



Economic Letter

Renewable Fuel Standards Hit the 'Blend Wall'

by Michael D. Plante and Mine Yücel

► *The Energy Policy Act of 2005 mandated that a minimum amount of biofuel be blended into transportation fuels. But nine years after the law was passed, the energy landscape has changed.*

Consumption and imports of oil products reached record highs in 2005, while oil prices increased significantly. In response, lawmakers decided that a good domestic solution would be biofuels, which are typically produced from corn or agricultural byproducts.

The Energy Policy Act of 2005 mandated that a minimum amount of biofuel be blended into transportation fuels, primarily gasoline and diesel. The requirement, called the renewable fuel standard, was extended under the Energy Independence and Security Act in 2007.

But nine years after the original law was passed, the energy landscape has changed. While oil prices remain elevated, U.S. crude oil production, riding the tide of the shale boom, has risen significantly and imports have fallen.

Moreover, the biofuels system created under the law has proven difficult to implement. The renewable fuel standard stipulates that ever-increasing amounts of biofuels be mixed into the U.S. fuel supply. Behind these requirements were critical suppositions about rising U.S. gasoline consumption and technological developments in the production of cellulosic ethanol, a biofuel.¹

In recent years, it has become clear that domestic gasoline consumption has leveled off and cellulosic ethanol targets are

not viable; hence, meeting the laws' provisions will grow increasingly unfeasible.

As an indication of implementation difficulties, the Environmental Protection Agency (EPA) has proposed significantly lower 2014 ethanol targets. The plan, announced in November 2013, provides relief but does not permanently address the underlying problems arising from the 2005 and 2007 laws.

Renewable Fuel Standards

Renewable fuel standards, as written into the Energy Independence and Security Act, require U.S. refiners to mix a minimum amount of biofuels with gasoline and diesel every year. These standards also apply to importers of gasoline and diesel intended for sale in the U.S. market. The mandate for total renewable fuel use started at 9 billion gallons of biofuels in 2008, rising to 36 billion gallons by 2022 (*Table 1*).

Individual mandates are in place for four different types of biofuels: corn ethanol, biodiesel, cellulosic ethanol and other advanced biofuels. Importantly, the system limits how much corn ethanol can be used to meet the mandates for total renewable fuels. In 2010, for example, the mandate for total renewable fuel use was 12.95 billion gallons, of which corn ethanol was capped at 12 billion gallons.

To make the system operational,

▶ When the renewable fuel standard was extended in 2007, assumptions were made about ethanol production technology and gasoline consumption—some of which turned out to be flawed.

Table 1 Mandate for Biofuel Use to Rise Through 2022

Year	Original Biofuel Mandates Set in 2007 (in billions of gallons)			
	Total renewable fuels	Cap on corn starch-derived ethanol	Portion from advanced biofuels	
			Cellulosic	Biodiesel
2008	9.00	9.00	0	0
2009	11.10	10.50	0	0.50
2010	12.95	12.00	0.10	0.65
2011	13.95	12.60	0.25	0.80
2012	15.20	13.20	0.50	1.00
2013	16.55	13.80	1.00	*
2015	20.50	15.00	3.00	*
2020	30.00	15.00	10.50	*
2022	36.00	15.00	16.00	*

*To be determined by the Environmental Protection Agency through future rulemaking, but no less than 1 billion gallons.

SOURCES: Congressional Research Service, 2010; Energy Independence and Security Act of 2007.

the EPA requires individual refiners and importers to mix a certain amount of biofuel into the gasoline and diesel they sell.² The exact amounts are known as renewable volume obligations (RVOs). The EPA calculates an RVO for each refiner annually, and at the end of the year, refiners have to verify that they have achieved their number. This is done through the use of renewable identification numbers (RINs).

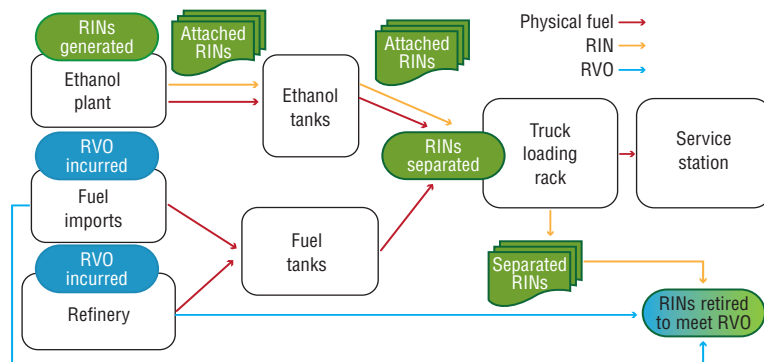
What Are RINs?

Each gallon of biofuel produced or imported into the U.S. is assigned a RIN, and each type of biofuel has its own RIN

system. As a gallon of biofuel moves along the production chain, its RIN moves along with it (*Chart 1*). When the biofuel is blended into gasoline or diesel, the RIN is “separated” from the biofuel and becomes the property of the refiner that mixed the biofuel into the gasoline.

A refiner meets its RVO by turning over to the EPA an equivalent amount of RINs at the end of the year. If the refiner has extra RINs above and beyond what’s needed to meet its RVO, it can bank them for future use or sell them to another refiner. The system gains flexibility from the trade in RINs, providing refiners the possibility of

Chart 1 Lifecycle of a Renewable Identification Number



NOTE: Refiners and Importers incur renewable volume obligations (RVOs) with each gallon of fuel introduced into the U.S. production and distribution system. Renewable identification numbers (RINs) are used to document that RVOs have been met.

SOURCE: Energy Information Administration.

blending more or less biofuel than their RVOs require.

If the total amount of biofuel blended into gasoline by all refiners across the U.S. exceeds the amount in the target, there will be a surplus of RINs available for that biofuel. If a surplus occurs, RIN prices tend to fall very close to zero. Until 2012, for example, corn ethanol production generally exceeded fuel-standard targets and its RIN price was close to zero (*Chart 2*).

Conversely, if the total amount of biofuel blended by all refiners across the U.S. does not meet the amount in the target, there will be a shortage of RINs. RIN prices will rise and refiners will need to use RINs banked from previous years.

The fuel standards distinguish among different types of biofuels (each with its own RIN), and rules limit the substitutability between the RINs. For example, a biodiesel or a cellulosic ethanol RIN can take the place of a corn ethanol RIN, but the opposite is not possible. This twist in the system can have important implications for how an increase in RIN prices affects production of various biofuels.

High RIN prices for corn ethanol might not automatically lead to significantly greater ethanol production. The substitution rules could, in theory, prompt more production of biodiesel if that were more profitable.

Problems with Mandates

When the renewable fuel standard was extended in 2007, assumptions were made about ethanol production technology and gasoline consumption—some of which turned out to be flawed—in order for the fuel targets to be fulfilled. Three incorrect assumptions help explain recent problems with the system.

Assumption 1: Cars will be able to burn gasoline with more than 10 percent ethanol.

Currently, most cars in the U.S. can use only E10, a blend of 10 percent ethanol and 90 percent gasoline. Only a small fraction of the U.S. vehicle fleet can use higher ethanol blends, effectively limiting the amount of ethanol that can be mixed into gasoline. This threshold has become known as the “blend wall.”

To see how this poses a problem, consider the renewable fuel standard for etha-

nol in 2013. The mandate for the year was set at 13.8 billion gallons of ethanol in 2007. But U.S. gasoline consumption in 2013 was only 134.8 billion gallons, which puts the standard at 10.2 percent of gasoline consumption. This exceeds the maximum that can be absorbed in the market given that most vehicles in the U.S. use only E10.

Assumption 2: Gasoline consumption will grow at a healthy rate.

When the Energy Independence and Security Act was passed in 2007, U.S. gaso-

line consumption was growing and forecast to continue growing for the foreseeable future. Even with the 10 percent blend wall, growing gasoline consumption would enable greater biofuel use over time.

However, gasoline consumption has not grown as forecast. The current estimate for 2014 is about 13 percent below the estimate made in 2007. With the blend wall in place, it's essentially impossible to mix enough corn ethanol into gasoline to meet the mandate given expected U.S. consumption levels (*Chart 3*).

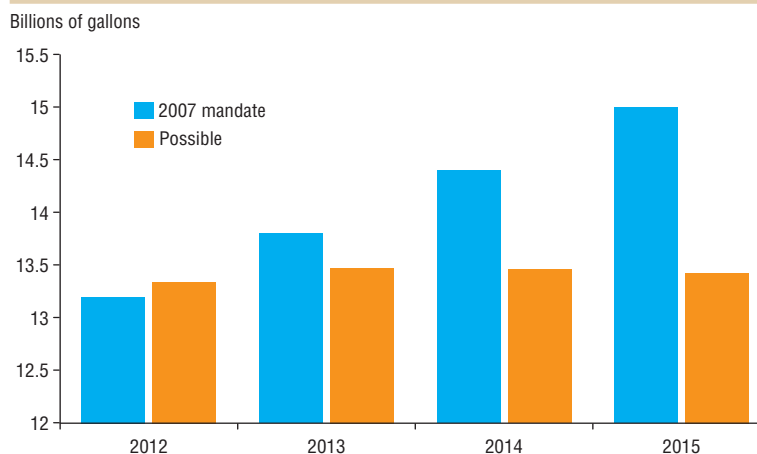
Chart 2 Roller Coaster Ride for Corn Ethanol RIN Prices in 2013



NOTE: If a refiner has more renewable identification numbers (RINs) than needed to meet its obligation for a particular fuel blend, it can bank them or sell them. The price varies according to demand.

SOURCE: Bloomberg.

Chart 3 Ethanol Mandates Hit the 10 Percent Blend Wall



NOTE: Most U.S. vehicles cannot use ethanol blends above 10 percent; thus, the ability to increase ethanol content is limited. This is known as the blend wall.

SOURCES: Energy Independence and Security Act of 2007; Energy Information Administration.

Assumption 3: Cellulosic ethanol will be a viable biofuel.

The laws originally mandated that 100 million gallons of cellulosic ethanol be used in 2010, with the requirement rising and eventually reaching 16 billion gallons by 2022. However, cellulosic ethanol production technology didn't develop as hoped and production failed to reach anticipated levels. In fact, the EPA reduced the 2010 mandate to just 6.5 million gallons because production was so low. In each successive year, the EPA has revised the original mandates downward. Thus, it seems highly unlikely that the original mandates for future years will be met.

RIN Roller Coaster

If a mandate cannot be met, RIN prices should rise as refiners attempt to get enough RINs to meet their renewable volume obligations. That happened in 2013 to corn ethanol RINs, which rose from practically zero to \$1.40 in a short period, as seen in Chart 2.

Some of the issues with corn ethanol in late 2012 and 2013 were temporary. The drought of 2012 significantly increased corn prices, which reduced the incentive to produce corn ethanol. The RIN system is designed to deal with such temporary problems because banked RINs can be used to meet the shortfall. When corn prices fell dramatically toward the end of 2013, the problem eased as ethanol production picked up.

However, the system is not designed to deal with the more permanent problem the blend wall poses—at least not in a very cost-efficient manner. With the corn ethanol mandate increasing over time and

gasoline consumption stagnant, mandated levels will likely prove elusive in years to come, leaving corn ethanol RIN prices persistently high.

Interestingly, it's unclear whether corn ethanol production would rise. Underlying blend wall issues severely limit how much ethanol can enter the market at any one time. A more likely result would be increased blending of biodiesel, because biodiesel RINs can be used as a substitute for corn ethanol RINs. That, in turn, could inflate the price of biodiesel RINs because of quirks in the substitution rules.

A Temporary Fix

The RIN price increase in 2013 prompted substantial discussion about the costs and benefits of the renewable fuel standards requirement. In November, the EPA proposed, for the first time, reducing the mandate for corn ethanol. RIN prices for corn ethanol are now sharply off their 2013 peaks.

The EPA's recent proposal alleviates problems that would have occurred in 2014 due to the blend wall and other factors. However, the solution is temporary and does not address the inherent problems with volume targets in the renewable fuel standards. As such, the mandated targets will continue to be troublesome in coming years.

It's possible that these problems could be mitigated in the future. For example, the blend wall issue would be reduced if there were more automobiles capable of accepting a higher ethanol mix. It's also possible that a technological breakthrough could lead to increased production of cellulosic ethanol. Neither of these solutions

seems likely in the near future, suggesting that further temporary measures will be needed in the next few years unless a more substantive response occurs.

Plante is a senior research economist and Yücel is senior vice president and director of research at the Federal Reserve Bank of Dallas.

Notes

¹ Cellulosic ethanol is produced using grasses, wood and other nonedible materials, as opposed to corn ethanol or so-called advanced biofuels, typically ethanol produced using sugar cane. Biofuel can also refer to biodiesel, which is often produced using vegetable oils.

² For brevity, we mention only refiners from this point forward in the text.

**Economic Letter**

is published by the Federal Reserve Bank of Dallas. The views expressed are those of the authors and should not be attributed to the Federal Reserve Bank of Dallas or the Federal Reserve System.

Articles may be reprinted on the condition that the source is credited and a copy is provided to the Research Department of the Federal Reserve Bank of Dallas.

Economic Letter is available on the Dallas Fed website, www.dallasfed.org.

Federal Reserve Bank of Dallas
2200 N. Pearl St., Dallas, TX 75201

Mine Yücel, Senior Vice President and Director of Research
E. Ann Worthy, Senior Vice President, Banking Supervision
Anthony Murphy, Executive Editor
Michael Weiss, Editor
Kathy Thacker, Associate Editor
Ellah Piña, Graphic Designer

100 YEARS™
FEDERAL RESERVE SYSTEM