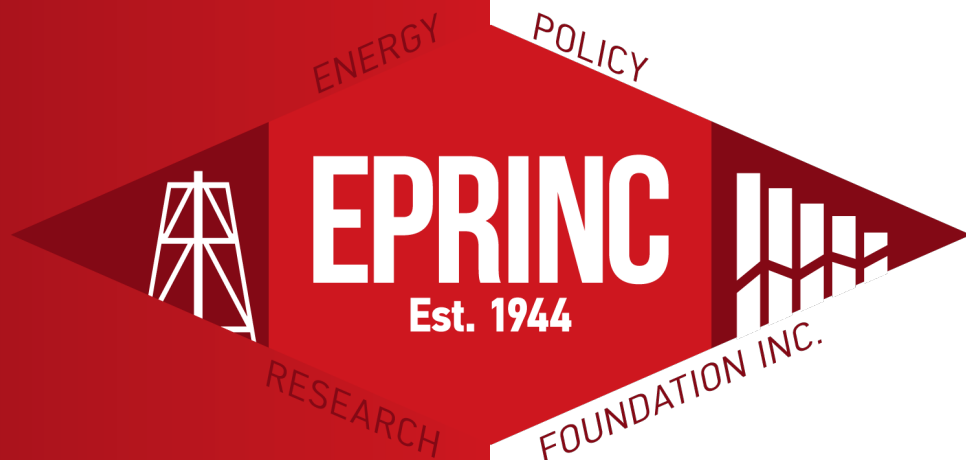


The Mortar is Nearly Set

*The Consequences of Exceeding
the Blendwall in 2013 and 2014*

Ben Montalbano

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Energy Policy
Research Foundation, Inc.
1031 31st Street, NW
Washington, DC 20007
▶ 202.944.3339
▶ eprinc.org

Introduction

Ethanol, when blended into gasoline, can play an important and cost effective role in meeting both automobile octane and environmental fuel specifications. The use of ethanol in the gasoline pool, when adjusted to both market and technological limitations, presents no major economic or technical risks as a supplement to the production of gasoline. The fundamental policy challenge regarding ethanol is directly attributable to a regulatory regime, the Renewable Fuel Standard (RFS), that requires annual upward adjustments in volumetric mandates covering ethanol and biofuels use, without regard to either its contribution to the cost of gasoline or technical limitations in the use of ethanol within the U.S. automobile fleet.¹

The current regulatory regime, if not reformed in some substantial manner, will likely spike gasoline prices in 2014, as federal mandates take the U.S. gasoline pool significantly above 10 percent ethanol by volume.

EPRINC estimates that given market conditions and constraints in cost effective opportunities to blend larger volumes of renewable fuels into the U.S. gasoline pool, E10 prices will likely rise by a minimum of 20 cents per gallon in 2014. This lower estimate only occurs under somewhat unrealistic and favorable assumptions regarding enormous gains in market penetration and consumer acceptance for E85. A more likely outcome is a price spike considerably higher than 20 cents a gallon, perhaps as high as 50 cents to a \$1.00 per gallon.

The RFS in 2014

Refiners and other obligated parties (such as importers) must document that they have blended biofuels into the gasoline and diesel they supply to the U.S. market by acquiring RINs (renewable identification numbers). Obligated parties acquire RINs directly by blending certain biofuels into gasoline and diesel or by purchasing them from other parties (who may or may not be obligated parties). In recent years, the RFS could be met with ethanol blending below 10% concentration. Refiners and other obligated parties could, however, blend above their mandated requirement and then retain those extra RINs for sale to obligated parties who had not met their volumetric mandates or carry those RINs, with certain limitations, into the following year.

Until 2013, ethanol RINs were abundant and generally sold for a few pennies a gallon. Much attention was called to the RFS this past week following new record high RIN prices. The price for 2014 D6 RINs, conventional renewable fuel RINs generated in 2014, breached \$1.40. What is perhaps most significant about this most recent surge in RIN prices is not the price of RINs per se, but how the price foreshadows RFS compliance costs in 2014.

This EPRINC report provides an assessment of the compliance options and costs of meeting the RFS for the U.S. gasoline and diesel fuel market in 2014.

¹ *The regulatory program and renewable fuel mandates are implemented by the Environmental Protection Agency (EPA) under the Energy Independence and Security Act of 2007 (EISA).*

Carryovers, Deficits and Compliance in 2013

EPA has estimated that approximately 2.02 billion D6 conventional ethanol (corn) RINs, 289 million D4 (biodiesel) RINs and 141 million D5 (advanced) RINs were carried over from 2012 into 2013.² This represents a total carryover of about 2.5 billion RINs which may be applied to 2013 mandates.

The overall RFS mandate for 2013 is 16.55 billion gallons of ethanol equivalent (bgee). Nested requirements for cellulosic and advanced biofuels are as follows:

- Total Advanced Biofuel: 2.75 bgee
 - Cellulosic: 1 bgee
 - Biodiesel: 1.28 bg (actual volume); 1.92 bgee (credited volume)
- Implied Corn Ethanol: 13.8 bg
- Total: 16.55 bgee

EPA waived down the cellulosic mandate to 0.014 bg but left the total advanced requirement unchanged. Thus, obligated parties must use a combination of carryover advanced RINs and imports of Brazilian sugarcane ethanol (the most likely supply of advanced ethanol) to meet the remaining advanced requirement of 0.816 bgee. Current blending trends indicate that both the biodiesel and total advanced requirements will be met in 2013 but will require using all remaining carryover RINs for those two categories.³ The 0.014 bgee cellulosic mandate will largely be met with cellulosic RINs purchased from the EPA.

In order to comply with the 2013 mandates, obligated parties will use a combination of physical blending and carryover RINs to meet the mandate.

The 1.28 bg Biodiesel requirement will be met with physical blending and the banking of RINs. This reduces the 16.55 bgee by 1.92 bgee to 14.63 bgee (each gallon of biodiesel blended generates 1.5 ethanol equivalent RINs).

Given the looming RIN shortage and the current high-cost RIN environment, obligated parties will blend as much ethanol as possible into the E10 gasoline pool. EPRINC estimates that 133 bg of gasoline demanded in 2013 will contain 9.7% ethanol, the maximum practical concentration, or 12.7 bg.⁴ It is likely that a portion of this will be advanced ethanol and that the remaining portion of the advanced requirement will be met with carryover RINs.

The 12.7 bg blended into the E10 pool reduces the outstanding deficit for the year to 1.93 bgee. An additional 100 million RINs will be generated through the sale of E85, bringing the 2013 deficit to 1.83 bgee.⁵

Carryover D5 and D6 RINs will be required to meet the remaining 1.83 bgee deficit for 2013. The remaining 0.141 bg of carryover D5 advanced RINs will be applied to complete the advanced requirement, reducing the

² 2012 RFS2 Data, as of June 7, 2013, EPA EMTS, <http://www.epa.gov/otaq/fuels/rfsdata/2012emts.htm>

³ RIN Update: More Evidence for D6 RIN Stock Use in 2013. Farmdocdaily, June 20, 2013. <http://farmdocdaily.illinois.edu/2013/06/rin-update-evidence-d6-rins-stock-use-2013.html>

⁴ Gasoline demand taken from EIA July 2013 STEO, 8.67 mmb/d for 2013, ~133 bg.

⁵ EIA AEO 2013 projects 0.01 mmb/d of E85 sold per day in 2013, or 153 million gallons for the year. E85 may contain 51% - 83% ethanol.

total deficit to 1.69 bgee. The 1.69 bgee deficit will be met with D6 RINs. This reduces the 2013 -> 2014 D6 RIN carryover, and overall RIN carryover, to 0.33 billion RINs. Cellulosic RIN purchases from EPA bring the final carryover to 0.32 billion RINs.

Compliance in 2014

Compliance becomes much more difficult in 2014 due to higher volumetric mandates and a considerably smaller RIN carryover.

The 2014 mandates are as follows (subject to EPA rulemaking):

- Total Advanced Biofuel: 3.75 bgee
 - Cellulosic: 2 bgee
 - Biodiesel: 1.28 bg (actual volume); 1.92 bgee⁶ (credited volume)***
- Implied Corn Ethanol: 14.4 bg
- Total: 18.15 bgee

***This figure has not yet been specified by EPA. EPRINC is using 1.28 bg as a placeholder and assumes that the 2014 biodiesel mandate will be no less than the 2013 mandate.

Cellulosic ethanol production capacity remains close to zero and is unlikely to make a tangible impact on 2014 compliance. Judging by EPA's 2013 waiver actions, the agency is likely to waive a large portion of the cellulosic requirement (but nevertheless to a volume that is far above actual production capacity) but keep the total advanced requirement unchanged at 3.75 bgee. For the sake of simplicity, it is assumed that cellulosic supply and mandate are near zero, but that the advanced requirement of 3.75 bgee remains intact.

It will be assumed that the full requirement 1.28 bg of biodiesel and then some, for a total of 1.5 bg, are blended, generating 2.25 bgee RINs. The 18.15 bgee requirement now sits at 15.9 bgee. This is where the problems begin; 15.9 bgee must now be met entirely with ethanol and carryover RINs.

EIA's AEO 2013 puts 2014 gasoline demand at 131.8 billion gallons. Blending ethanol at 9.7% implies blending 12.78 bg of ethanol, reducing the outstanding 2014 deficit to 3.12 bgee (1.83 bg of the 12.78 bg must be imported from Brazil to meet the advanced requirement). The remaining supply of 0.32 billion carryover RINs will be applied, bringing the remaining deficit 2.8 bgee, thus exhausting the last economically and logistically feasible compliance option.

Even if one grants 100 million RINs generated from baseline E85 sales and 200 million ethanol equivalent RINs from a combination of cellulosic blending and RIN purchases from EPA (at a cost, of course), the deficit remains at 2.5 bgee.

⁶ The biodiesel mandate for 2014 has not been specified or proposed but must be more than 1 bg.

What now?

With the E10 pool fully saturated and ethanol and carryover RINs exhausted, obligated parties have few options when it comes to finding 2.5 billion bgee to meet the 2014 mandate. The two primary outlets for generating RINs after the blendwall are E15 and E85. These are both problematic for logistical and cost reasons.

Obligated parties may also reduce their RVO (renewable volumetric obligation) by reducing the amount of gasoline and diesel they supply to the U.S. market. This can be achieved through reduced crude runs, exports (only product supplied into the U.S. market counts towards one's obligation), fewer imports and a shift in yields from on-road transportation fuels to fuels such as heating oil and jet fuel. To shift or reduce production in a market that does not call for it is costly. However, with RINs approaching \$1.50 and many obligated parties, particularly those without widespread blending facilities, already experiencing large deficits and large RIN purchase costs, a reduction in domestic supply may be the most economic choice for some obligated parties.

Diesel is the most likely product to see an increase in exports as it generates the largest deficit. In 2013 the mandate's percentage standard was set at 9.63%. This effectively means that every gallon of diesel or gasoline must contain 9.63% biofuels. However, biodiesel is only blended at about 2.4% concentration (cost competitive biodiesel supplies do not exist to induce significant volumes of additional blending), therefore each gallon of diesel generates a 7.23% deficit. In past years when obligated parties were blending biofuels well above mandated levels and generating extra RINs, this was easily and cheaply overcome. But now that the gasoline market is entering a phase in which each gallon of gasoline supplied also generates a deficit, this is no longer the case.

If 1% of the diesel supply were exported over a base case scenario in which the RFS did not incentivize exports, roughly 0.55 billion gallons, obligated parties would effectively reduce their obligation by 0.053 bgee. Using an elasticity estimate (the amount of likely reductions in consumption from higher prices) that assumes that for every 1% reduction in the supply of diesel its price increases by 10%, the price impact would be high (about 30 cents per gallon) for even a relatively small amount of RFS induced exports.

Obligated parties (and non-obligated parties) may generate RINs through the blending and sale of midlevel blends E15 and E85. These blends face obstacles on two fronts. The first obstacle is cost. Ethanol is generally less expensive than neat gasoline on a volumetric basis (cost per gallon). However, it only contains about two-thirds as much energy as gasoline. Therefore it is ultimately more expensive than gasoline and must be discounted (subsidized) to compete with gasoline as E15 or E85.

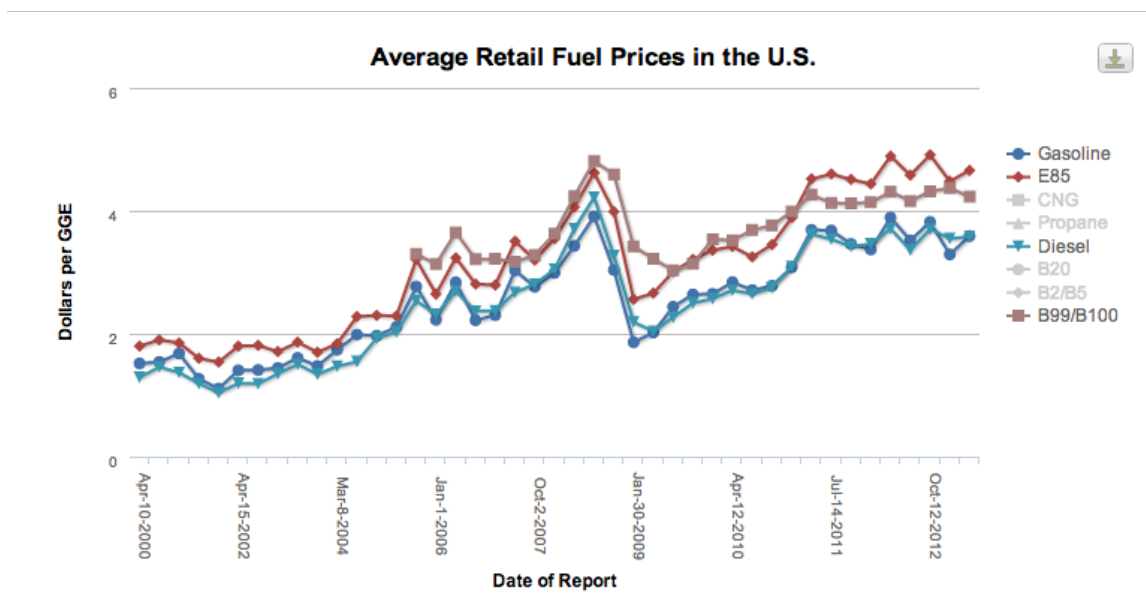
The second major obstacle consists of logistics and market size. E85 may only be consumed by specially designed flex-fuel vehicles (FFVs) and dispensed by special pumps. There are approximately 11 million FFVs on the road, out of a US vehicle fleet of approximately 250 million vehicles, and E85 is only sold at 2,400 of the nation's 150,000 gasoline stations.

EPA in 2011 issued a waiver allowing the sale of E15 for model year 2001 vehicles and newer. A variety of concerns including but not limited to cost competitiveness with gasoline, vehicle damage and warranty

concerns, limited infrastructure (less than two dozen pumps nationwide), and regulatory issues at the state level have prevented E15 from becoming a viable fuel. Going into 2014, E15 will have a negligible impact on RFS compliance.

Although uneconomic and difficult to scale, E85 will provide an outlet (perhaps the only outlet) for modest RIN generation in a post-blendwall gasoline market. E85 must be substantially discounted to compete with gasoline. As the following chart from DoE’s Alternative Fuels Data Center shows, E85 has never been cheaper than gasoline on a cost per gallon of energy equivalent basis (cost per BTU basis) from the beginning of 2000 through the most recent month of data reporting, April 2013. In April, E85 would have had to be discounted by \$1.07 to compete with gasoline.

Figure 1. US Retail Fuel Prices, Energy Adjusted



Source: Department of Energy’s Alternative Fuel Data Center

With the recent surge in RIN prices, some ethanol producers have begun producing their own E85 blends and selling them to retailers at a discount.⁷ They earn back the discount by capturing the high-value RIN and selling it to obligated parties. The majority of ethanol producers are not obligated parties. These sales are generally a positive development for the gasoline market as it generates critically needed RINs in a tight market. However, it leaves obligated parties such as refiners with an unrecoverable cost; they must purchase RINs simply to stay in compliance with the law without selling a product and the gaining the economic benefits that entails.

⁷ **Biofuels Digest**, May 27, 2013, <http://www.biofuelsdigest.com/bdigest/2013/05/27/absolute-energy-launches-direct-e85-distribution-to-retailers-at-1-93-per-gallon/>

Whether blended, discounted and sold by obligated parties or non-obligated parties, such as ethanol producers or terminal operators, the burden of the discount, or subsidy, will eventually fall upon obligated parties. Either they discount the fuel themselves or purchase a RIN from someone else who did the same in order to show compliance. Because many obligated parties such as refiners and importers do not possess the infrastructure to blend biofuels into their entire product supply, or have entered into arrangements with terminal operators and blenders to share RINs, many obligated parties are currently short RINs and actively purchasing RINs in the market despite the fact that obligated parties as a whole should have a small RIN surplus at the end of 2013. Many parties with a 2013 surplus are likely acquiring additional RINs to be used next year when they enter a deficit phase. When RINs were inexpensive, less than a nickel, it was not a significant cost of doing business. As noted above, 2014 obligated parties will be short 2.8-2.5 billion RINs. Some obligated parties will have greater deficits than others. Short of exporting and other obligation reduction options, the only practical way to generate these needed RINs is through additional sales of E85. However, the combination of large discounts to encourage the sale of E85 and purchasing high-cost RINs will increase the cost of producing transportation fuels. The energy discount and other discounts to required make up for E85's poor logistics and availability will significantly raise the marginal cost of supplying gasoline and diesel into the US market.

Given that the market will be short 2.5 billion RINs (if not more) in 2014, 2.94 billion gallons of E85 must be sold at 83% ethanol concentration to meet the RIN shortfall. Because E85 may contain 51% to 83% ethanol this figure could be significantly higher. The required sales volume of 2.94 billion gallons of E85 to bring obligated parties into compliance would represent consumption growth of nearly 3,000% over recent years.

Such a plan is only barely feasible from a logistical standpoint. In order to sell 2.94 billion gallons in a year, each of the 2,400 retail station that offer E85 would have to sell 140 gallons per hour, 24 hours per day, for 365 days. The average US gas station sells 100 gallons of gasoline per hour across all of their pumps.

The cost of discounting and incentivizing the sale of one gallon of E85 is as follows: (given the April 2013 DoE AFDC Data):

- \$1.07/gallon discount for energy deficit
- \$0.05/gallon refueling time⁸
- \$0.14/gallon for limited availability⁹
- **Total: \$1.26/gallon discount (subsidy required)**

This implies a RIN generation cost of \$1.52 (each gallon of E85 is 83% ethanol max, therefore $\$1.26/0.83$). It is no coincidence that RINs are currently trading over \$1.40. The market is anticipating the actual cost to generate RINs in a post-blendwall, RIN short environment.

⁸ EPA Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis, EPA-420-R-10-006, Feb 2010

⁹ Ibid, for 2022, therefore \$0.14/gallon is conservative

The 2014 mandate essentially requires a 12% ethanol blend (this is after biodiesel is blended into the diesel pool)¹⁰. For every gallon of gasoline supplied into the market, nearly one-eighth of a RIN is required. At the margin, RINs will be generated through E85 subsidization at a cost of \$1.52 per RIN. This in theory enables an obligated party who is short RINs (nearly all will be in 2014, some much more so than others) to supply 8 gallons of gasoline at a compliance cost of \$0.19 each. Thus, the marginal cost of supplying gasoline into the US market will rise by at least \$0.19 per gallon.

It can be expected that the marginal cost, and therefore overall price increase for gasoline, will be higher than \$0.19. If one tried to give away 3 billion or more gallons of E85 for free with the current infrastructure it would be quite difficult.

A price increase of 'only' \$0.19 per gallon of gasoline in 2014 would raise consumer expenditures on gasoline by \$25 billion. A significant portion of the US gasoline and diesel supply will be in jeopardy of non-compliance without a dramatic adjustment such as higher exports, a cut in crude throughput or E85 subsidies. Any additional price adjustments caused either by reduced supply of refined product and/or inefficient allocation of scarce RINs, could easily cause this number to double, triple or worse.

Market Risks

The nature of the RIN market also complicates issues. Anyone can trade RINs, not just obligated parties. Speculation and other rent-seeking behaviors can be expected. This is not unique to the RIN market. However, in most markets, a portion of participants are not fined by the government if they do not hold a certain amount of stock at the end of the year. It is not unreasonable to expect that the allocation of RINs among obligated parties will be inefficient. EPA has implicitly acknowledged this flaw: In its proposal for a Tier III sulfur standards credit trading program, only parties regulated by the proposed standards may trade credits.

Acquiring and holding RINs is an extremely risky venture. Several facets of the U.S. government, including EPA and Congress, have the ability to wipe out the value of RINs with a few pen strokes. If EPA were to issue a waiver(s) sufficient to fix the blendwall and alleviate RIN shortages, an action that is dearly needed, RINs could be rendered worthless. An act of Congress could convey a similar impact. Obligated parties that are currently spending tens or hundreds of millions of dollars to acquire RINs for current and future compliance could see huge losses on these purchases. This carry risk provides a disincentive to devote financial resources towards future compliance in the present with the goal of avoiding potentially higher compliance costs down the road.

Is there a palatable solution for all involved?

The short answer is no, but some solutions might be more tolerable than others. One temporary remedy that has been mentioned in recent months is an elimination of the advanced ethanol requirement when cellulosic ethanol volumes are waived. This would have reduced the 2013 mandate by 1 billion gallons and the 2014 by 2 billion gallons. This regulatory fix would likely reduce Brazilian ethanol imports substantially as they would no

¹⁰ Total mandate 18.15 bgee, minus 2.25 bgee for biodiesel = 15.9 bgee. $15.9 \text{ bgee} / 131.8 \text{ bg of gasoline for 2014} = 0.12$, or 12%.

longer be required to fulfill the advanced biofuel gap left by the absence of cellulosic ethanol. It is worth considering if the existing incentive to import Brazilian ethanol and export corn ethanol back to Brazil matches the spirit of the RFS. The fundamental flaw in the program is that the mandate replaces important price signals in the market with an administrative decision process that can easily run counter to changes in consumer demand or efficient production solutions.

Such a waiver for 2013 and 2014 might be enough to kick the can into 2015, buying time for Congress to either act or ignore the problem for another year. If the latter is the case, the same issues and costs outlined in this paper will reappear in 2015, but with more severe symptoms as the mandates rise beyond 2014 levels. The situation is also complicated by EPA's waiver authority. The agency may only issue a waiver of the RFS for one year at a time. Therefore, it will be difficult to provide obligated parties with the assurance that the following year's volumetric mandates will be achievable. Congress will be required to perform a balancing act for a long-term solution to be had.