



October

2013

**HOW THE RFS ACTUALLY  
DELIVERS RENEWABLE ENERGY  
POLICY OBJECTIVES**

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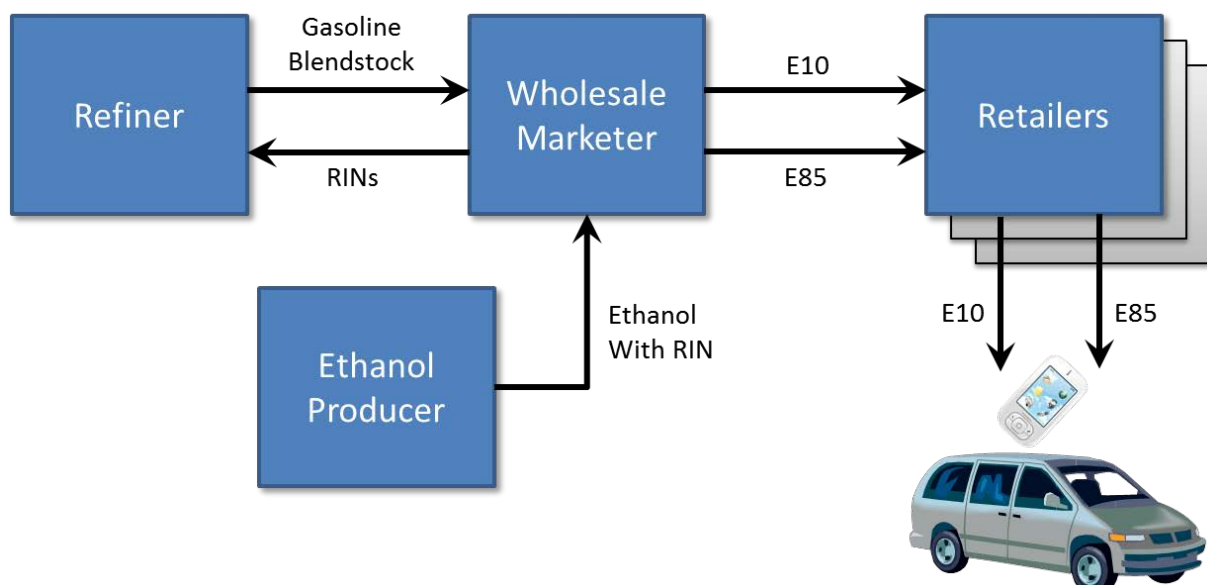
## HOW THE RFS ACTUALLY DELIVERS RENEWABLE ENERGY POLICY OBJECTIVES

Jane Q. Public drives her flex fuel vehicle (FFV) in to her local gas station, checks the prices, enters them into a smart phone app and is advised that she should purchase E85 today. Many of her fill-ups lately are with E85. She chooses E85 for one basic reason, cost. Aside from cost, her vehicle works exactly the same on E85 or E10. This simple act, multiplied by millions of FFV owners and thousands of gas stations offering E85 are the key to how the biofuel targets of the Renewable Fuels Standard 2 (RFS) can be met. They can be met with vehicle types already on the road, retail equipment already available and under current law as written.

A number of critics have suggested that the RFS is flawed, broken or infeasible and therefore must be either substantially re-written or simply abolished. We emphatically disagree. In fact, we assert the RFS is working as designed and the goals of the RFS are being realized. Recent proposals to reduce biofuel blending targets are fundamentally at odds with the objectives of the RFS and must be reconsidered. This paper provides a detailed explanation of how the mechanisms within this legislation are successfully working as intended.

### THE FUEL VALUE CHAIN AND RFS REQUIREMENTS

An understanding of the RFS first requires an understanding of the roles of the different entities in the fuel supply system and how their activities are interconnected. The accompanying figure provides a simplified illustration to support this discussion.



The system shown above provides incentives for all players in value chain to allow RFS2 compliance to be achieved. For a refiner, as their renewable volume obligation (RVO) increases, they will need to acquire renewable identification numbers (RINs) generated from blending in order to be able to supply gasoline blendstock. The cost of these RINs will be reflected in the price of gasoline blendstock offered to wholesale marketers, since it is part of the “license” to supply gasoline. For wholesale marketers, generation of RINs will be a core requirement for them to be able to source gasoline from refiners. Once the E10 blend wall is reached, the immediate option for wholesale marketers to increase supply of RINs (beyond that which is possible with E10 alone) is to blend and sell E85 to retailers. Wholesale marketers will be incentivized to do this because of the value of the RINs generated, and retailers will be incentivized to offer E85 because of the opportunity to sell a growth product which offsets declining gasoline sales. Retailers will need to install appropriate dispensing equipment to allow them to do this and will need to price it attractively to consumers to generate demand. RINs are the mechanism that allows this to happen; the price of a RIN will rise to the level needed for the wholesale marketer to price E85 attractively to the retailer and for retailers to price E85 attractively to consumers. These factors work together to incentivize generation of the number of RINs required by refiners. As will be discussed throughout this document, all of this can be achieved without significant impact on retail gasoline prices.

While some commentators have suggested the recent increase in the price of RINs is indicative of fundamental problems with the RFS, in fact the complete reverse is true. It is clear evidence that the mechanism designed to stimulate compliance with RFS targets works in exactly the way that was intended. RINs create the required incentives throughout the value chain to cause unrelated parties to work in concert to deliver the legislated targets. More detail on the roles of each of these parties is provided in the Appendix.

## **ACTIONS REQUIRED TO DELIVER RFS**

Much of what has been written about the RFS focuses on the refiner (who, as the obligated party, has a very large stake) or the ethanol producer (generally seen as the principle beneficiary of this law). The role of the retailer is often ignored, yet they are the key – the goals of the RFS will only be realized if retailers offer and consumers purchase the mix of fuels necessary for refiners to achieve compliance. The RFS, between the statutes and the implementing regulations, is prescriptive on the requirements placed on refiners as well as the qualifications and actions of biofuel producers. The RFS is deliberately non-prescriptive in terms of fuel types and formulations. The intent of this structure is to avoid picking winners and losers in an area characterized by technology that is evolving rapidly. Butamax has been leading this innovation with the development of technology to produce biobutanol and introduce it to the fuels value chain. Making this mix of

prescriptive and non-prescriptive elements work requires a focus on the fuel needs of the consumer.

For the scenario envisaged at the start of this paper to be realized, E85 will need to be increasingly available at retail and offered at prices which make it economically attractive for FFV owners. We focus on E85 because it is matched with the designed capabilities of the existing FFV fleet and its high ethanol concentration enables RFS requirements to be achieved with a smaller and more gradual deployment of new E85 installations and FFVs than would be possible with mid-level ethanol blends (e.g. E30). Other types of biofuels (sometimes referred to as “drop in fuels”), such as biobutanol, which do not require new retail infrastructure are expected to be an important and growing part of the market. While it could ultimately become material in the market, E15 alone will not be sufficient to meet the intent of the RFS. E85, on the other hand, represents a cost-effective fuel blend, immediately available for market deployment, with potential to underpin the full objectives of the RFS. Accordingly, E85 should be considered as a core component of any RFS compliance strategy. E85 also has the added benefit that it is complementary to new drop-in biofuel technologies, enabling them to develop in the market as their cost performance improves.

Building increased retail availability of E85 at attractive prices requires several factors:

- **GROWING THE NUMBER OF E85 INSTALLATIONS** – Currently, there are about 3000 gas stations in the US offering E85<sup>1</sup>. It is estimated that 80% of FFV owners live within 10 miles of an E85 station. Nonetheless, in order for E85 to have the necessary impact on fuel markets, the availability will need to grow. These 3000 stations demonstrate that retailers will invest if they see market demand. With store sales being an increasingly important driver of station profitability and declining fuel volumes retailers may find that they need to offer new fuels if they are to retain the store traffic required for station profitability. With refiners needing growth in E85 sales volumes to supply a growing RIN obligation, they are incentivized to make commercial arrangements with blenders and retailers which will facilitate a growing retail E85 presence.
- **ATTRACTIVE E85 PRICING TO CONSUMERS** – E85 has only recently started to draw mainstream consumer interest in the US because it has not previously been priced at a level which reflects its reduced fuel economy compared to E10. Market data from Brazil, where FFVs are widely available (90+% of new car sales for the past decade have been flex fuel vehicles) and high ethanol content fuel is universally

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<sup>1</sup> Babcock, B.A., and S. Pouliot. [“Price It and They Will Buy: How E85 Can Break the Blend Wall.” Policy Briefing Paper 13 PB-11](#). Center for Agricultural and Rural Development, Iowa State University.

available at retail, shows that FFV owners will buy this fuel if it is readily available and priced appropriately relative to gasoline. The same result can be expected in the US once consumers are familiar with the benefits of E85 and it is priced consistently with the fuel economy delivered.

Retailers can only offer an attractive E85 price to consumers if they are able to purchase E85 at a price which allows them to make that offer while earning a profit margin similar to that which they earn selling E10. As the wholesale marketer also has no RFS obligation, they will require the value of the RINs they capture (through blending of E85) to be sufficient to enable them to price E85 at the level required by the retailer. In fact, if E85 is the marginal source of RINs for the refiner, as can be expected when RVOs exceed RIN supply from E10 alone, the market value of RINs will continuously adjust<sup>2</sup> to enable the wholesaler to offer this pricing while earning a normal profit margin. As Jane and her fellow FFV owners will vary somewhat in how they assess E85 prices, wholesale marketers and retailers will learn to adjust their E85 price to move their sales mix as needed to balance with refiner demand for RINs.

- **MAINTAINING AND GROWING THE NUMBER OF FFV'S** – The current FFV fleet in the US is estimated at about 14 million vehicles. Historically, automobile companies have produced these vehicles in the general absence of material consumer demand because they earned the manufacturer credits towards their compliance with fuel economy (CAFÉ) standards. With the opportunity for CAFÉ credits being reduced, there is a risk that automobile companies will begin to scale back their FFV offerings unless consumer demand or other incentives make this attractive.

Wholesale marketers have incentive to maintain and grow their fuel sales volumes in a shrinking gasoline market and they have an opportunity to grow their RIN sales by blending increasing volumes of biofuels. Moving greater volumes of high biofuel blends, such as E85, requires them to secure demand from retailers with E85 capability and to price the E85 at levels which will enable retailers to profitably grow their E85 sales volumes. This will typically require wholesale marketers to transfer much of the RIN value to the retailer by way of a lower E85 price, so that retailers, in turn, can pass it on to the consumer. With E85 as the marginal source of RINs, market forces will drive RIN values to levels which enable the wholesale marketer to profitably price E85 at levels which incentivize retailer demand. While widespread adoption of this strategy may take some time, there is already evidence of the market responding to the incentive created by the market need for additional RINs.

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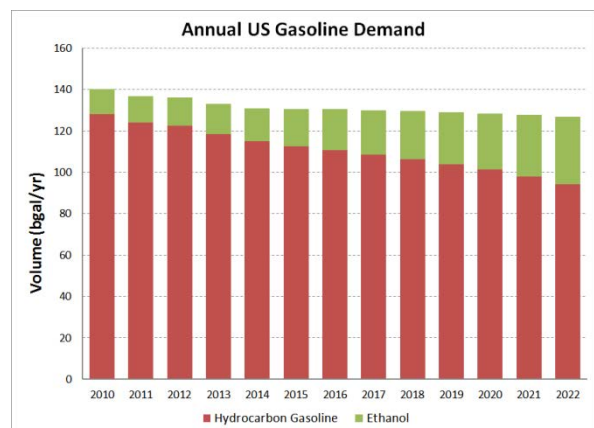
<sup>2</sup> RIN values are expected to decrease when gasoline prices rise relative to ethanol and increase when gasoline prices fall relative to ethanol.

In summary, E85 must be viewed as the core mechanism for delivery of the RFS in the near term. It plays this role because it is an existing product with a substantial base of compatible vehicles and retail infrastructure.

Accordingly, it offers the most immediate opportunity to greatly expand the RIN supply to the market. Growth of E85 demand has historically been impeded by retail pricing at levels above its value to most consumers. The RIN mechanism of RFS changes this by providing economic incentive for all parties in the value chain to align in a manner which grows E85 availability and supports retail pricing that can stimulate the required levels of consumer demand. The RIN mechanism also serves to incentivize commercialization of drop-in biofuels such as biobutanol. These fuels will serve to enable deeper penetration of biofuels through their enhanced RIN delivery and full compatibility with existing, non-FFV, vehicles and retail infrastructure. Conversely, modifications to RFS which reduce RIN prices will reduce costs to refiners but will also eliminate incentives for wholesale marketers, retailers and consumers to grow E85 markets or deploy drop-in biofuels.

## IMPACT ON THE MARKET AND GASOLINE PRICES

The underlying aim of the RFS is to grow the share of domestically produced renewable fuels in the US fuel market. The key benefits from this action are improvements in US energy security, improvement in air quality (both traditional pollutants and greenhouse gas emissions) and moderation of the growth in global oil demand. This is being done in a context where US gasoline demand is gradually decreasing as a result of demographic shifts, economic factors and gradual improvement in fuel economy standards for new cars. While the RFS is applicable to both the gasoline and diesel fuel markets, this paper focuses on the gasoline market as it is larger and the transition issues are more complex. In the case where ethanol is the dominant renewable gasoline component, analysis of the projected US gasoline market<sup>3</sup> and the gasoline portion of the RFS<sup>4</sup> requires that ethanol takes a growing share of a declining US gasoline market, as illustrated.

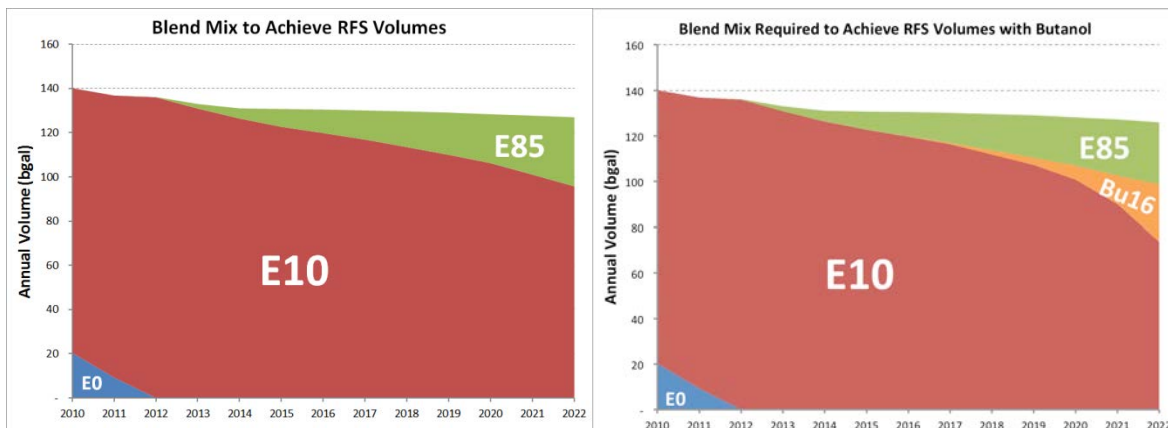


<sup>3</sup> Butamax analysis, based on projected US gasoline and E85 demand from the US Energy Information Agency (EIA) Annual Energy Outlook for 2013 (AEO2013) reference case.

<sup>4</sup> Butamax assumes that the biomass-based diesel portion of the RFS gradually increases from the 1.28bgal requirement for 2013 and subtracts this contribution from the Total Renewables requirement.



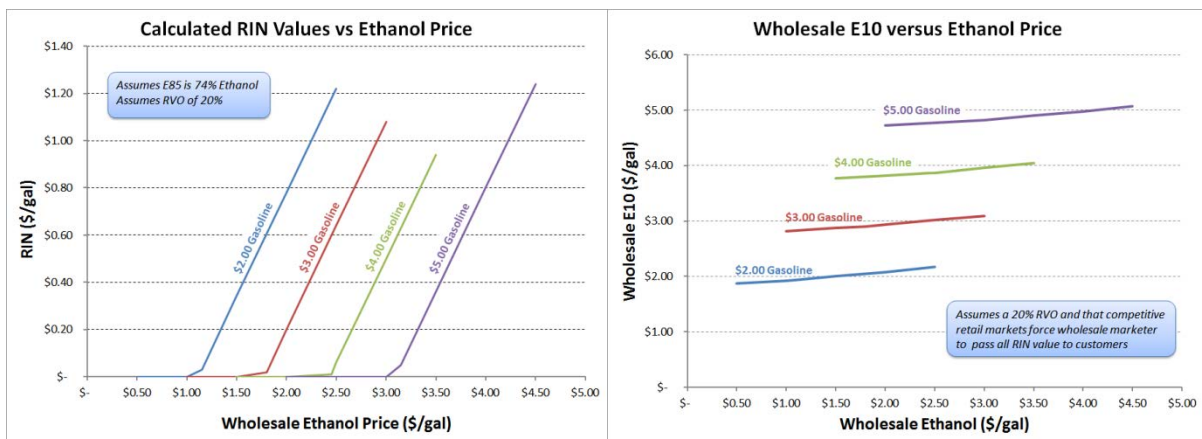
Delivery of this growing quantity of ethanol to the gasoline market requires a shift to higher ethanol blends. For simplicity, we assume that the US market first transitions away from straight gasoline (E0) to E10, a step which has already largely occurred. From there, E10 is gradually displaced by growing volumes of E85. As discussed above, delivering this result requires retail pricing which incentivizes FFV owners to regularly purchase E85, as well as growing the FFV share of the vehicle population and increasing retail availability of E85. With those enabling requirements in mind, the accompanying chart estimates the share of E0 and E85 in the market required to generate the quantity of RINs implied by full RFS implementation. (Sales of E15 or other types of biofuel would directionally reduce the amount of E85 sales required). As illustrated, the required ethanol volume share grows from about 8% in 2010 to over 25% in 2022, E0 virtually disappeared by 2012 and E85 slowly grows to 24% of fuel sales by 2022. E0, in fact, has continued in the US market at low levels as biomass-based diesel and some E85 sales have contributed to the fuel mix and generated RINs to enable RFS compliance. A slower ramp-up of the RFS obligation due to cellulosic ethanol coming to market more slowly than statute would also reduce the required rate of E85 penetration.



Drop in biofuels, such as biobutanol, provide an opportunity to further reduce the amount of E85 and, therefore, FFV's needed to achieve the RFS targets while staying within the capabilities of the existing vehicle fleet and infrastructure. A 16% blend of butanol in gasoline (Bu16) offers consumers the same fuel economy as E10 while generating twice the number of RINs per gallon as E10<sup>5</sup>. The accompanying chart uses the same fuel energy demand data as the prior chart while assuming the gradual introduction of butanol capacity (from either retrofit of existing ethanol plants or new construction of cellulosic butanol plants) of 4bgal/yr by 2022. In this scenario, required E85 volumes are reduced as butanol blends double the number of RINs which can be realized with fuel for standard vehicles.

<sup>5</sup> 10% ethanol X 1 RIN per gallon of ethanol generates 0.10 RIN per gallon of E10. 16% butanol X 1.3 RIN per gallon of butanol generates 0.21 RIN per gallon of Bu16.

While delays in commercialization of cellulosic ethanol technology or different levels of penetration of non-ethanol biofuels, (such as biobutanol or biomass-based diesel), may result in a shift of both the timeline and the amount of ethanol penetration required for RFS compliance, RIN prices will be set by the marginal source of compliance. We believe that, once RFS requirements exceed what can be achieved by E10, E85 will be the marginal source of compliance. The RIN will price at the level required to incentivize FFV owners to regularly purchase E85; for the large majority of such motorists, that will require reducing the retail price of E85 to the level where the cost per mile is less than or equal to the cost per mile for consuming E10<sup>6</sup>. The RIN value necessary to achieve this retail pricing will be set by the delivered wholesale cost of ethanol and hydrocarbon gasoline respectively, as well as applicable state and local taxes in a given market<sup>7</sup>. The net effect of this structure is that the RIN moderates the terminal rack price of E10 (see charts below) and enables the terminal rack price for E85 to be sufficiently discounted to incentivize broad use by FFV owners. (This analysis does not assume any reduction in crude price levels due to displacement by renewables; such effect would further mitigate any price impacts on gasoline).



The manner in which these effects can be expected to appear in the marketplace is illustrated in the following examples.

<sup>6</sup> Babcock (Babcock, B.A., and S. Pouliot. ["Price It and They Will Buy: How E85 Can Break the Blend Wall." Policy Briefing Paper 13 PB-11.](#) Center for Agricultural and Rural Development, Iowa State University.) Provides a more rigorous analysis which infers a demand elasticity for E85 based on consumer behavior in Brazil. The result of that analysis is that steadily larger E85 discounts, and thus increasing RIN prices, are needed to support increasing E85 market share. We agree in principle with his analysis but have chosen not to analyze to that level of detail for this paper.

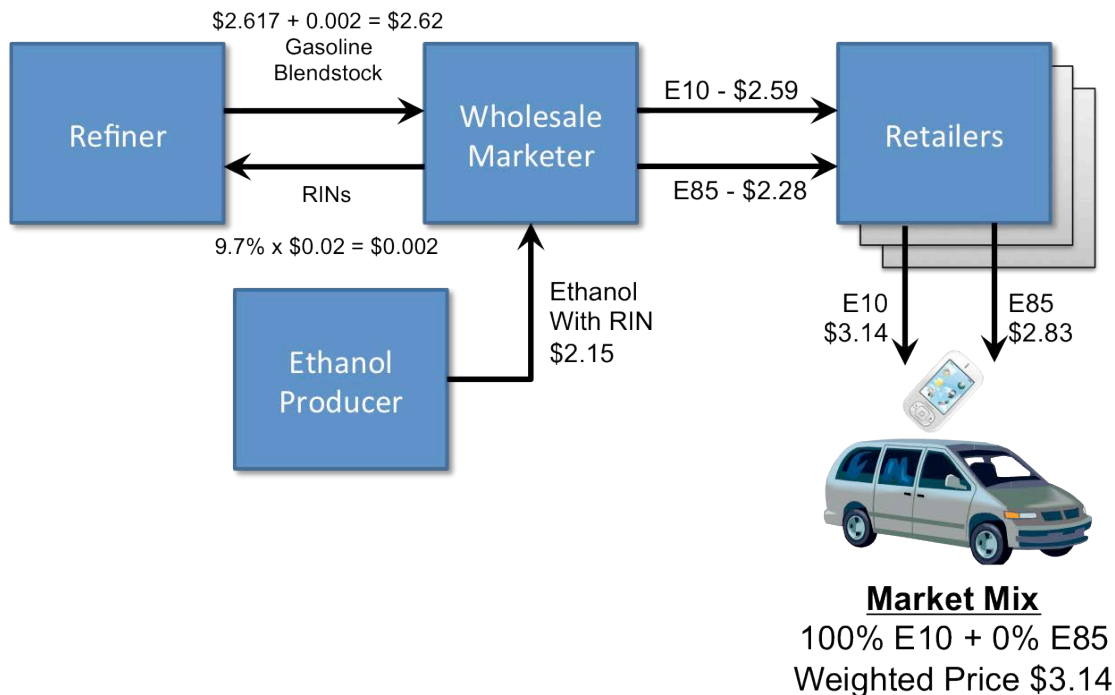
<sup>7</sup> As RINs trade on a national market, it will actually be the highest cost market which will determine the national market value of RINs. The location of this highest cost market will be determined by local delivered bulk ethanol price relative to local delivered bulk gasoline price as well as local tax structures.



### Case 1 – RVO set at 9.7% of Gasoline Production (below blend wall)

A recent<sup>8</sup> New York Harbor (NYH) spot price for reformulated gasoline blendstock (RBOB), the gasoline product produced by refiners for blending into E10 for the New York market, was \$2.64 per gallon. Deducting any charges related to RFS obligations, this equates to \$2.617. On that same day, the spot ethanol price (which includes one RIN) was \$2.15 per gallon.

Now assume that the RFS obligation is maintained at 9.7% in perpetuity, so that there is no regulatory need for E85. This would cause RIN prices to drop to historic levels, assume \$0.02. If refiner's costs remain the same as current market conditions, the spot RBOB price should go to the \$2.617 /gallon calculated above plus a reduced RIN cost of 9.7% X \$0.02 = \$0.002 /gallon, for a total of \$2.62 /gallon. Using the current ethanol price (\$2.15/gal) and typical values for fuel taxes, transportation costs and margins, the flow of prices through the marketing system, expressed in \$/gallon, can be estimated as illustrated below:

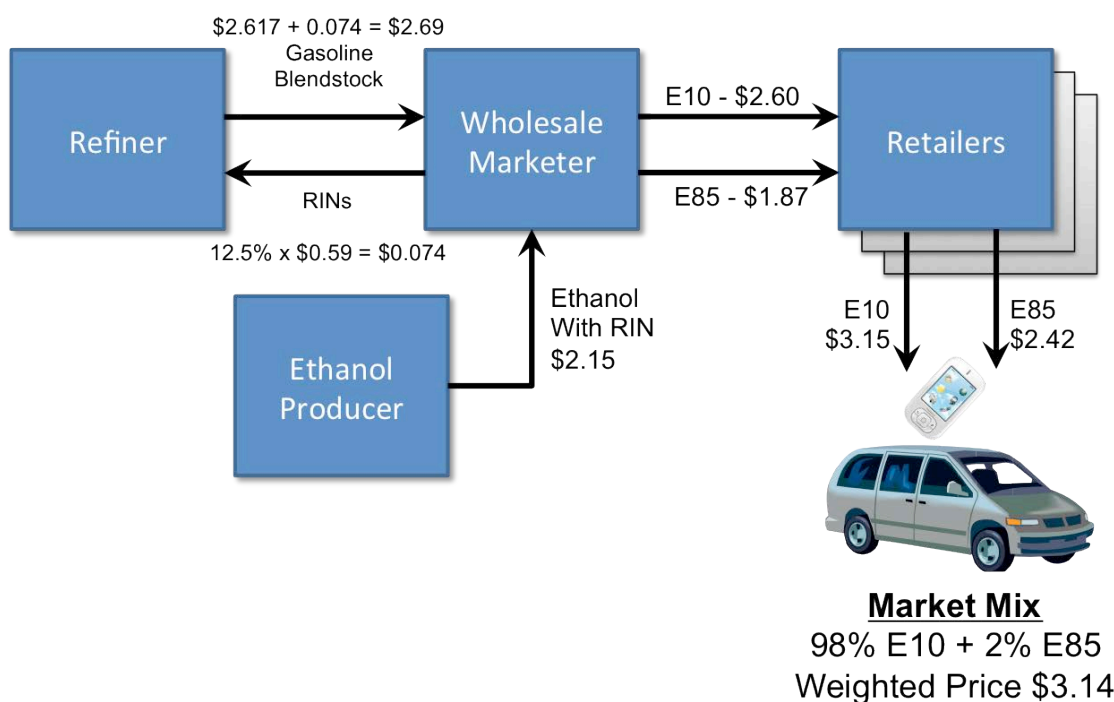


In this scenario, RIN cost has a minimal impact on refiners' cost of supplying the market and the expected retail pricing relationship between E10 and E85 (E85 at about 10% less than E10) is not likely to incentivize any significant E85 sales through existing pumps or installation of new E85 pumps.

<sup>8</sup> October 25<sup>th</sup>, 2013. The quoted price for a 2013 corn ethanol RIN was \$0.24 and the current RIN obligation is 9.7%. Assuming that refiners are passing all of their RIN costs on to their customers, that amounts to 9.7% X \$0.24 = \$0.023 per gallon of RBOB. Thus, we can infer that the spot price of RBOB would be \$2.640 - \$0.023 = \$2.617 in the absence of any RFS obligation.

### Case 2 – RVO set at 12.5% of Gasoline Production (above blend wall)

In this case we assume the RFS obligation increases to the equivalent of ethanol at 12.5% of the refiner's gasoline production. This is roughly what would be required if the 2014 statutory obligation of 18.15 billion gallons were to be enforced with 1.28 billion gallons of biodiesel required. With this requirement and the same market environment as in Case 1, the retail market would need to sell 98.3% E10 and 1.7% E85 to generate the required number of RINs. We estimate that RIN prices would need to increase to \$0.59 to enable retail E85 to be priced at levels which will incentivize this amount of consumer demand. This price level for RINs amounts to \$0.074 per gallon of RBOB ( $12.5\% \times \$0.59 = \$0.074$ ). This also lowers the effective cost of ethanol to the wholesale marketer to  $\$2.15 - \$0.59 = \$1.56$  per gallon. As a result, costs now flow through the distribution system as illustrated below:



The net result is that retail E10 prices are projected to be essentially unaffected, rising from \$3.14 in Case 1 to \$3.15 in Case 2 while E85 price decreases from \$2.83 to \$2.42. This pricing relationship between E85 and E10 at retail is expected to incentivize the required consumer demand for E85. It should be noted that the market-weighted price mix remains unchanged at \$3.14 per gallon. This level of E85 demand can be accommodated through the existing 3000 E85 pumps plus new pumps which retailers can be influenced to install when they see that there will be a consistent policy in place to incentivize consumer demand.

## CONCLUSIONS

- The Renewable Fuels Standard is a farsighted and robust piece of legislation prompted by sound government policy. To quote the EPA “RFS2 lays the foundation for achieving significant reductions of greenhouse gas emissions from the use of renewable fuels, for reducing imported petroleum and encouraging the development and expansion of our nation’s renewable fuels sector”. It has successfully stimulated massive private investment in technology to create new, clean and diverse sources of renewable energy and superior fuel molecules for the US fuels market. The technology challenge has been considerable, but this investment has successfully delivered game changing technologies that put the U.S. firmly ahead of the rest of the world in the vital renewable energy sector.
- As the blend wall approaches, the market mechanisms created by this legislation have been proven to work as intended. The recent escalation of RIN prices is driven by the RFS obligations, and is precisely what is needed to incentivize growth in the share of renewable components in the fuel mix.
- E85 and Flexible Fuel Vehicles represent a readily available solution to enable the immediate blending targets of the RFS to be delivered, and should be considered a core part of any compliance strategy for meeting the RFS obligations. A clear signal to this effect from government, and maintenance of incentives for the Auto industry to maintain production of material numbers of flexible fuel vehicles, are necessary to ensure that the refuelling and vehicle infrastructure required are available to support this opportunity.
- RVO obligations beyond the level that can be achieved through E10 alone are essential to create the incentives within the value chain for renewable fuels to increase, and to create the growth envisaged by government policy.
- As such, relaxation of blend targets to levels below the so-called blend wall would immediately cause RIN prices to collapse, halt the growth in E85, and severely damage prospects of advantaged biofuel molecules (such as biobutanol) breaking into to the fuels market.
- When considering whether to diminish the aspirational objectives of the Renewable Fuels Standard, Congress and the Administration are faced with a clear choice. On the one hand, whether, to continue pursuit of energy security, reduced energy costs, rural job creation and lower greenhouse gas emissions, benefitting from new, world beating, technology developed in response to government leadership or, on the other hand, to forego this opportunity in favour of the status quo.

## **IMPACT OF DRAFT EPA 2014 RVO PROPOSAL**

A draft proposal outlining a methodology for setting RVO's for 2014 (and beyond) was recently produced by the EPA and leaked to public. The approach outlined was to define RVO's based on the volume of ethanol required to produce essentially all US gasoline as E10, plus a small amount of additional ethanol from current E85 sales. This approach is fundamentally at odds with the objectives of the RFS, which clearly anticipated moving very substantially beyond what is possible with E10 alone. It appears that the methodology is specifically designed to collapse RIN prices in the mistaken belief that RIN prices impact gasoline prices at the street. However, as explained above, the RIN price is essential to creating incentives in the fuel value chain to drive increased levels of renewable energy in the fuel mix, but does not affect overall fuel price to consumers. If the leaked approach is implemented, the following impact can be expected:

- Conventional RIN prices will collapse to near zero, in line with historical trends.
- The reduction in RIN prices will force wholesale marketers to increase E85 prices significantly, and sales will drop to token levels. Any investment to increase E85 distribution and marketing can be expected to cease.
- Blending economics for drop-in biofuels will deteriorate substantially, since drop-in biofuels require high RIN prices in order to remunerate the difference in production cost per gallon of higher energy content biofuels.
- Ethanol blending will revert to being driven by the economic incentive. The vast majority of gasoline will be blended with corn ethanol at 10% volume, which is readily available and for which there is a clear blend incentive.
- The gasoline price for consumers will increase over time, since the failure to implement the RFS as intended would underpin global crude oil demand and price.

## RECOMMENDATIONS

Butamax is a joint venture of BP and DuPont which was established in 2009 to commercialize the biobutanol technology which they had been jointly developing since 2003. The goal of this privately funded effort, initiated prior to enactment of RFS, was to find a way to grow the benefits of biofuels while addressing many of the limitations of ethanol. The outcome is a fuel which is available to the transportation market and is not dependent upon on either government subsidy or government purchase of the product.

Commercialization of a new fuel technology is necessarily time consuming as both gasoline and ethanol manufacturing processes are highly efficient, the markets in which they operate are very cost-sensitive and safety must be assured.

Specific Recommendations --

- **Maintain the existing mechanisms around RFS RINs** – The existing structure provides obligated parties with incentive to move forward towards achieving the goals of the RFS, while consumer choice creates the dynamic required to bring forward the most cost-effective solutions. While the issue of RIN fraud must, and is being addressed, the existence of RINs is vital to fuel our Nation's drive to support biofuel growth.
- **Retain clarity about the ultimate direction and scale** – While the RFS volume schedule will likely require adjustment due to the pace of commercialization of cellulosic biofuels, the demand side of the market requires long-term certainty to assure that necessary evolution of retail offerings, vehicle fleet and consumer behavior will occur as needed to achieve the policy objectives of the RFS. (It is important to note that the EPA has the authority to adjust the aspects of the advanced volume schedule to reflect the challenges of commercialising new technologies.)
- **Retain the technology neutral elements of RFS** – The RFS was specifically designed to be technology neutral. Drop-in fuels, such as biobutanol, offer the potential to greatly lower the cost of deploying a growing volume of biofuels. Loss of technical-neutrality risks these benefits.



## APPENDIX – PARTICIPANTS IN THE FUEL VALUE CHAIN

**Refiner** –The vast majority of “gasoline” produced by US refiners today is actually not a finished gasoline product suitable for use in motor vehicles but instead is a blendstock designed to be blended with ethanol (90% gasoline, 10% ethanol) to produce E10. Different refiners have differing levels of downstream integration. Merchant refiners (i.e. Valero, PBF, HollyFrontier) typically sell large volume lots of their product at the refinery fence. Many refiners also participate in wholesale marketing (for example Exxon, BP and Shell); they blend E10 and sell it in truckload quantities out of distribution terminals to distributors or “jobbers”. Only a small portion of refiners (e.g., Marathon, Northern Tier) directly supply or own retail gas stations.

- Refiners need to acquire RINs in proportion to their gasoline and diesel production in order to satisfy their RFS obligations.
- A large majority of these RINs are acquired at no cost through their integrated wholesale marketing businesses.
- When the refiner’s obligations are less than the RINs they acquire through their wholesale marketing business, they are able to bank the excess RINs or sell them to others. When their obligations are greater than the RINs they acquire through their wholesale marketing activities, they can draw from any banked RINs (to a maximum of 20% of their obligation in a given year) or seek to purchase RINs from other parties.
- When the obligations of the refining industry, as a total, exceed the number of RINs which can be generated through E10 blending, market prices will increase RIN prices until they reach the level needed to incentivize blenders to produce E85 and sell it at prices which make it attractive to retailers and consumers.
- The US had recently become a net exporter of refined products and incremental exports above current levels can further reduce refiners’ RFS obligations. However, attractive export markets are finite and US market demand is relatively inelastic. Accordingly, market forces can be expected to incentivize the US market to be fully supplied with various parties in the fuels market blending incremental E85 or other biofuel blends to generate the required RINs.

**Ethanol Producer** – An ethanol producer creates a RIN for every gallon of ethanol that they produce. This RIN is “attached” to the physical gallon of ethanol and may only be detached when that gallon of ethanol is blended into a finished fuel product for sale to an end-user in the US market. This program is managed by the EPA. Thus, the quoted wholesale price of ethanol is actually a combined price for the physical commodity and the attached RIN. Much of the ethanol used for gasoline blending in the US market is sold directly to refiners for use in their integrated wholesale blending

and marketing businesses. Some ethanol is blended into E85 directly by ethanol producers – in such cases, the ethanol producer is able to detach the RINs and sell them separately to other parties.

Ethanol producers have no obligation to produce under the RFS but refiners do have an obligation to use their product; this structure effectively assures that ethanol producers are able to recover their variable costs in the product price. RIN values effectively increase directly with ethanol price, largely shielding consumers from volatility in ethanol prices.

The potential price setting ability of ethanol producers is constrained by additional structural factors inherent in the industry and created by the RFS. Recall that the ethanol market, under RFS, effectively consists of three independent sets of producers – corn (conventional) ethanol, sugarcane (advanced) ethanol and cellulosic ethanol. While these three types of ethanol differ in the feedstocks employed and the greenhouse gas performance of their production technologies, they are producing the same ethanol molecule which must be treated the same way when blending gasoline. Further, the structure of RFS permits the refiner to use sugarcane ethanol in place of corn ethanol and cellulosic ethanol in place of both sugarcane or corn ethanol.

**CORN ETHANOL** – producers in this market are relatively fragmented, this industry has generally had excess capacity and there is an upper limit on the amount of corn ethanol which can be used annually for RFS compliance; this structure has generally limited the prices corn ethanol producers have been able to realize. Competition from sugarcane and cellulosic ethanol may, in the future, also serve to limit prices.

**SUGARCANE ETHANOL** – producers in this market are also relatively fragmented, but demand in the domestic Brazilian market and other parts of the world have generally served to limit supply to the US market. Planned production growth in Brazil, however, may make additional supply available to the US feasible in the coming years. Delivered cost to the US places an upper limit on corn ethanol prices; biodiesel and, in the future, competition from cellulosic ethanol can be expected to create a price ceiling on sugarcane ethanol. The market value of an advanced RIN can be expected to reflect the incremental cost of sugarcane ethanol over corn ethanol in the US market.

**CELLULOSIC ETHANOL** – Growth of the RFS significantly beyond current volumes is largely dependent upon the rate at which cellulosic production becomes available. While the first wave of cellulosic production may be more costly than existing technologies, it is expected that lower feedstock costs will ultimately overcome higher capital and operational costs to make cellulosic ethanol cost competitive with corn and sugarcane. So long as cellulosic ethanol production is projected to fall short of the statutory targets of the RFS

program, EPA is obligated to offer cellulosic waiver credits at a formula price. As refiners have the option of meeting their cellulosic obligation with either a cellulosic RIN or the combination of an advanced RIN and a cellulosic waiver credit, this sets an upper limit on cellulosic ethanol prices at the delivered cost of sugarcane ethanol plus the cost of a cellulosic waiver credit (42 cents/gal in 2013).

**Wholesale Marketer** – A wholesale marketer manages the combination of gasoline blendstock with ethanol to produce a finished product, such as E10 or E85 and sells those blended products to distributors (jobbers) or retailers. The blending activity generally occurs at a petroleum distribution terminal which receives and stores bulk shipments of gasoline blendstock (usually via pipeline or barge) and ethanol (usually via truck or rail). The terminal may be owned by a refiner, a wholesale marketer or an independent distribution company. In some markets, the blending is commonly done by or for jobbers. In some states, refiners are legally required to make unblended gasoline blendstock available to jobbers to do their own blending.

- Ownership of RINs detached as a result of the blending activity typically goes to the party who hired the blender. If this is not an obligated party (refiner) they will typically seek to sell the RINs in the market.
- Most terminals service more than one refiner with fungible gasoline blendstocks commingled in shared tankage and each refiner supplying their own ethanol to a community ethanol tank.
- The wholesale marketer chooses which blends to offer, typically based on input from their customers. Each marketer utilizing a shared terminal sets their own product prices.

In a market where fuel demand is declining and which is short on RINs, wholesale marketers can create value for refiners by finding a market for their fuel and supplying them with their RIN requirements. This requires that they offer successful retailers the right product blends at prices which will enable them to be competitive. The market value of the RINs generated will be set at a level which bridges from the costs of hydrocarbon gasoline and ethanol to the relative market value of E10 and E85 with a small incentive left for the wholesale marketer. The wholesale marketer's share of the RIN value will be capped by the ability of ethanol producers and jobbers to do their own blending and compete with the wholesale marketers for sales of RINs back to the refiners.

**Retailer** – Many retailers in the US today operate independently of refiners. While a large share of gas stations carry a refiner brand, these are generally franchisees (they agree for a period of years to exclusively source their fuel from the refiner, offer the refiner's standard set of fuel products to the refiners

quality specifications and configure the look of their site to the refiner's image standards; they do this in exchange for the refiner's marketing support and supply terms). While refiner brands retain a large share of the retail gasoline business, an increasing share is from big box retailers (Costco, Wal-Mart), grocers (Safeway, Kroger) and independent retail companies (Wawa, QuikTrip).

- Declining fuel demand and growing diversity of retailers makes retail gasoline pricing highly competitive. Fuel margins are often very small and store operations represent a major share of revenues.
- Independent companies (e.g., Propel) are entering the business of offering standalone biofuel product dispensing on existing retail sites.
- While retailers set their own product pricing and, increasingly, select their product offerings they ultimately need to price at levels which drive consumers who have multiple choices to buy. For E85 and other new biofuel blends this feeds back into the prices wholesalers must offer in order to drive volume and generate the RINs which are needed by refiners to meet their RFS obligations.

With stagnant vehicle miles travelled (VMT) and steadily increasing fuel economy, E85 has the opportunity to be a growing retail fuel product in an otherwise declining market. Retailers offering E85 will be able to maintain or grow their fuel volumes and have the best prospect for sustaining the store sales generated by fuel traffic. With retail fuel volumes declining and the mix of fuel retailers shifting away from refinery-branded dominance, successful retailers are well-placed to negotiate the best terms for supply of the range of fuels consumers are demanding; this may include being able to negotiate assistance in the installation of E85 dispensing equipment.

**Consumer** – With U.S. gasoline demand steadily declining, existing market participants compete vigorously to retain volume. Retail gas sales in the U.S. are very much driven by price over all other considerations. (Branding of gas in the US does not impact consumer choice as much as it does in other countries.) Compared to non FFV users – who will still continue to enjoy price dictated by competition, consumers with FFVs will be able to make even more strategic choices where to buy their gasoline and at what price.

Consumers, particularly those who own FFV's, are the key to making the RFS succeed. They need to be incentivized to purchase E85 regularly. That incentive needs to be sufficient not only to impact current fuel purchases but also to incentivize demand for new FFV's by a growing percentage of new car buyers As E85 becomes increasingly available at attractive prices, informed consumers with FFV's can be expected to choose this product.