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Testimony

before

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Subcommittee on Energy Policy, Health Care, and Entitlements

Up Against the Blend Wall: Examining EPA's Role in the Renewable Fuel Standard

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Submitted by:

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Executive Summary

Chairman Lankford, Ranking Member Speier and members of the Subcommittee on Energy Policy, Health Care and Entitlements, I want thank you for the opportunity to testify on the Renewable Fuel Standard (RFS) and the U.S. Environmental Protection Agency's (EPA) management of this program. Of particular importance is EPA's use of its waiver authority, which will shortly become the most important policy instrument in determining the path of gasoline and diesel prices over the next 2-3 years. My testimony today includes an assessment of EPA's waiver authority under the RFS and why it will be the main determinant in driving up gasoline prices in the near future.

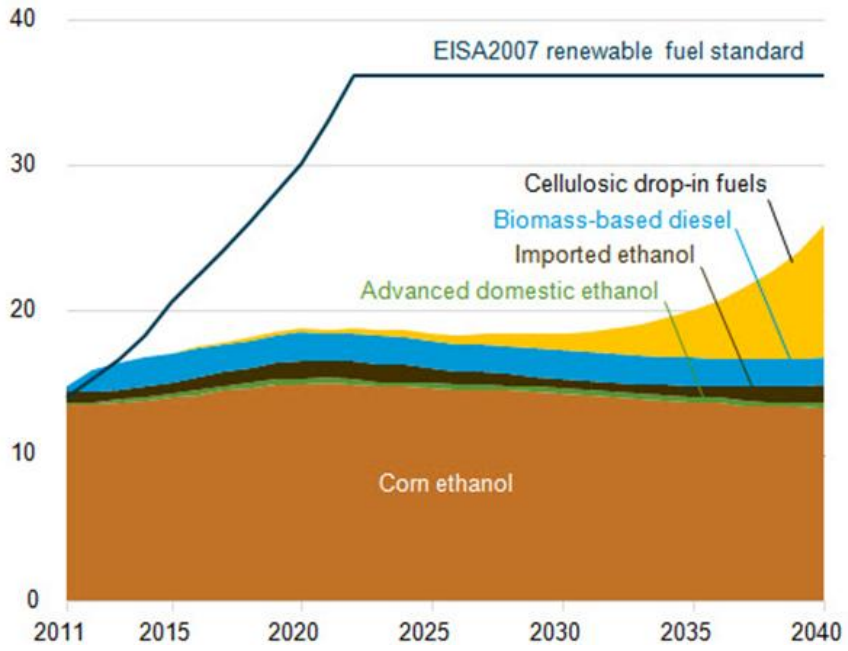
I am president of the Energy Policy Research Foundation, Inc. (EPRINC). EPRINC was incorporated in 1944 and is a not-for-profit organization that studies energy economics with special emphasis on petroleum and the downstream product markets. EPRINC researches and publishes reports on all aspects of the petroleum markets which are made available free of charge to interested organizations and individuals. We are recognized internationally for providing objective analysis of energy issues.

EPRINC has undertaken research and analysis on ethanol's role in the transportation fuels sector since 2006, including a major workshop with the Energy Information Administration (EIA) in 2008. Our full publication list on this topic is provided in the appendix. More importantly, as early as 2007, EPRINC published detailed assessments of ethanol's role in the transportation fuels sector.

From 2006-2008 EPRINC's research on the RFS concluded that it would not be feasible to implement the RFS at levels above 10% of the gasoline pool without significant disruptions to the transportation fuel supply network and without substantial increases in the cost of gasoline for American consumers. Similar outcomes are also likely for diesel fuel.

Our long-standing assessments of the RFS issue are now largely substantiated by work undertaken by EIA and also recent work undertaken by National Economic Research Associates (NERA). EIA is now forecasting that the production of cellulosic and advanced biofuels will not meet the volumetric mandates under the law (36 billion gallons per year by 2022) and, as a result, EPA will have to compensate for the expected deficit in the required volumes by issuing credits. The central point is that however EPA decides to address the shortfall, a large shortfall is coming. EIA forecasts (Figure 1) show that production of large volumes of cellulosic are not expected until after 2030.

FIGURE 1
Credits Earned from the RFS, EISA 2007
(billions of credits)



Source: EIA, AEO 2013

In this scenario, refiners and importers (so-called obligated parties) cannot obtain the volumetric requirements under EISA (RFS2) and therefore face rising costs from lack of supply and payments for credits issued by EPA. These rising costs lead to falling demand and lower production of transportation fuels. Reduced production brings about rising prices which resulted in NERA concluding that by 2015, diesel prices would rise by 300% and gasoline prices would rise by one-third if the program were not substantially reformed. Virtually the entire run up that occurs in the NERA analysis occurs through a loss of supply to the domestic market, which then leads to higher fuel prices, bringing about higher and more costly blending levels as demand for transportation fuels is suppressed.[1]

Even if we create an unrealistic and highly unlikely case in which large scale marketing channels are available for E85 (and one of the few legal means available to *generate* RINs after crossing the blend

[1] *See Economic Impacts Resulting from Implementation of RFS2 Program, National Economic Research Associates (NERA). October 2012.*

wall), and we further assume no major decline in demand for transportation fuels, EPRINC's research shows that near term increases in volumetric blending above the blend wall (10% ethanol in gasoline) would only be possible by financially encouraging consumers to buy E85 and then shifting that cost onto the price of E10. Such a cost shift would cause a spike in the price of E10 with prices escalating as the volumetric mandate grows.

Under this best case scenario, the marginal cost to supply E10 gasoline will rise by about $0.18/g in 2014 and $0.36/g by 2022 through E85 sales, a cost to American consumers of $20-$40 billion per year. This relatively low cost compliance scenario also requires that advanced and cellulosic biofuels enter the market at scale so that E85 blending is not limited by the 15 billion gallon per year (bg/y) limitation on ethanol from cornstarch. We have not included biodiesel in this estimate. However, diesel supplied into the domestic economy currently generates a larger RIN deficit than gasoline. Therefore, the per gallon marginal cost to supply diesel will rise by a greater amount than E10 gasoline. I cannot emphasize enough that this is a very optimistic best-case scenario; the most likely outcome is a much higher price spike in gasoline.

One of the fundamental issues preventing greater adoption of ethanol beyond 10% concentration in the gasoline pool is cost. According to DOE's AFDC (Alternative Fuels Data Center) data, the nationwide retail price of E85 has always been higher than that of gasoline since 2000 when adjusted for energy content; at no point in the past 13 years has E85 been cost competitive with gasoline. The inherently high cost of ethanol is at the heart of the RFS blend wall problem. Any discussions to address the failed expansion of mid-level blends and related infrastructure should be mindful of this data. Fuel suppliers are unlikely to make large investments in mid-level blending infrastructure for a product which is inherently too expensive and unlikely to be adopted by consumers.

We are seeing the early signs of problems from rising RIN values. The higher cost for RINs is sending a strong signal that the cost of transportation fuels are likely to rise in the near future. Several ethanol producers have begun blending E85 themselves, thus keeping the increasingly valuable RIN to sell to obligated parties, and selling the blended E85 directly to retailers.[2] For obligated parties, these higher

[2] http://domesticfuel.com/2013/05/29/siouxland-energy-steps-up-to-step-down-gas-prices/

cost RINs mean that RFS compliance will require additional outlays. By law, obligated parties must adhere to the RFS mandate regardless of cost or cut production. Ethanol futures prices have converged with wholesale gasoline (called RBOB)[3] prices since the beginning of the year, significantly increasing the cost of producing E10. At the beginning of January 2012, ethanol sold at a discount of over $0.60/gallon to RBOB; June futures settled less than $0.10/gallon apart, a slight premium for RBOB on a volumetric basis but a steep discount when energy content is accounted for. This $0.50/gallon convergence raises the cost of E10 by approximately $0.075 per gallon on an energy equivalent basis. Ten gallons of E10 generate one RIN and D6 (ethanol) RINs are currently trading in a range of $0.70 - $0.80 each, therefore the rise in the price of ethanol relative to gasoline since January is mirroring the increased costs of RINs over that same time period. The cost of complying with the RFS is rising.

EPA does have the authority to waive the RFS, and has done so on four occasions between 2010 and 2013, but each of these instances was for reductions in cellulosic biofuels volumes due to a lack of production capacity.[4] However, the EPA waiver process as practiced by the agency has at least two important limitations. The first is that EPA may only issue a waiver for one year at a time. This provision was included in the legislation to deal with relatively short-term disruptions or economic dislocations from the RFS program. However, our research shows that to prevent a rapid increase in gasoline prices, EPA should not only immediately issue a waiver holding volumetric mandates for renewable fuels at no more than 10% of the gasoline pool, but also signal its intention to extend the waiver beyond one year.

As long as volumetric blending mandates and the cost of achieving those levels remain highly uncertain (and costly), short-term waivers do not address what is essentially a long-term systemic constraint in absorbing higher volumes into the gasoline pool. The high costs associated with blending ethanol above 10% of the gasoline pool as well as evaluating the technical feasibility of bringing large volumes of advanced biofuels into the transportation fuel sector will take time. EPA can only prevent large increases

[3] RBOB refers to reformulated blendstock for oxygenate blending. This is how the wholesale price of gasoline is often quoted before it is blended to meet national and state environmental specifications.
[4] See Schnept, Randy and Brent Yacobucci, *Renewable Fuel Standard (RFS): Overview and Issues*, Congressional Research Service, March 14, 2013.

in gasoline prices by issuing a waiver holding blending at 10% and indicating it will likely extend the waiver through 2015.

A second major flaw is that a waiver may be issued only if EPA determines that the RFS is causing "severe" economic damage. It is not clear how EPA defines severe economic damage. EPA set itself a high bar for "severe" when it denied drought-related waiver requests in 2012. As there is no nominal dollar value associated with EPA waiver criteria and EPA remains vague on how high gasoline prices will have to rise before a waiver might be issued, this opens up the domestic gasoline market to substantial price and dislocation risks. Keep in mind that rising gasoline prices act as an excise tax on consumers and each penny increase costs consumers $1.4 billion. A $0.50 per gallon increase in E10 is the equivalent of a $70 billion tax on consumers with all the subsequent harm to the national economy. All of these costs do not include the additional consumer losses from rising costs of corn which have moved from an average of $2/bushel in 2006 to $6-8/bushel in recent years.[5]

It is my view that EPA has two immediate tasks. If they are concluding that the blend wall is not a problem, EPA should provide Congress with a detailed analysis how the program can be implemented without substantially increasing the price of E10 and diesel fuel. EPA should also inform Congress and the public of how large a price increase it is willing to tolerate before the economic damage is "significant."

Understanding the Volumetric Fuel Mandate

The renewable fuel program was adopted in the Energy Policy Act of 2005 (EPACT), and was expanded in the Energy and Independence Security Act of 2007 (EISA). EPACT mandated that a minimum of 4 billion gallons be used in 2006, rising to 7.5 billion gallons by 2012. EISA expanded the mandate to 9 billion gallons in 2008 rising to 36 billion gallons in 2022 (placing a 15 billion gallon cap on ethanol

[5] USDA, ERS, Feed Grains Database.

production from cornstarch and requiring growing volumes of advanced and cellulosic ethanol as well as biodiesel).[6]

The program is administered by requiring all refiners and other obligated parties (such as importers) to document that they have blended ethanol into gasoline by acquiring RINs (renewable identification numbers). Ethanol producers generate RINs when product is produced. RINs are then acquired from ethanol producers by obligated parties when blended into gasoline. In recent years, the ethanol fuel mandate (also known as the Renewal Fuel Standard or RFS) permitted ethanol blending below 10% of the gasoline pool. 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.

The Clean Air Act allows the Administrator of EPA, in consultation with the Secretaries of Agriculture and Energy, to waive the requirements of the RFS under certain criteria. The waiver could be issued if the Administrator determines -- after a notice and comment period -- that implementation of the RFS requirements would severely harm the economy or environment of a State, a region, or the United States.

Ethanol, when blended into gasoline, can play an important and cost effective role in meeting both automobile and environmental fuel specifications. The use of corn ethanol or advanced biofuels in the gasoline pool, when adjusted for both market and technology limitations, presents no major economic or technical risks as a supplement to the production of gasoline. The fundamental policy challenge today is directly attributable to a regulatory regime that requires annual upward adjustments in volumetric targets in ethanol 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.

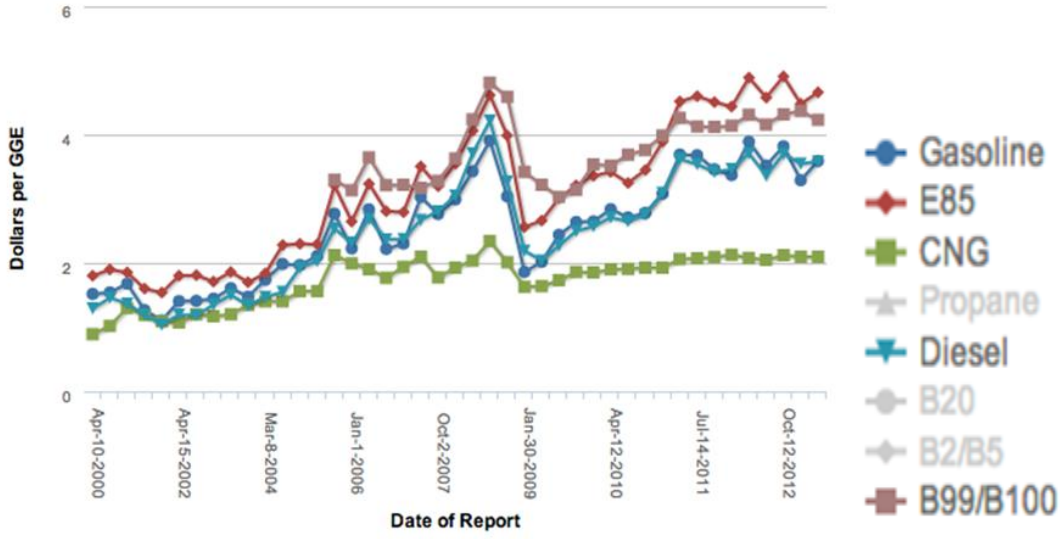
It is not ethanol per se that presents a risk of a price spike in gasoline or a major risk to automobile engines, but the federal mandate requiring ever larger volumes of ethanol into the gasoline pool. The

[6] The RFS program as modified by EISA (also called RFS2) divides the RFS requirement into four separate nested categories (total renewable fuels, advanced biofuels, biomass-based diesel, and cellulosic biofuels. Each of these categories comes with its own volume requirement. In addition, biofuels qualifying under RFS2 must meet lifecycle greenhouse gas emission performance standards.

current regulatory regime, if not reformed in some substantial manner, will likely spike gasoline prices. The high cost problems associated with the blend wall are exacerbated by the RFS requirement that ever larger volumes of cellulosic biofuels must be used even though only limited supplies exist.

As federal mandates take the U.S. gasoline pool above 10% ethanol by volume, increased use of ethanol can only enter the transportation fuels market through a separate gasoline product, E85 (60-85% ethanol). This fuel can only be used in so-called flex fuel vehicles. Consumers have been resistant to E85 because of its high cost when adjusted on a BTU basis to regular gasoline (E85's lower energy content corresponds directly to reduced fuel economy in flex-fuel vehicles), limited availability and higher frequency of refill. As shown in Figure 2 below, at no time since 2000 has E85, when adjusted for BTU content, been less expensive that E10 gasoline. This is a fundamental and potentially lasting condition in the domestic gasoline market and the principal reason it will be both difficult and costly to

FIGURE 2
E85 and B99/B100 Are Most Costly Transportations Fuels

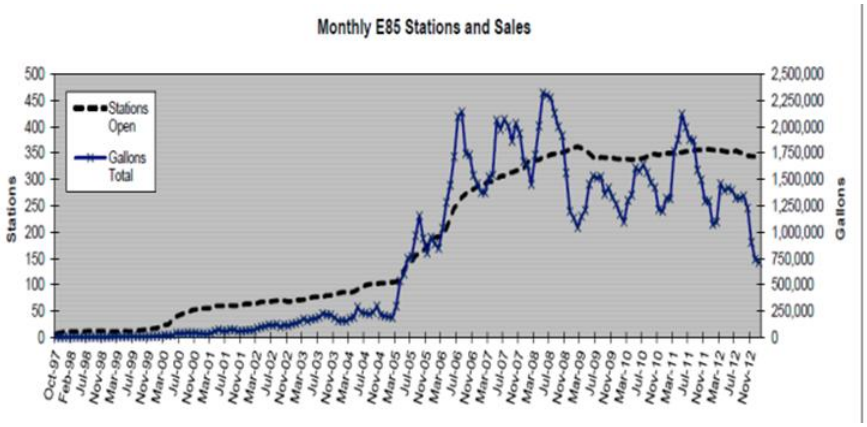


Source: Clean Cities Alternative Fuel Price Reports

Notes: Fuel volumes are measured in gasoline-gallon equivalents (GGEs), representing a quantity of fuel with the same amount of energy contained in a gallon of gasoline.

encourage consumers to purchase larger volumes of E85.[7] We know this because even with growing availability of flex fuel vehicles, consumers have been resistant to increasing consumption of E85 As shown in Figure 3 below for Minnesota, E85 sales have been declining as consumers find it too expensive.

Figure 3
Minnesota
E85 Sales Continue to Lag



Historical E85 Sales

Year	# Stations Year-End	Total Yearly Volume Est.
1997	11	6,607
1998	12	37,353
1999	17	99,514
2000	55	377,653
2001	64	704,120
2002	69	1,257,065
2003	84	2,168,305
2004	103	2,626,550
2005	181	8,154,977
2006	287	17,913,153
2007	320	21,412,686
2008	357	22,515,438
2009	339	15,925,119
2010	349	16,643,232
2011	357	19,804,100
2012	343	14,691,585
2013	342	711,360

Source: NREL

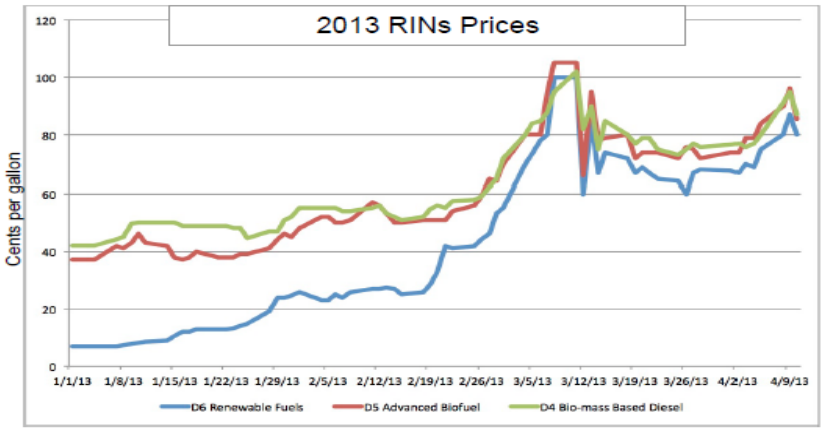
EPA has recently approved another gasoline product, E15 (gasoline blended with 15% ethanol), for a large portion of the U.S. automobile fleet. But neither the driving public nor the U.S. auto industry is prepared to use E15 in large volumes. E15 also faces the same cost constraints as E85, although to a lesser extent. For the most part, in the next few years, higher volumes of ethanol blending will require higher sales of E85.

Why the Blend Wall is a Problem

Historically, RINs have sold for a few pennies a gallon, but in recent months RIN prices have risen to as high as a $1 gallon or more as shown in Figure 4 below.

[7] As of March 2013, there were 3,028 fueling stations selling E85 in the U.S. Most stations were in the Corn Belt states. As of 2008 the leading state was Minnesota with 353 stations, followed by Illinois with 181, and Wisconsin with 114.

Figure 4
Ethanol RINS (in blue) Become Expensive



Source: Stillwater Associates

The cause of rising RIN prices is complicated, but is largely driven by expectations among obligated parties that they will soon face very high costs of blending ethanol at levels above 10% of the gasoline pool and will require RINs from an ever diminishing supply to meet the requirement. Historically ethanol RINs sold for pennies a gallon, but have not been quickly bid up to level equivalent to advanced biofuels and Bio-mass Based Diesel.

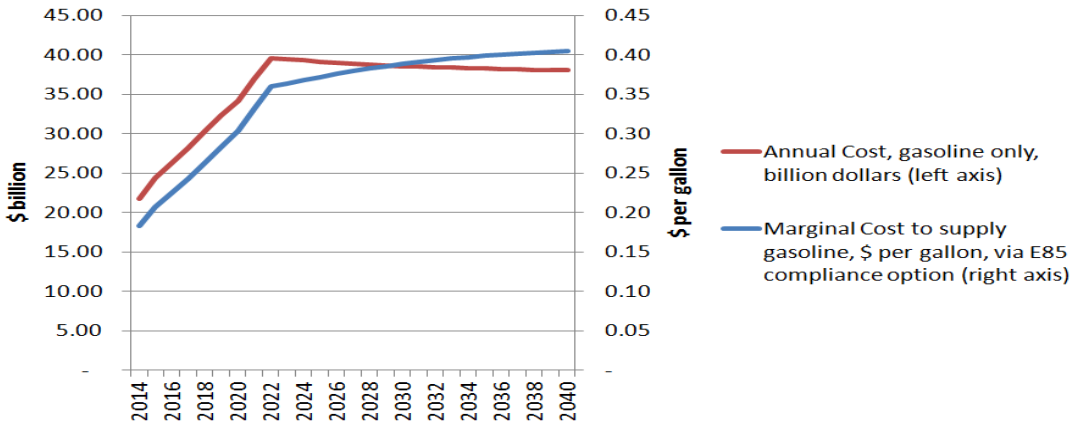
As the U.S. gasoline pool has approached 10% ethanol concentration over the past year, the supply of RINs has declined as U.S. refiners cannot physically blend above RFS mandated volumes to generate surplus RINs as they could in the past when volumetric mandates were far below the 10% threshold.

Other refiners who are already at (or will soon hit a 10% blending volume) are now entering the market to buy RINs to meet the newer and higher RFS volumetric blending requirements. RIN values are rising now because markets are forward looking and expectations remain that EPA will take the entire transportation fuels market head-on into the blend wall. Instead of purchasing high cost RINs, obligated parties could attempt to distribute increased ethanol volumes through E85 or E15, but this option is highly limited and expensive. The remaining options are: (1) cut throughput (gasoline production) so a refiner's or importer's renewable fuel obligation (RVO) can be lowered and bring requirements under 10%, (2) shift domestic production to exports so incremental capacity utilization is not captured by the

mandated volume obligations, or (3) pay a large fine for not meeting the mandated blending volume. These options reduce the supply of gasoline and diesel to the market while raising the cost of the product that is supplied into the domestic market. While the refining industry, and perhaps the ethanol industry, is likely to absorb some cost increases, much of these cost increases will be passed on to consumers in the form of higher pump prices.

Under our best case scenario, the marginal cost to supply E10 gasoline will rise by about $0.18/g in 2014 and $0.36 by 2022, about $20-$40 billion per year (Figure 5). This low cost scenario also requires that advanced and cellulosic biofuels enter the market at scale so the E85 blending is not limited by the 15 billion gallon/yr (bg/y) limitation on ethanol from corn. We have not included biodiesel in this estimate. However, diesel supplied into the U.S. currently generates a larger RIN deficit than gasoline. Therefore, the per gallon marginal cost to supply diesel will rise by a greater amount than E10 gasoline.

FIGURE 5
Cost Compliance Curve Under Best Case Scenario



Source: EPRINC Calculations

I cannot emphasize enough that this is a very optimistic scenario and the most likely outcome is a much higher price spike in gasoline. Adding to these consumer costs is an annual federal budget liability of $16 billion by 2022 from the cellulosic biofuels production tax credit of $1.01 gallon.[8]

This highly optimistic scenario provides some insight into what the low-end of the RFS price would look like. Obligated parties would have to take on billions of dollars of losses promoting the sale of E85 with the expectation that these costs could be passed through to E10 and other petroleum products. Most refiners do not own retail stations, so they cannot simply set the price at the retail level or order loss-making ethanol blending. Geographic and infrastructure constraints would limit the amount of E85 that could be sold and where it might be sold, giving some obligated parties a compliance advantage over others.

The blend wall affects each obligated party differently. Some have more carryover RINs than others. Midwest refiners have better access to ethanol supplies and E85 outlets, while coastal refiners have direct access to export markets. Obligated parties will take different steps to reduce their RVO (by exporting) or generate RINs (with E85) depending on their individual operations. But regardless of individual circumstances, the RFS sends all obligated parties the same message: the U.S. is going to be a very difficult and expensive place to sell gasoline.

EPRINC notes that a study recently completed by *Informa Economics* concludes that ethanol, instead of increasing the price of gasoline, has led to a reduction in the price of gasoline by 2-4 cents a gallon, and that in any case, gasoline prices are determined largely by crude oil costs and gasoline taxes. We agree that any kind of long-term assessment of gasoline markets will conclude that crude oil and taxes account for 80-90% of the cost of gasoline. The remainder is determined by refinery margins, distribution costs and retail margins. While in general feedstock costs and taxes determine gasoline prices, the *Informa Economics* study fails to explain ethanol's prospective role (and more importantly, the role of the RFS fuel mandate) in driving up refinery margins. The principal confusion in such analyses is that as mandated ethanol use exceeds 10% of the gasoline supply, a large differential opens up between the cost of purchasing ethanol and the much higher cost of "using" (or blending) ethanol into the gasoline pool.

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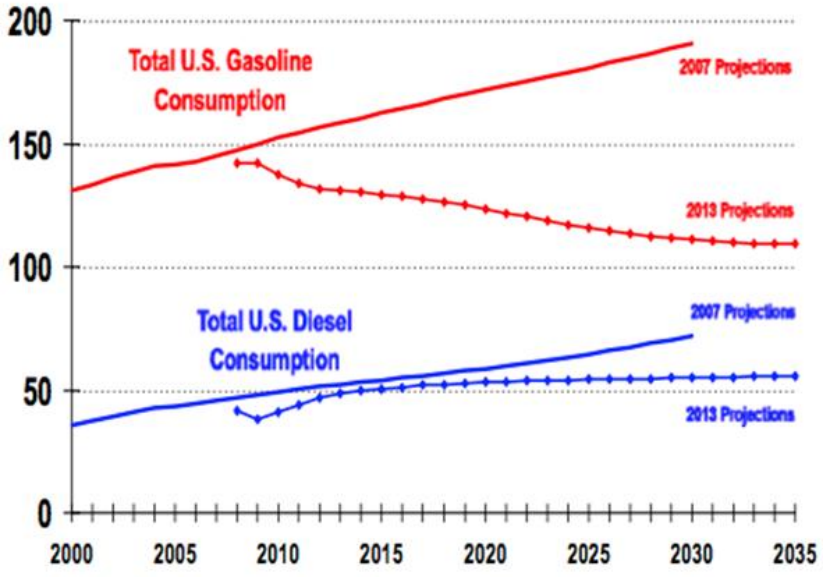
[8] See Schnept, Randy and Brent Yacobucci, *Renewable Fuel Standard (RFS): Overview and Issues*, Congressional Research Service, March 14, 2013. P. 20.

How Did We Get Here

In the years preceding the passing of EPACT and EISA, a large segment of U.S. policy makers and analysts believed U.S. gasoline consumption would grow to well over 170 billion gallons from 2007 levels of 145 billion gallons, thus accommodating the conventional renewable fuel volumes proposed in EISA at ethanol blend rates below 10%. However, this forecast was not universally accepted among independent energy analysts nor was acceptance of this forecast necessarily evidence that fuel mandates were a wise decision. Note as shown in Figure 6 below, EIA projections in 2013 show that 2022 U.S. gasoline consumption will decline to slightly more than 120 billion gallons and diesel consumption is expected to remain flat. The difference in the outlook in U.S. transportation fuel use between forecasts made in 2007 and 2013 is stark. Clearly RFS2 targets were established in an era of expectations of rising gasoline demand and circumstances in which exceeding 10% of the gasoline pool was considered unlikely.

FIGURE 6

EIA Projections of U.S. Transportation Fuel Use



Source: EIA, Annual Energy Reviews, 2007 and 2013

The drawback of both EPACT and EISA is not that the legislation was based on a poor forecast. Any forecast is likely to be incorrect because advances in technology, changes in demand, automobile technology, and feedstock prices are all inherently uncertain. The fundamental flaw in the legislative program was that the fuel mandate provided for no flexibility for changes in either the technology or economics of producing gasoline should new conditions prevail in the marketplace. The legislation did provide for a waiver for economic harm, but this appears to be an extremely high threshold for EPA

A 2006 EPRINC report pointed out that, "At the very least, additional measures to promote ethanol should not aggravate supply risks by reducing flexibility in how the overall mandates are met." In addition, EPRINC research released in November 2007, before EISA was signed into law, had determined that ethanol could easily be absorbed into the gasoline pool at levels of approximately of 5%, but that volumes above 10% would be problematic. The study pointed out that:

> *There is an easy amount of ethanol that can be absorbed in the gasoline pool. That is about 5%, and that is where the market is now: about 8 billion gal/year, or 500,000 b/d. At that level, ethanol is a necessary and complementary component of the gasoline pool. It is the current situation. It represents the replacement of MTBE in an economic environment that accommodates ethanol prices higher than gasoline prices.*
>
> *…For years beyond 2012, there are proposals for ethanol sales mandates that assume concentrations in gasoline above the current 10% cap. How that might be achieved is an unanswered question, given that only US automakers espouse the plan, and they account for only about half of US vehicle sales. Proposals or sharply increased ethanol sales simply assume that auto manufacturers will warranty existing cars for fuel blends containing far more than the current 10% maximum…*
>
> *Depending on an agricultural commodity to accomplish these goals, however, just adds the risk of the crop cycle to present instabilities. That dependency will be a concern until ethanol from cellulose becomes economic and available in large amounts. More immediately, the ethanol industry faces the stresses of consistently high corn prices, weakening product prices, the consequent compression of margins, and the possibility of producer consolidation. How the immediate stresses affect the ultimate shape of an industry still in its formative stages remains*

uncertain. What is certain is that the modern energy economy has constraints on how much ethanol it can absorb.

Three Myths About Ethanol and the RFS Mandate

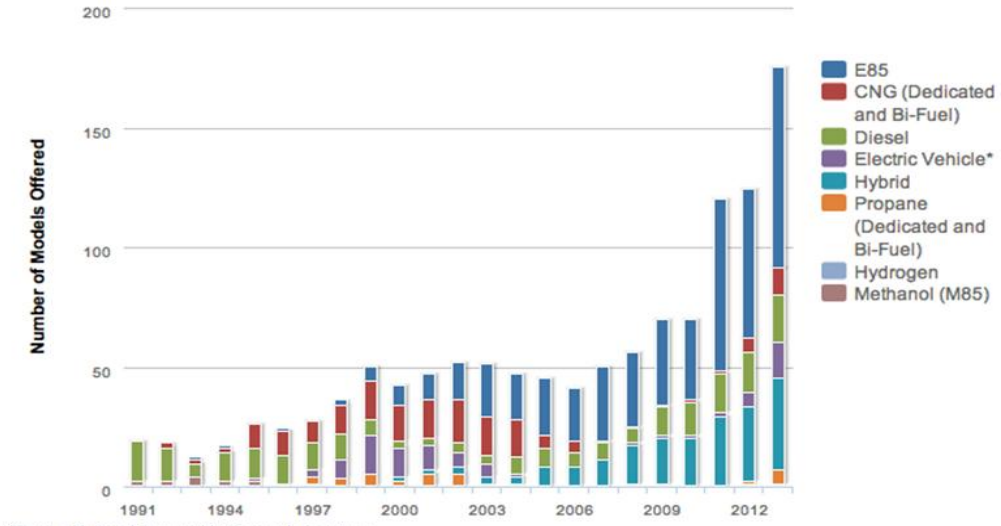
If the mandate did not exist no ethanol would be sold into the U.S. transportation fuels market.

Even if ethanol blending were determined strictly by cost and market conditions, total blending would be unlikely to fall below 400,000 bbl/d from current blending volumes of around 800,000 bbl/d, and depending upon market conditions could sustain levels close to current levels. Ethanol blending would continue because it remains a valuable blending component to meet octane requirements and other fuel specifications required by EPA. Higher blending levels would occur depending upon cost and market conditions. However, ethanol's role at concentrations above 3-5% of the gasoline pool are largely as a substitute for gasoline, but its value is limited by ethanol's lower BTU content, and ultimately, by limitations of the U.S. auto fleet to absorb ever higher volumes of ethanol. On a volumetric basis, ethanol is often cheaper than gasoline. When adjusted for energy content, ethanol is generally more expensive than the gasoline.

Consumers don't buy E85 because there are too few stations selling the fuel.

Although representatives of the ethanol industry blame the lack of E85 distribution infrastructure on oil producers and refiners, there is little evidence that the petroleum industry is a major impediment to the installation of E85 pumps. Most service stations in the U.S. are owned independently and have seen rapid growth in the installation of CNG and electric charge stations (Figure 7 below). The problem with E85 is a lack of consumer demand and not infrastructure.

FIGURE 7
Light Duty AFV, HEV, and Diesel Model Offering, by Fuel Type



Source: National Renewable Energy Laboratory

Notes: *EVs do not include neighborhood electric vehicles (NEVs), low speed electric vehicles, or two-wheeled electric vehicles. Conversion models were counted for natural gas and propane vehicles for the first time in 2012.

Ethanol has reduced the price of gasoline by nearly $1/gallon

U.S. government officials, including Secretary of Agriculture Tom Vilsack, representatives of the Renewable Fuels Association (RFA), and other supporters of expanded mandates for the use of renewable fuels in the transportation sector have argued that the growth in ethanol blending spurred by the RFS has contributed to large reductions in the price of gasoline.

These conclusions were taken from a series of studies from the Center for Agricultural and Rural Development at Iowa State University (CARD). The studies concluded that ethanol use had reduced gasoline prices by approximately $0.89/gallon in 2010 and $1.09 per gallon in 2011.[9] The results of the study were also circulated widely among members of Congress and were part of an extensive advertising program undertaken by RFA.

[9] Xiaodong Du and Dermot J. Hayes, The Impact of Ethanol Production on U.S. and Regional Gasoline Markets: An Update to 2012. May 2012, Working Paper 12-WP 528. See http://www.card.iastate.edu/publications/dbs/pdffiles/12wp528.pdf

The authors of the studies undertook a series of econometric calculations evaluating how the U.S. refining sector and gasoline prices would adjust if growth in the use of ethanol in the transportation fuels sector were constrained. The studies evaluated the consequences of limiting ethanol use across several time periods, but most notable were the consequences of constrained blending between January 2000 and December 2010.

The econometric model tested by Du and Hayes did not adequately reflect operating conditions in the U.S. refining industry. The calculations undertaken by CARD prohibited any adjustments in refining capacity and then made a series of calculations on the consequences of limiting annual ethanol use to 1.6 billion gallons annually for the 2000-2010 and then 2000-2011 time periods. However, ethanol production has grown by billions of gallons per year and refining capacity grew by 1 mm bbl/d (million barrels per day) from 2000 to 2010 and by 1.2 mm bbl/d from 2000 to 2011. This is enough refining capacity to process over 15 billion gallons of crude annually.

Gasoline prices rise in the CARD calculations because demand can only be met through higher cost production from the existing installed capacity, either in the U.S. or abroad. Additionally, the CARD model does not account for demand rationing. If gasoline prices were $1.09 higher in 2011, a 30% increase which would have sent prices to nearly $5/gallon, certainly demand would have been somewhat curtailed. It should also be remembered that gasoline is a globally traded commodity. The spot price of gasoline in the Gulf Coast is only a few cents per gallon different from the European spot price in Rotterdam. It is unlikely that the loss of 700,000 bbl/d of ethanol under the CARD model, 460,000 bbl/d of gasoline equivalent after BTU adjustment, would have the effect of raising prices $1.09/gallon globally. The CARD report specifies a price impact only in the U.S. market, but the U.S. market is perhaps the most globally integrated fuels market in the world.

A recent study by joint authors from MIT and UC Davis highlighted the limitations of the econometric approach undertaken in the CARD study.[10] The MIT/UC Davis assessment points out that the

[10] Christopher R. Knittel and Aaron Smith. "Ethanol Production and Gasoline Prices: A Spurious Connection." July 12, 2002. MIT/UCSD criticisms of the CARD results were very specific, "We show that their (CARD) results are driven by implausible economic assumptions and spurious statistical correlations. In doing so, we show that the empirical results are extremely sensitive to the empirical specification; however, empirical models that are most consistent with

estimates of reductions in gasoline prices were inconsistent with the basic economics of the industry. The authors of this study concluded that, at best, they were only able to calculate a $0.13/gallon reduction in gasoline prices. In terms of their econometric model results, these conclusions are insignificant or essentially zero. As the authors of the MIT/UCSD study point out, using the same model as the CARD authors, eliminating ethanol use also would have increased natural gas prices by 65 percent and would have caused an increase in U.S. and European unemployment.

Conclusion

Ethanol is a very important component of gasoline supply at concentrations levels of approximately 5% of the gasoline pool. It replaced MTBE as the primary oxygenate for U.S. gasoline and serves as an octane booster. However, as blends approach 10% concentration, the relative cost of ethanol increases as its value declines. Mid-level blends such as E15 and E85 are simply uneconomic under current market conditions. Sustainable solutions will be those that promulgate strategies for renewable fuels that hold up well under a wide range of future market conditions.

Regarding changes to programs that promote the use of renewable fuels into the gasoline pool, any policy remedy should provide adequate market flexibility for refiners and importers to adjust to large movements in feedstock prices, production costs, and automobile technology. Bringing flexibility to volumetric renewable fuel mandates, which cannot by definition, adjust to uncertainty in market conditions, is clearly an important starting point in any reform program.

Finally, the U.S. is in the midst of a renaissance in oil and gas production. As shown in Figure 8 below, EPRINC estimates that combined U.S. and Canadian oil production is likely to grow to 13.75 million barrels a day (mmb/d) by 2020, up from the 2010 level of 8 mmb/d in 2010.

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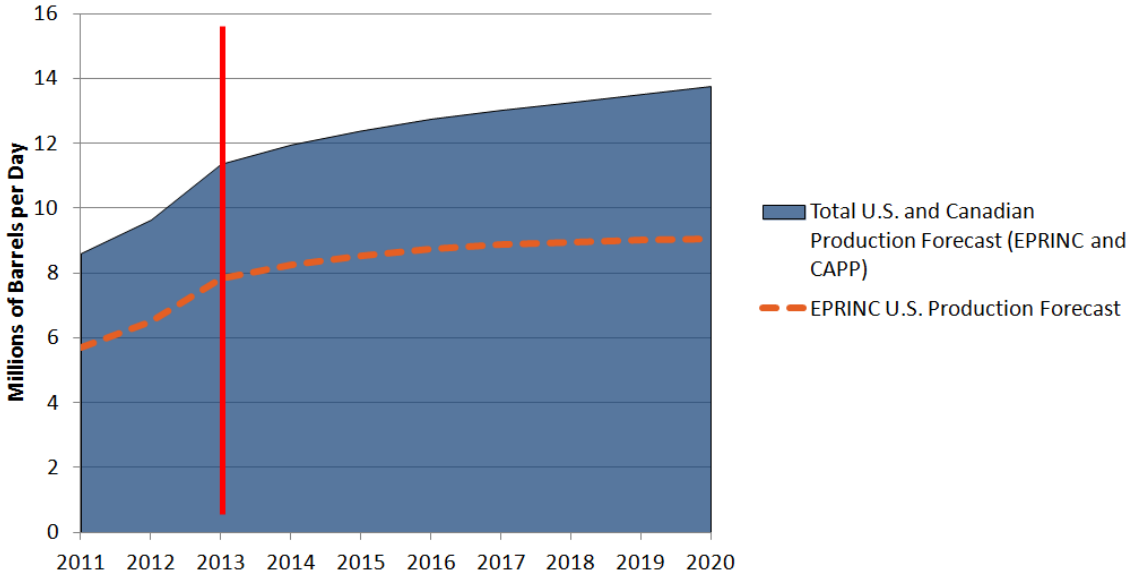
economic theory suggest effects that are near zero and statistically insignificant."See http://web.mit.edu/knittel/www/papers/knittelsmith_latest.pdf

FIGURE 8
North American Oil Production Forecast



Petroleum is no longer an instrument of economic distress, but a major driver of economic growth and a much improved strategic outlook for the U.S. When the RFS was established as law, the U.S. faced rising consumption of transportation fuels, declining domestic natural gas and crude oil production, and rapidly rising petroleum product imports. None of these conditions exist today. Given the vast changes in our energy landscape we should now revisit not just the RFS, but the entire regulatory programs that were put into place in a much different era.

APPENDIX (Selected EPRINC Publications on Ethanol and the RFS)

Montalbano, Ben. *Get Ready for a Bumpy Ride - It Could Be a Turbulent Year for Gasoline Prices*. Publication. N.p.: n.p., n.d. Web. 15 Mar. 2013. http://eprinc.org/pdf/EPRINC-GASOLINETURBULENCE-2013.pdf

Pugliaresi, Lucian. "Time to Rethink Renewable Fuel Rules." *www.cnbc.com*. N.p., 18 Apr. 2013. Web. http://www.cnbc.com/id/100653882

Pugliaresi, Lucian. "Ethanol's Hidden Gasoline Tax." *Www.washingtontimes.com*. N.p., 7 May 2012. Web. http://www.washingtontimes.com/news/2012/may/7/ethanols-hidden-gasoline-tax/?page=all

Montalbano, Ben. *Ethanol's Lost Promise: An Assessment of the Economic Consequences of Renewable Fuels Mandate.* 14 Sept. 2012. http://eprinc.org/pdf/EPRINC-ETHANOL-LOSTPROMISE-2012.pdf

Montalbano, Ben. *Implementation Issues for the Renewable Fuel Standard*. Publication. N.p.: n.p., n.d. Web. 28 Apr. 2011. http://eprinc.org/pdf/EPRINC-CornLimitsEthanol.pdf

Pugliaresi, Lucian, and Ben Montalbano. *Will the Ethanol Mandate Drive Up the Cost of Transportation Fuels?* Publication. N.p.: n.p., n.d. Web. Feb. 2009. http://eprinc.org/pdf/costofethanolmandate.pdf

A Report on the EPRINC-EIA Ethanol Roundtable Discussion That Took Place on April 15th. Publication. N.p.: n.p., n.d. Web. June 2008. http://eprinc.org/pdf/ReonEPRINCEIAEthRtDis.pdf

Kumins, Larry. "Energy System Limits Future Ethanol Growth." *Oil & Gas Journal* (2007) 2-5. 26 Nov. 2007. Web. http://eprinc.org/pdf/ETHANOLUPDATEOGJ.pdf

Kumins, Larry. *Ethanol II: Is Home-Grown Fuel Policy Undermining U.S. Energy Security?* Publication. N.p.: n.p., n.d. Web. Apr. 2007. http://eprinc.org/pdf/HomeGrownFuelUSEnergySecurity.pdf

Goldstein, Larry, and Ron Gold. *Update on Ethanol*. Publication. N.p.: n.p., n.d. Web. July 2006. http://eprinc.org/download/UpdateOnEthanol.pdf

MTBE, Ethanol - Sorting Through the Oxygenate Issues. Publication. N.p.: n.p., n.d. Web Dec. 2001.http://eprinc.org/download/oxyissues.pdf