-ethanol blends are offset by cost increases resulting from higher diesel fuel prices. The per gallon pricing changes for diesel

fuel are high relative to the pricing changes in E10 and low relative to the pricing changes in E85 primarily due to the relative renewable fuel content of these three fuel blends.

While not shown in the examples above, increasing D4 RIN price while holding the D6 RIN price constant would be expected to result in a slight increase in blended gasoline prices and a decrease in diesel prices. This is a result of the structure of the RFS program. Both gasoline and diesel blendstocks are subject to the same renewable volume obligations, and therefore the same costs associated with acquiring the necessary RINs. As shown in Table 1, this cost is $0.01 per gallon under the low D6 RIN price scenario and $0.06 per gallon under the high D6 RIN price scenario. In the scenarios presented above, the high D6 RIN prices can be used to reduce the net purchase price of fuels that generate D6 RINs, which in the majority of cases is corn ethanol. Gasoline-ethanol blends, such as E10 and E85, benefit from the lower net ethanol costs enabled by the higher D6 RIN prices, while diesel and biodiesel blends do not benefit as ethanol cannot be added to these fuels. The reverse scenario would also be true. If D4 RIN prices increased while D6 RIN prices were relatively unchanged the RIN cost for producing petroleum-based gasoline and diesel blendstocks would increase by the same amount. This would be expected to decrease the price of biodiesel blends (as the D4 RIN price reduced the net price of biodiesel) and cause slight increases in the price of gasoline-ethanol blends (which cannot be blended with biodiesel and therefore experience only a RIN cost). The magnitude of this impact, however, would likely be smaller as the D4 RVO is significantly lower than the D6 RVO.

Finally, we note that the price for unblended gasoline and diesel fuel increases in both the high and low RIN price scenarios as compared to a scenario where there are no RIN prices (no RFS). For E10, the most common fuel type sold for use in gasoline vehicles, this cost increase is offset by the effective cost reduction in the price of ethanol, resulting in little or no net change to the price of E10. For diesel-biodiesel fuel blends, however, this is not the case. The lowest price diesel fuel across the three scenarios is for unblended diesel in the no RIN price case. While it is true that in low and high RIN cases biodiesel blends are the same price as, or cheaper than unblended diesel fuel all of these products are more expensive than unblended diesel in the scenario where there is no RIN price.

Observing RIN Price Impacts in the Marketplace

After considering these simplified examples of how increasing RIN prices might impact the price of blended fuel to retailers, EPA examined available price information to determine if the expected price impacts (higher costs for petroleum blendstocks and lower net costs for renewable fuels) could be observed in the data. Due to the many independent factors that impact the cost of transportation fuels, this is not a straight-forward exercise. For example, it is not enough simply to observe the retail price of transportation fuel as the RIN prices fluctuate. If changes in RIN prices corresponded with changes in the price of crude oil (the primary cost of producing gasoline blendstocks), simply observing the relationship between RIN prices and retail fuel prices may give the false impression that increasing RIN prices have a direct impact on the retail pricing of blended fuels. Conversely, decreasing crude oil prices might mask the impact that changing RIN prices have on the price of gasoline blendstocks at the wholesale level or the retail price of blended fuels.

If the market is reacting to changes in RIN prices in the way that the scenarios presented in the previous section suggest, there are two places we expect we would be able to observe the impacts of the changing RIN prices in the market. The first is in the wholesale pricing of similar types of fuel with and without a RIN obligation. The scenarios presented above suggest that if RIN prices increase, obligated parties will respond by increasing the price they charge for petroleum based fuels to recover the cost of purchasing RINs to satisfy the RVO associated with the sale of these fuels. We would not, however, expect to see an increase in the price of similar fuels that are not subject to a RIN obligation. If we observed a sustained price delta between similar types of fuels with and without a RIN obligation, and if this price delta was approximately equal to the RIN cost associated with producing a gallon of petroleum based transportation fuel, it would provide support for our understanding that obligated parties are able to increase the cost of their petroleum blendstocks in order to recover the cost of their RIN obligations.

In the current market there exist several pairs of similar types of fuels wherein one of the pair carries a RIN obligation while the other does not. This allows us to examine the impact of RIN prices on the wholesale price of petroleum fuels. One such pair of fuels consists of gasoline produced for the domestic market (which is subject to an RVO) and gasoline sold for export to the European market (which carries no RIN obligation). Two other pairs are diesel based: diesel fuel is very similar to jet fuel and heating oil sold in the United States, but diesel fuel produced or imported into the U.S. has a RIN obligation while heating oil and jet fuel do not. EPA examined available pricing data for these three pairs of fuels (gasoline sold in the domestic v. foreign markets, diesel v. jet fuel, and diesel v. heating oil). Figure 13 shows the future quotes for RBOB Gasoline vs. Euro-bob Oxy for the December futures[27] (the price difference between gasoline grades sold for the United States and European markets) and the RIN obligation cost for gasoline produced or imported into the United States. Figures 14 and 15 show the price differentials between diesel and heating oil and diesel and jet fuel and the RIN obligation costs associated with diesel fuel. The correlation between the price differences of these similar fuels and the RIN obligation costs suggests that obligated parties were generally able to increase the price they charge for the RIN obligated petroleum products they sell for use as transportation fuel in the US to help recover their compliance costs under the RFS program.[28]

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[27] Futures prices are for December of the current year, i.e. December 2012 throughout 2012, December 2013 throughout 2013, and December 2014 throughout 2014

[28] Or alternatively, that the market price adjusted to reflect the RIN cost just as it adjusts to reflect changes in crude oil prices and other costs

Figure 13
RBOB Gasoline vs. Euro-bob Oxy Futures Quotes (December Futures)
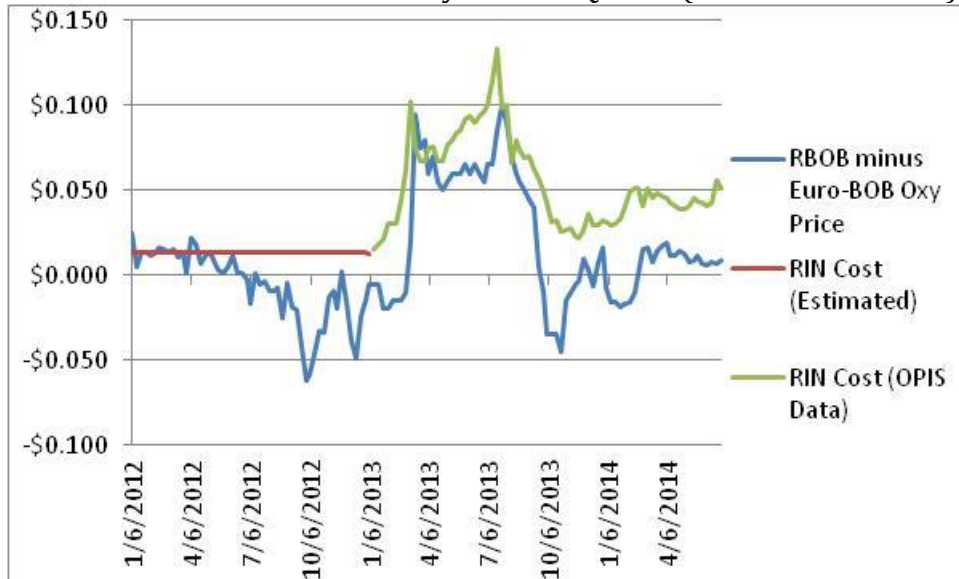
RIN Prices from OPISEthanol and Biodiesel Information Services
RBOB Gasoline vs. Euro-bob Oxy Futurer prices from CME Group

Figure 14
ULSD Price Minus Heating Oil Price (New York Harbor) and Per Gallon RIN Cost
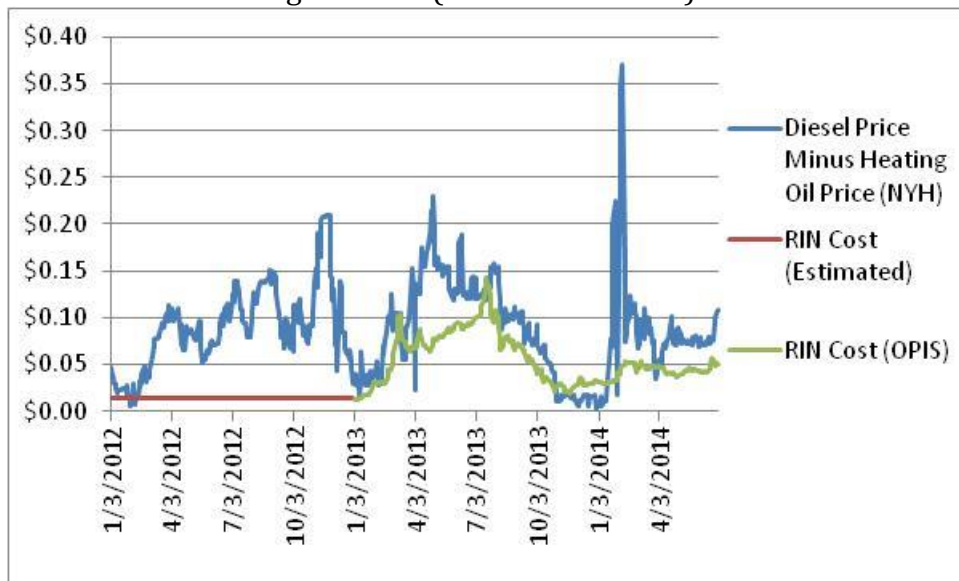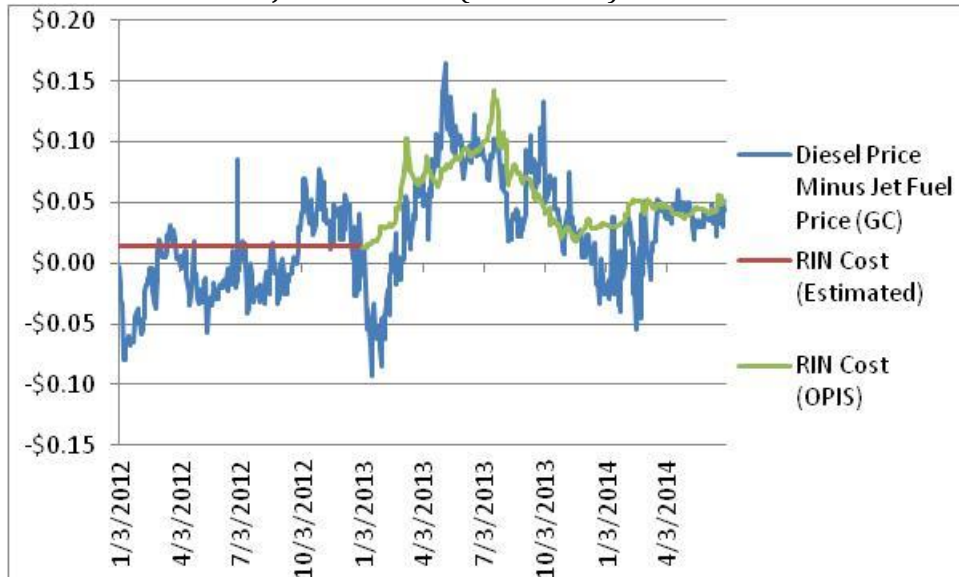
Figure 15
ULSD Price Minus Jet Fuel Price (Gulf Coast) and Per Gallon RIN Cost

The second area EPA examined to corroborate the results of our example scenarios was the pricing of ethanol, unblended gasoline, and blended fuels (such as E10 or E85) at the wholesale level. Examining this data should indicate whether or not the value of the RIN, which can be separated by the fuel blender when the ethanol is blended to produce a transportation fuel, is reflected in the wholesale price of the blended fuels. If the wholesale price for blended fuels, such as E10 and E85, is equal to or slightly greater than the volume weighted average price of neat ethanol (E100) and clear gasoline (E0) it would indicate that the RIN value is not reflected in the wholesale price of the blended fuels.[29] In this scenario, the fuel blender would retain any value associated with the separation and sale of the RIN. If, however, the price for the blended fuels was lower than the volume weighted average of neat ethanol and clear gasoline, it would indicate that the RIN value was at least partially reflected in the price of the blended fuels at the wholesale level.

The fuel blender can only profitably sell a blended fuel for less than the component costs of that fuel if they are realizing value elsewhere. Fuel blenders are able to separate and sell a RIN every time they blend a gallon of renewable fuel, and the RIN value can be used to discount the price of the blended fuel and offer it at a competitive price. Alternatively, the fuel blenders may attempt to retain some or all of the RIN value, especially in less competitive markets. As in the case where we examined the price delta between similar fuels with and without RIN obligations, if the difference between the blended fuel price and the volume weighted average price of neat ethanol and clear gasoline was approximately

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[29] This is true when RIN prices are relatively high. When D6 RIN prices are only a few cents any blended fuel discount due to the sale of the RIN may be masked by a mark-up of the fuel price at the fuel blender

equal to the RIN value for each of these fuels, this would provide support for the argument that the RIN value is the basis for this difference.

For this analysis we used terminal pricing information from Des Moines, Iowa. We chose to use Des Moines for two reasons. First, unlike many terminals in other states, clear gasoline (E0) is readily available in Iowa at the wholesale level. Knowing the price of clear gasoline allows us to see RIN price impacts on petroleum blendstocks before they are blended with ethanol. Second, Iowa contains a relatively high number of ethanol plants that currently market E85 fuel blends, making it more likely to represent a competitive marketplace for E85. This increase in the competition in the E85 wholesale market increases the likelihood that the RIN value will be reflected in the price of E85 at the wholesale level (see Figure 6, where E85 sales in Iowa increased when RIN prices were high). In other markets, where blenders of E85 face less competition, they may be able to retain more of the RIN value for these higher level ethanol blends rather than reflecting them in the wholesale pricing of these blends.[30] Figure 16 shows the pricing of neat ethanol (E100), clear gasoline (E0), and E10 at the Des Moines terminal, as well as the average price for E85 available at the terminal and direct from ethanol production facilities.[31] Figure 17 compares the difference between the reported price of E10 and the calculated price using a volume weighted average of the component fuels (E100 and E0)[32] to the RIN value associated with E10.[33] Figure 18 compares the difference between the reported price of E85 and the calculated prices using a volume weighted average of the component fuels (E100 and E0)[34] to the RIN value associated with E85.[35]

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[30] Over time, however, we would expect markets that are currently relatively uncompetitive to see increased competition and a decreasing opportunity to withhold RIN value from fuel costomers

[31] Prices for E0, E10, and E100 are Des Moines rack average prices, provided to EPA by Iowa RFA. Price for E85 is the average of all prices listed on the Iowa RFA Wholesale E85 Price Listing website (http://www.iowarfa.org/E85PastPriceProgram.php)

[32] Component E10 price = 0.9 * E0 price + 0.1 * E100 price

[33] E10 RIN value = 0.1 * D6 RIN price (RIN price information from OPIS Ethanol and Biodiesel Information Service

[34] Component E85 price = [1 – Ethanol Content] * E0 price + [Ethanol Content] * E100 price; Ethanol content is calculated based on the weekly average of all E85 offerings reported by Iowa RFA

[35] E85 RIN value = [Ethanol content of E85] * D6 RIN price (Ethanol content is calculated based on the weekly average of all E85 offerings reported by Iowa RFA ; RIN price information from OPIS Ethanol and Biodiesel Information Service

Figure 16
Clear Gasoline (E0), Neat Ethanol (E100), E10, and E85 Pricing at Des Moines
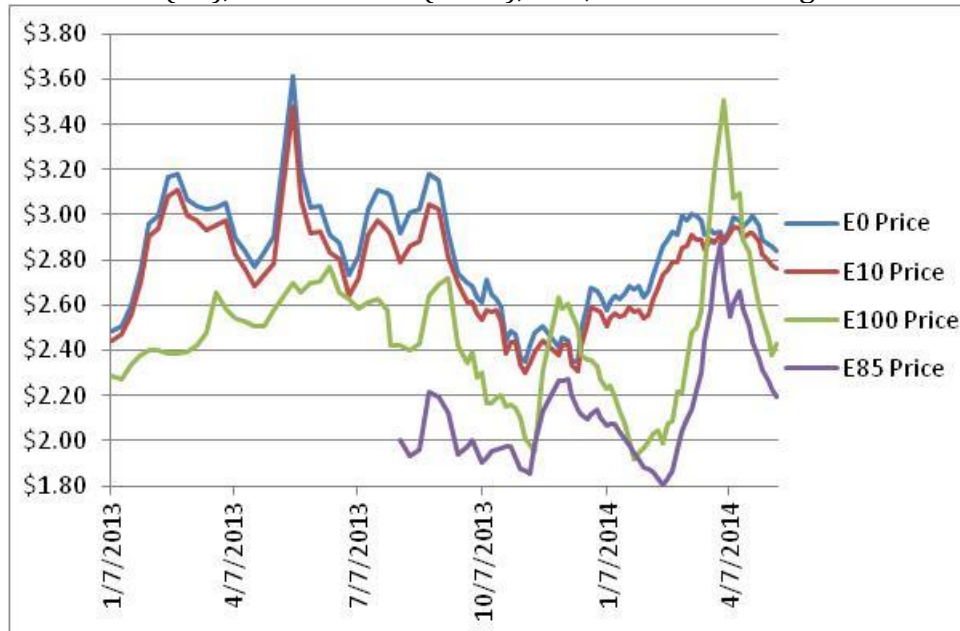
Fuel Prices from Iowa RFA (E85 Prices only available after August 8, 2014)

Figure 17
E10 Discount to Component Fuels vs. E10 RIN Value

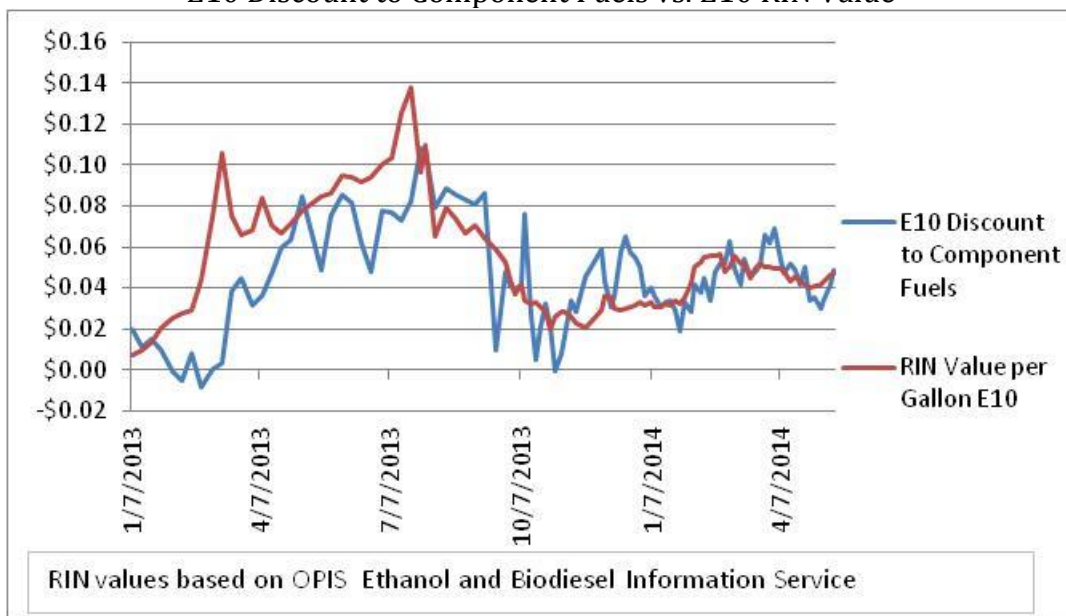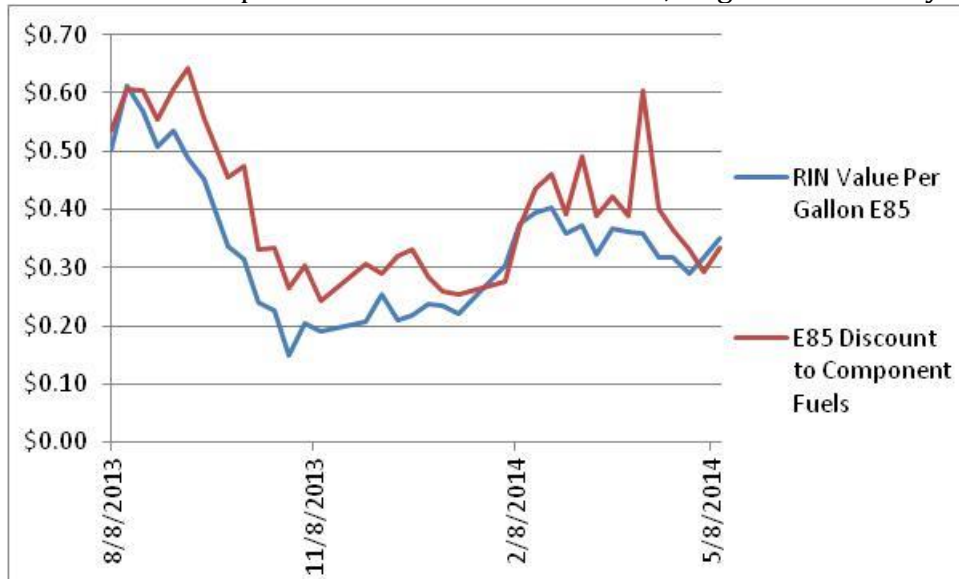RIN values based on OPIS Ethanol and Biodiesel Information Service

Figure 18
E85 Discount to Component Fuels vs. E85 RIN Value; August 2013 – May 2014

In reviewing the available data, it appears that, as predicted by scenarios in the previous section, the blended fuel prices at the wholesale level generally reflect the changing RIN prices. To state this another way, when determining the price at which to offer blended fuels, the data suggests the fuel blenders are taking into account the value received in the sale of the RIN. This further supports EPA's argument that, if all else remains equal, rising RIN prices may impact the relative pricing of fuel blends containing differing amounts of renewable fuel, but should not result in overall increases to blended fuel prices. We expect that these dynamics will hold when there are generally competitive markets for blended fuels at the wholesale and retail level. This is currently the case for much of the United States for E10 blends, however in most of the United States there is limited competition for E85 at both the wholesale and retail level. In their efforts to maximize profit and pay off their infrastructure investment, E85 wholesalers and retailers who face less competition may choose to withhold some or all or the RIN value if they believe that any increased sales volumes that result from lower priced E85 will be insufficient to overcome the lower per gallon profit margin. These high per-gallon profit margins may over time result in new parties entering the E85 wholesale or retail marketplace, and ultimately greater competition and lower E85 fuel prices for customers.[36]

While EPA has examined the available data in the marketplace to answer these two questions (Are obligated parties increasing the price of their RIN obligated fuels to recover RIN costs? And are fuel wholesalers reflecting the price of the RIN in their blended fuels?) we have not conducted a comprehensive analysis to address the question of whether or not a causal relationship between RIN prices and retail gasoline prices could be observed. EPA is aware, however, of others who have directly explored this issue, including an analysis

released by the Renewable Fuels Association conducted by Informa Economics[37] and Scott Irwin and Darrel Good of FarmDoc Daily,[38] and concluded that RIN prices in 2013 did not cause higher gasoline retail prices.

RIN Price Impacts on Merchant and Integrated Refiners

After RIN prices surged in 2013, several parties argued that high RIN prices put merchant refiners (refiners that do not blend the petroleum blendstocks they produced with renewable fuels) at a competitive disadvantage relative to integrated refiners (refiners who do own fuel blending operations). EPA maintains that this conclusion is based on a flawed analysis of the RIN and transportation fuel markets. Specifically, this argument rests on the assumption that parties who blended renewable fuels with petroleum-based fuels to produce transportation fuel were able to separate RINs from renewable fuel and obtain them at a lower cost, while merchant refiners were forced to buy RINs at a higher market price. Those who raised this concern argued that while this dynamic existed even when RIN prices were low, the high RIN prices in 2013, specifically the high D6 RIN prices, put them at a significant competitive disadvantage.

The misunderstanding at the heart of this flawed conclusion concerns the manner in which merchant refiners acquire RINs, which may differ from the method generally used by integrated refiners. Because merchant refiners do not own fuel blending infrastructure, they generally purchase RINs from fuel blenders who do not have RIN obligations, or other parties who have RINs in excess of their obligations. For these merchant refiners there is a direct and obvious cost of purchasing RINs to satisfy their obligations. Integrated refiners generally obtain RINs by purchasing renewable fuels with attached RINs. As a result, integrated refiners are not paying a separate price for the RINs they acquire, but rather simultaneously purchasing both the renewable fuel and the associated RINs. At the same time, the increased value merchant refiners receive for their petroleum fuel is hidden in the market pricing of the fuels. Several merchant refiners have claimed that they cannot increase the price of their petroleum products, as the price they receive is determined by market listings such as NYMEX. However, even if true, the higher NYMEX price for gasoline sold in the United States relative to the price of gasoline in foreign markets shown in Figure 13 suggests that the NYMEX prices reflect the RIN cost incurred by refiners who sell petroleum products into the U.S. market. While these merchant refiners may simply be receiving prices for their products based on market listings, the data we have reviewed

[37] "Analysis of Whether Higher Prices of Renewable Fuel Standard RINs Affected Gasoline Prices in 2013." Informa Economics. January 2014. In examining the available information, Informa Economics concluded that RIN prices did not have a causal relationship with gasoline prices. Other factors, notably the refiner crude oil composite acquisition cost, were found to have a causal relationship with gasoline prices in 2013. While this paper does not explore the mechanics of the RIN and transportation fuels market, and therefore cannot be used to verify EPA's understanding of the RIN market dynamics, it nevertheless supports our conclusion that high RIN prices did not cause higher gasoline prices in 2013.
[38] Irain, Scott, and Darrel Good. "High Gasoline and Ethanol RIN Prices: Is There a Connection?" FarmDoc Daily. Department of Agriculture and Consumer Economics, University of Illinois Urbana-Champaign, 27 Mar. 2013. Web. 10 Sept. 2014.

suggests that the market has adjusted to increased D6 RIN prices and they are nevertheless receiving a higher price for their products that generally reflects their RIN costs. If this is the case, exempting merchant refiners (or any other obligated party) from their RIN obligation while maintaining RIN obligations for other obligated parties would allow the exempted parties to benefit from higher petroleum prices that reflect RIN costs while incurring no RIN costs themselves. This would allow the exempted parties to benefit from increased profit margins relative to other obligated parties as a direct result of the RFS program.

The data EPA has analyzed also indicates that parties that blended renewable fuels were not able to retain the full RIN value. Rather, the price received for a RIN was effectively used to subsidize the price of the renewable from which it was separated, and the price of blended fuels generally reflected this lower renewable fuel price. As discussed in the preceding section and shown in Figures 17 and 18 above, the data EPA has reviewed for Iowa shows that the price of blended fuels at the wholesale level in 2013 was generally less than the weighted average prices of the component fuels. This difference was related to the RIN value associated with the renewable fuel content in these blended fuels. This suggests that fuel blenders who purchased renewable fuels with attached RINs, whether independent or owned and operated by integrated refiners, were selling the renewable fuels for significantly less than the purchase price after the renewable fuels had been blended to produce transportation fuel and the RINs had been separated. Whether the integrated refiners attribute the cost associated with selling the renewable fuels for less than the price they paid to purchase these fuels to their renewable fuel acquisition operations, blending operations, or refining operations, they are subject to a cost for acquiring RINs just like the merchant refiners as long as they are selling renewable fuels at a price lower than the purchase price. If the integrated refiners were to attempt to recover the full purchase price of the renewable fuels in the price of the blended fuel they would likely not be competitive with the independent fuel blenders as the available data suggests blended fuel prices generally reflect discounted renewable fuel prices (net the RIN value).

We further believe that the obligated parties were generally able to recover this increase in the cost of meeting their RIN obligations in the price they received for their petroleum-based products in 2013. We do not argue the fact that higher RIN prices lead to greater RIN acquisition costs for some obligated parties. We do believe, however, that these higher costs have a similar impact on all obligated parties. This includes not only merchant and integrated refiners, but also fuel importers who may import only a single product, such as gasoline or diesel fuel, as the primary mechanism for recovering the RIN cost is through the sales price of the petroleum based blendstocks. There are a number of factors that may impact an individual obligated party's RIN costs, including their RIN purchasing strategy (contract v. spot purchases, separated RINs v. RINs attached to renewable fuels), investments in renewable fuel production and blending infrastructure, geographic location, and many others unique to each obligated party's business. While changing RIN prices may result in profit or costs for one obligated party relative to another, these impacts are largely due to individual business decisions rather than the systematic design of the RFS program. In this way the increasing RIN prices are similar to an increase in the price of crude oil. A rise in the price of crude oil has a significant impact on a refiners cost to produce gasoline

blendstocks, but it will likely not impact their competitiveness, as all refiners are similarly impacted. The impacts on individual refiners may have slight variations due to crude oil purchase contracts or crude supply options, but these differences are indicative of market positions taken by individual refineries rather than a systematic competitive disadvantage.[39]

In the preceding section we examined available data on the price obligated parties received for similar fuel types with and without RIN obligations. In demonstrating that there was a difference in the prices for these fuels, this data, shown in Figures 13 and 16, suggests that obligated parties are generally able to recover the cost of meeting their RIN obligations in the price of their petroleum blendstocks. If this were not the case, we would expect that merchant refiners would have an incentive to export the gasoline and diesel fuel they produce or to increase production of heating oil or jet fuel, as these fuels do not incur a RIN obligation. If a significant volume of fuel was exported to foreign markets this would create a shortage of supply in the U.S., and prices in the U.S. would rise. These higher domestic prices would provide a price signal to increase domestic production, increase fuel imports, or reduce exports to meet the demand, despite this fuel being subject to an RVO.

Finally, claims that high RIN prices put merchant refiners at a competitive disadvantage relative to integrated refiners ignore the compliance flexibility built into the RIN system. Obligated parties, including independent refiners, may acquire RINs by purchasing renewable fuel with attached RINs and retaining the RINs after selling or blending the renewable fuel, by purchasing separated RINs on the RIN spot market, or through contract arrangements. A merchant refiner's status does not mandate that the refiner purchase only separated RINs. Rather, all obligated parties can choose how and when to acquire RINs to comply with the RFS program. To the extent that merchant refiners choose—for economic or other reasons—to limit themselves to purchasing RINs on the market, that choice is their own, and not one required by EPA's rule. If merchant refiners believe that owning and operating blending operations, or purchasing renewable fuels, separating and retiring the RINs, and reselling the renewable fuel without RINs would present a significant financial or strategic advantage, they may, and generally would, enter the marketplace in this capacity.

Conclusion

In this document we have examined the RIN, renewable fuels, and transportation fuels marketplace. We have explored the question of the cause of elevated D6 RIN prices observed in 2013 and shown that the E10 blendwall was a significant factor in these rising RIN prices. Due to the complexity of the RIN market, we cannot precisely predict the future

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[39] There are significant similarities between the RIN markets and how refiners make their crude oil purchasing decisions. Integrated refiners may process their own crude or procure it from the open market, while independent refiners purchase all of their crude oil. Refiners, both integrated and independent, are differently situated to process or option different crudes. They have differing business strategies for making these decisions that may impact their relative profitability.

price of D6 RINs. We would not, however, expect the D6 RIN price to return to the prices experienced from 2010 to 2012 unless the cost of production of ethanol or other renewable fuels fell sufficiently below the cost of gasoline on an energy-equivalent basis.

We also examined data from 2013 which suggested that rising RIN prices did not result in an increase in retail transportation fuel prices in 2013 (considering both gasoline and diesel together), due to the lower net cost of renewable fuels enabled by the high RIN prices. While higher RIN prices increase the cost of RFS compliance for obligated parties purchasing separated RINs, these obligated parties generally recover these costs in the price of their petroleum blendstocks. As a result, a slight decrease in the price of ethanol-gasoline blends, which contain a relatively large amount of renewable fuels, is expected to be offset by an increase in the price of diesel fuel, which generally contains lower levels of renewable fuel. This does not necessarily mean that there is no cost to increasing the volume of renewable fuels required to be blended into the transportation fuel pool. If renewable fuels cost more on an energy-equivalent basis than the petroleum fuels they displace, as they did in 2013, there is a cost to using these renewable fuels. The higher the required volume of these fuels, the higher this cost will be. As a result, blending increasing volumes of renewable fuels likely increased the total cost of transportation fuel in the United States in 2013, relative to a scenario where there was no mandate for renewable fuels.

Finally we examined how merchant refiners and integrated refiners were impacted by high RIN prices. The available data suggests that while there may be some variation in how high RIN prices impact individual obligated parties due to differing business decisions, RIN acquisition strategies, and many other factors, the structure of the RFS program does not cause a systematic competitive advantage for one type of refiner or the other. The RIN, renewable fuel, and transportation fuel market is complex, and there are limitations to the available data. EPA will continue to monitor market prices and impacts over time in an attempt to better understand the dynamics and watch for signs of market disruption. Based on available data, however, the RIN market seems to be functioning generally as expected; providing an incentive for the continued growth of renewable fuels in the transportation fuel market without causing overall increases to the retail price of transportation fuel.