



# THE *Main Street* ECONOMIST *Agricultural and Rural Analysis*



ISSUE 5, 2012

FEDERAL RESERVE BANK of KANSAS CITY

## *Markets, Not Mandates, Shape Ethanol Production*

*by Nathan Kauffman, Economist*

The 2012 drought has reignited the food versus fuel debate. After cutting U.S. corn production below recent years' consumption, the drought sparked a U.S. grain shortage and sent global food prices soaring. As the grain shortage intensified, pressure to relieve the shortage by easing ethanol mandates mounted. Escalating ethanol mandates under the Renewable Fuel Standard (RFS), which fueled the expansion of the U.S. ethanol industry, will soon exceed the amount of ethanol than can be used in current U.S. gasoline blends. Some industry participants believe that a waiver of the mandate has the potential to reduce ethanol production and relieve high corn prices.

However, ethanol production may not decline significantly, even if the mandates are waived temporarily, a request the EPA recently denied for the 2013 mandate. The RFS mandates stipulate ethanol blending for the next decade. A temporary waiver would not relieve the pressure on current production to build credits to satisfy future mandates. In addition, the ethanol industry has become more market-based as production has exceeded the mandates in recent years. If energy prices rise faster than agricultural commodity prices, ethanol profits could

expand and production soar regardless of mandated levels. Finally, ethanol is the primary octane enhancer and fuel oxygenate, and there are few alternatives for U.S. oxygenate blends. Thus, it is markets, not mandates, that ultimately will determine the scale of ethanol production and its use of scarce corn.

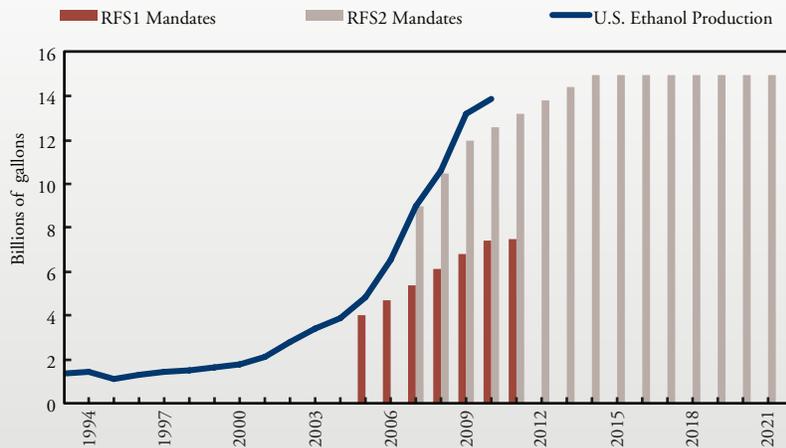
### ***The RFS Mandate***

Established in 2005, the RFS paved the way for the U.S. biofuel sector. The RFS specifies annual minimum levels of renewable fuel to be blended with gasoline for domestic consumption through 2022. The Environmental Protection Agency (EPA) administers the program and ensures compliance through a system of blending certificates called Renewable Identification Numbers (RINs). Although the RFS initially spurred ethanol production, output has exceeded the mandates in recent years, stirring debate about the significance of the mandates.

The RFS program has evolved over time. Under the Energy Policy Act of 2005, RFS1 mandated the blending of 7.5 billion gallons of ethanol by 2012. Two years later, the Energy Independence and Security Act modified the program. RFS2 required 9 billion gallons of renewable



## Chart 1 Annual U.S. Ethanol Production and RFS Mandates



Sources: Renewable Fuels Association and Environmental Protection Agency.

fuels in 2008, steadily ramping up each year to a peak of 15 billion gallons in 2015 (Chart 1).<sup>1</sup> Although there are other fuels that qualify as renewable, the vast majority is ethanol derived from corn starch.

The EPA enforces the RFS program through a system of certificates referred to as RINs. Any entity producing or importing gasoline in the United States is subject to the RFS mandates and must use RINs to comply. Every gallon of ethanol produced generates one RIN, which transfers along with the physical ethanol to the fuel blender. Once blended into transportation fuel, the RIN detaches from the gallon of

ethanol. At this point, the blender may use the RIN to comply with the current-year mandate or save it for future compliance. The structure of the RIN system allows up to 20 percent of one year's mandate to be satisfied with RINs carried over from the previous year, providing fuel blenders some flexibility in complying with the mandate.<sup>2</sup> For example, with a mandate of 13.8 billion gallons in 2013, 2.76 billion RINs can be carried over from 2012 and applied to the 2013 mandate.

The RFS program has greatly expanded the U.S. ethanol industry. After high crude oil prices and federal subsidies sparked U.S. ethanol production in the 1970s, ethanol was

primarily used as a fuel oxygenate throughout the 1980s and 1990s, gradually replacing Methyl Tertiary Butyl Ether (MTBE). Despite its recognized usefulness as an oxygenate, annual production grew by an average of only 14 percent from 1980 to 2005. Since the implementation of the RFS program, however, ethanol production has surged nearly 30 percent per year from 2005 to 2010 (Renewable Fuels Association, 2012).

The dramatic growth has pushed domestic ethanol production above the minimum volume requirements mandated by the RFS. In 2011, the RFS mandate required the blending of 12.6 billion gallons of ethanol with gasoline as transportation fuel. The industry exceeded the mandate by producing 13.9 billion gallons, exporting more than 1 billion gallons (Energy Information Administration, 2012). Although RFS mandates are thought to be driving ethanol demand, they have been largely irrelevant since 2010.

### *Ethanol Blend Wall*

In contrast to minimum ethanol blending mandates under the RFS program, domestic gasoline consumption restricts U.S. ethanol use. Currently, U.S. ethanol can contribute approximately 10 percent of a gallon of gasoline, which creates a blend wall based on total U.S. gasoline

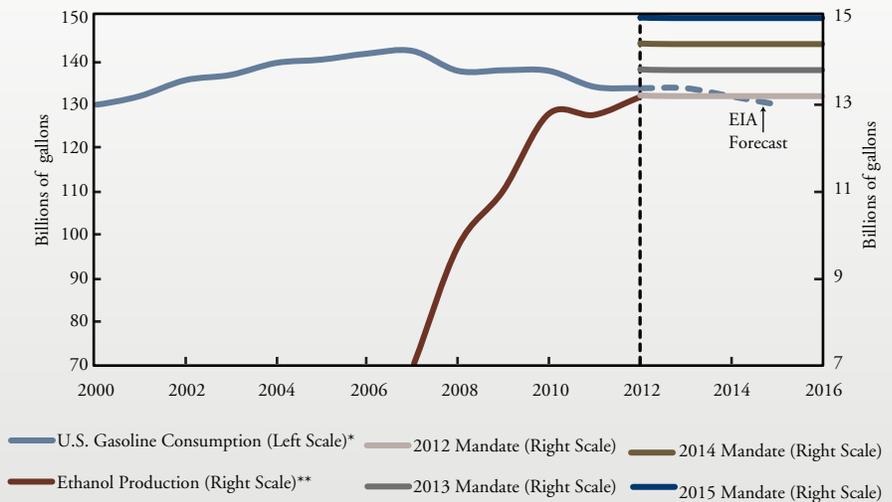


consumption. Historically, this blend wall has been above the mandate, allowing the industry to satisfy rising mandates by increasing production. Under current policy, however, the ethanol industry may face the challenge to satisfy future mandates as they rise above the blend wall.

U.S. motor gasoline consumption determines the ethanol blend wall. The most common renewable transportation fuel used to satisfy the RFS mandate is E-10 fuel, a mixture of 10 percent ethanol and 90 percent gasoline. Although the EPA has approved E-15 for use in vehicles 2001 or newer, large-scale commercialization has not yet developed due to costly infrastructure changes required to allow dispensing of an additional blend at fueling stations. Moreover, consumers and auto manufacturers are wary of the potential consequences of E-15 use on vehicle performance and durability. The use of E-85 in flex-fuel vehicles has also stagnated. Thus, the blend wall is essentially 10 percent of U.S. gasoline consumption (Chart 2).

Due to the recession and improved fuel efficiency trimming U.S. gasoline consumption, the blend wall is approaching more quickly than anticipated. In 2007, when gasoline consumption was at its peak, the Energy Information Administration (EIA) forecasted U.S. gasoline consumption to reach 150 billion gallons by 2015 (Energy

## Chart 2 U.S. Gasoline Consumption and RFS Ethanol Mandates



\* When read from the right axis, this number represents the 10% ethanol blend wall.

\*\* Ethanol production is net of trade

Source: Energy Information Administration (The EIA Short-term Energy Outlook, September 2012, is used for the projection to 2013. The EIA Annual Energy Outlook, June 2012, is used for the projection to 2015).

Information Administration, 2007). The 15 billion gallon ethanol mandate for 2015 would have equaled the projected 10 percent blend wall. Since then, U.S. residents are driving fewer miles with more fuel-efficient vehicles.<sup>3</sup> In 2012, EIA projected U.S. gasoline consumption to reach approximately 130 billion gallons by 2015, which would cut the blend wall to 13 billion gallons, 2 billion gallons below the mandate (Chart 2) (Energy Information Administration, 2012).

If the blend wall falls below the mandate, fuel blenders could still satisfy the mandate by using stored

RINs.<sup>4</sup> For example, the blend wall is expected to be approximately 13.2 billion gallons in 2014, but the mandate is set at 14.4 billion gallons. The gap, 1.2 billion gallons, could be filled using RINs stored from 2013. This could encourage ethanol production and consumption in 2013 above the mandate for that year in order to generate the RINs needed for 2014. In addition, the mandate for 2015 is projected to be 1.9 billion gallons above the blend wall. These gaps could persist until U.S. gasoline consumption rebounds, creating an incentive to



generate RINs now and store them for future compliance.

The exact quantity of RINs accumulated from previous years is not certain. Consequently, the exact number of RINs needed for compliance through additional ethanol production is uncertain. Researchers have estimated, however, that there are potentially 2.6 billion RINs (equivalent to 2.6 billion gallons of ethanol) outstanding (Paulson & Meyer, 2012). Since RINs are used for compliance, their price has been nearly zero in recent years as ethanol production has been above the mandate (Chart 3).

In recent months, RIN prices have risen, signaling that the ethanol industry might need to build inventories. As corn prices spiked this summer, RIN prices also surged as ethanol producers cut production, drew down existing ethanol stocks and used RINs for RFS compliance (Chart 3). In the future, RIN prices could climb if the mandate rises above the blend wall and stored RINs are needed to fulfill RFS mandates. RIN prices could also jump if corn prices rise further or if crude oil prices fall significantly and slash ethanol profits. In this scenario, ethanol producers could choose to cut ethanol production and rely on stored RINs to fulfill RFS mandates. A run-up in RIN prices would indicate strong demand for

**Chart 3**  
**Ethanol RIN Prices and Corn Prices**



*Note: The gap in successive RIN year prices is due to the storage provision of the RFS which implies that current year RINs are always valued at least as high as previous year RINs.*  
*Source: Oil Price Information Service and Commodity Research Bureau.*

RINs, strengthening the incentive for more ethanol and RIN production.

A temporary two-year waiver of the RFS mandate would drive current-year RIN prices to zero. The EPA denied recent calls to waive the 2013 mandate, but in general, a waiver might ensure ethanol is produced only up to the blend wall. However, expectations of a future mandate above the ethanol blend wall could limit the effects of a temporary waiver on production in the second year because RINs generated that year may be used the following year to fill a potential gap.

**Market Incentives**

Although the RFS has been an important component in building out the ethanol industry, ethanol production is becoming increasingly market driven. Numerous studies have attempted to determine the effect of an RFS waiver on ethanol production, concluding that markets, not mandates, will largely determine future production levels (Babcock, 2012; Tyner, Ackerman, Ackerman, Taheripour and Hurt, 2012; Irwin and Good, 2012; Thompson, Whistance, Westhoff and Binfield, 2012). Depending on profitability, ethanol production



may even rise above the mandates.

Crude oil and corn are the fundamental determinants of ethanol profitability, which drives ethanol production. Corn is the dominant input to ethanol production, accounting for approximately 90 percent of variable costs at an average Midwest ethanol plant (Hofstrand, 2012). Likewise, the price of crude oil is the key factor driving wholesale gasoline prices.

Over the past few years, fluctuations in corn and crude oil prices have shaped the corn-to-crude oil price ratio, a relative measure of ethanol profitability. The corn-to-crude oil price ratio measures the prices at which fuel blenders are indifferent to using ethanol and gasoline on a volumetric basis in consumer fuel (Chart 4).<sup>5</sup> A one standard deviation band surrounding the ratio, which allows for historical fluctuations in corn and crude oil prices, serves as a proxy for stable ethanol profits that support steady ethanol production.

As the corn-to-crude-oil price ratio moves to the edges of the band, significant shifts in ethanol profits can induce changes in ethanol production. For example, during 2005 and 2006, crude-oil prices rose faster than corn prices, the corn-to-crude-oil price ratio fell, ethanol profits soared and ethanol production expanded. In contrast, during 2008 and 2009, the corn-to-

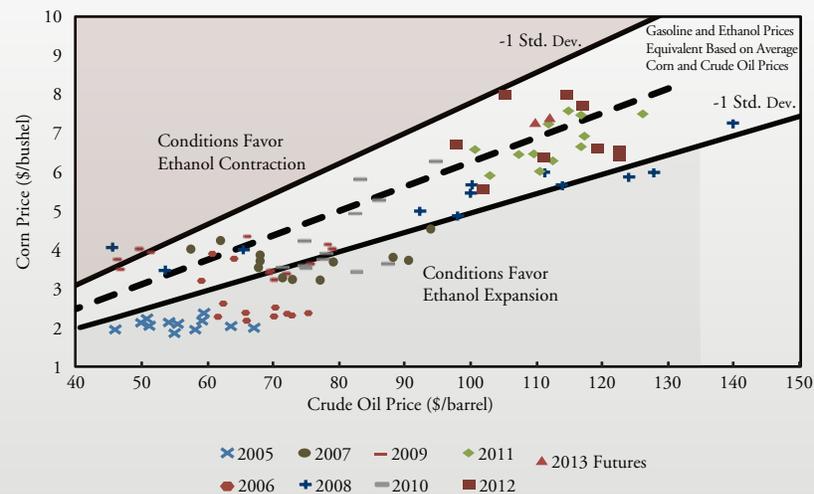
crude oil price ratio rose when crude oil prices plummeted nearly \$100 per barrel. Ethanol profits plummeted to the point that some plants filed for bankruptcy. Similar circumstances arose in July 2012 when corn prices spiked as a result of intense nationwide drought. The ratio of corn-to-crude-oil prices rose, ethanol profits deteriorated, and production declined.

Current commodity prices suggest that economic conditions may favor continued ethanol production. Futures prices for 2013 contracts of crude oil and corn (March and July) lie within the band surrounding the crude-oil-to-corn price ratio, suggesting that conditions favor relatively steady production. With Brent crude oil currently about \$115 per barrel, it would take a corn price

of approximately \$8.90 per bushel, likely with some persistence, to activate substantial contraction in the ethanol industry.

In addition to the use of ethanol as a transportation fuel, its use as an octane enhancer and fuel oxygenate could keep ethanol plants operating. As an octane enhancer, ethanol allows refineries to produce higher octane blends more economically by blending lower octane gasoline with high octane ethanol. As a fuel oxygenate, ethanol also reduces carbon monoxide emissions. Historically, MTBE, an additive derived from fossil fuels, was the primary oxygenate used to reduce carbon monoxide emissions. However, allegations of groundwater contamination and increased ethanol

### Chart 4 Implications of Corn and Crude Oil Price Ratios on Ethanol Production



Source: Based on author's calculations using data obtained from barchart.com.



availability have drastically reduced its use. Researchers estimate that refineries use about 5 billion gallons of ethanol as a fuel oxygenate annually (Irwin and Good, 2012). Oil refineries' nearly universal use of ethanol as an octane enhancer and fuel oxygenate is likely to support ethanol production, despite some uncertainty surrounding refineries' flexibility to transition to an alternative setup.

### **Conclusion**

The 2012 drought has led to a grain shortage and elevated U.S. crop

prices. Record-high corn prices have already led to softer export, feed and ethanol demand for corn. Further rationing of a severely short crop will most likely be necessary, especially if weather disruptions hinder crop production over the next year.

The ethanol industry, however, appears to be unlikely to curtail its corn use much further. In fact, ethanol production has steadied since its summer slowdown. During the slowdown, RIN prices began ticking up. Over time, rising RIN prices could signal the ethanol industry to raise production, since RINs can be

used to satisfy future mandates.

Although mandates were key in supporting biofuel expansion several years ago, the ethanol industry is increasingly market driven. Accordingly, market-based incentives emerging from crude oil and corn markets will stake the path forward. High crude oil prices relative to corn prices and the use of ethanol as an octane-enhancing fuel oxygenate should drive ethanol production going forward. The RFS mandates, or a temporary EPA waiver, may not be as important to ethanol production in the future.

### **ENDNOTES**

<sup>1</sup>RFS will refer to the current program as implemented under the Energy Independence and Security Act, RFS 2.

<sup>2</sup>Up to 20 percent of the current year's mandate may also be met by borrowing RINs from the next year. However, this seems to be an unlikely scenario in the foreseeable future. RINs can also be traded with other entities registered with the EPA.

<sup>3</sup>According to the U.S. Department of Transportation Federal Highway Administration, the number of miles driven in the United States have fallen 0.5 percent per year <http://www.fhwa.dot.gov/resources/pubstats/>.

According to Research and Innovative Technology Administration Bureau of Transportation Statistics, the fuel efficiency of passenger car vehicles has improved more rapidly, increasing 2.4 percent per year over the past five years, [http://www.bts.gov/publications/national\\_transportation\\_statistics/html/table\\_04\\_23.html](http://www.bts.gov/publications/national_transportation_statistics/html/table_04_23.html).

<sup>4</sup>Because of the structure of the RFS program, advanced or cellulosic biofuels could also be used to fill part of the mandate. Large scale production of these biofuels has its own difficulties, though, which are not addressed in this article.

<sup>5</sup>Nearby futures prices for Brent Crude Oil, RBOB Gasoline, Corn, and Ethanol from 2007–2012, obtained from [barchart.com](http://barchart.com), are used to construct Chart 4.



## REFERENCES

- Babcock, B. 2012. Updated Assessment of the Drought's Impacts on Crop Prices and Biofuel Production. Center for Agricultural and Rural Development, Iowa State University. CARD Policy Brief 12-PB 8. August 2012.
- Energy Information Administration. 2012. Retrieved October 12, 2012, from <http://www.eia.gov/tools/faqs/faq.cfm?id=90&t=4>.
- Energy Information Administration. 2007. Annual Energy Outlook 2007 with Projections to 2030. *DOE/EIA-0383(2007)*. February 2007.
- Energy Information Administration. (2012). Annual Energy Outlook 2012 with Projections to 2035. *DOE/EIA-0383(2012)*. June 2012.
- Hofstrand, D. 2012. Ag Decision Maker D1-10 Ethanol Profitability. Iowa State University.
- Irwin, S. and Good, D. 2012. Ethanol-Does the RFS Matter. *farmdocdaily*, August 2, 2012.
- Paulson, N. and Meyer, S. 2012. An Update on RIN Stocks and Implications for Meeting the RFS2 Mandates with Corn Ethanol. *farmdocdaily*, August 1, 2012.
- Renewable Fuels Association. 2012. Retrieved October 12, 2012, from <http://www.ethanolrfa.org/pages/statistics#A>.
- Thompson, W., Whistance, W., Westhoff, P., and Binfield, J. 2012. Renewable Fuel Standard Waiver Options during the Drought of 2012. Food and Agricultural Policy Research Institute (FAPRI), University of Missouri. October 2012.
- Tyner, W., Ackerman, J., Ackerman, L., Taheripour, F., and Hurt, C. 2012. Potential Impacts of a Partial Waiver of the Ethanol Blending Rules. Farm Foundation and Purdue University. August 2012.

View and subscribe to the *Main Street Economist* online at <http://mainstreet.kcfed.org>

For more regional economic insights, visit [www.KansasCityFed.org](http://www.KansasCityFed.org).



Connect with the  
KANSAS CITY FED:

