farmdoc DAILY

Department of Agricultural and Consumer Economics, University of Illinois Urbana-Champaign

# Fixing the RFS is Getting Easier and Easier

**Scott Irwin**

**Department of Agricultural and Consumer Economics**
**University of Illinois**

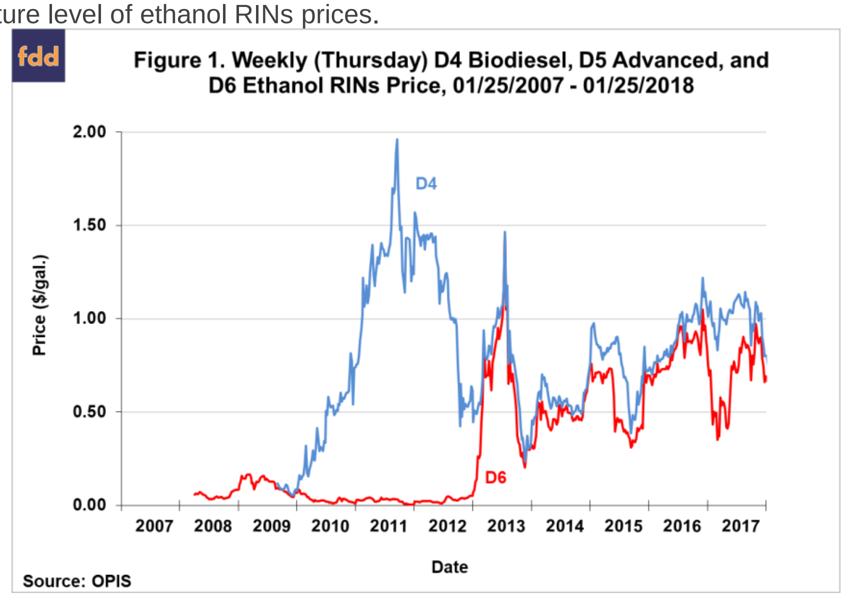
**February 15, 2018**

***farmdoc daily* (8):26**

Recommended citation format: Irwin, S. "Fixing the RFS is Getting Easier and Easier." *farmdoc daily* (8):26, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, February 15, 2018.

Permalink: http://farmdocdaily.illinois.edu/2018/02/fixing-the-rfs-is-getting-easier-and-easier.html

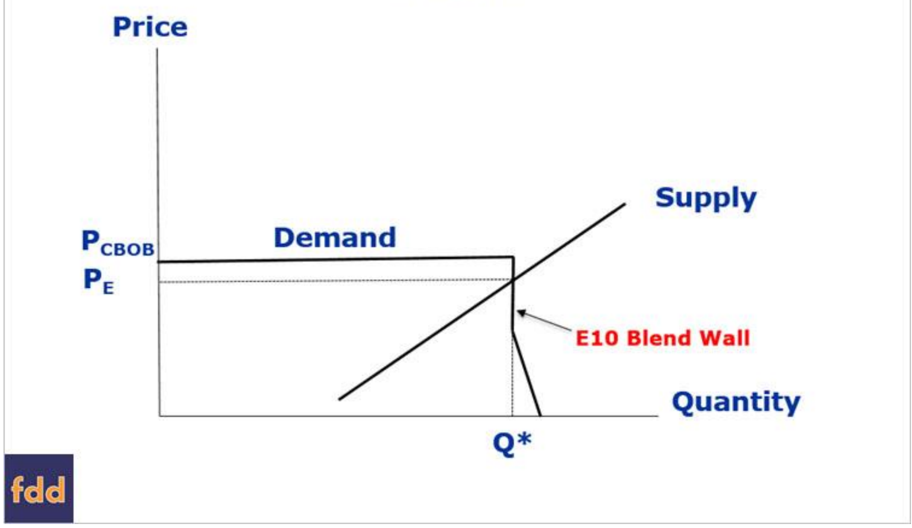
There has been no shortage of ideas in recent months about how to "fix" the Renewable Fuel Standard (RFS). These include application of the various waiver authorities under the RFS, expanding the number of small refinery exemptions, and a $0.10 per gallon cap on the price of the RIN credits used to comply with the RFS (*farmdoc daily*, August 9, 2017; August 18, 2017; October 5, 2017; October 12, 2017; October 19, 2017; December 6, 2017; December 21, 2017). The reason cited over and over for the need to fix the RFS is the high cost of ethanol RINs borne by independent "merchant" refiners. In late January, Philadelphia Refining Solutions declared bankruptcy, citing high RIN costs as a major contributing factor. There is no argument that the cost of D6 ethanol RINs has indeed skyrocketed since 2012 (Figure 1). The disagreement is whether refiners have to absorb most of the RINs costs or are able to pass them on to fuel blenders in the form of higher gasoline and diesel blendstock prices. What seems to have gotten lost in all the noise surrounding the political war over the RFS is how rapidly the conditions are changing that created the high ethanol RINs prices in the first place. The key is the "gap" between the ethanol blend wall and the conventional ethanol mandate. In this article, we analyze why this gap is so important to understanding the movement of ethanol RINs prices, how the gap is rapidly shrinking, and what this means for the future level of ethanol RINs prices.



**Looking Back**

In order to understand the history of ethanol RINs prices we use a basic model of the ethanol market. Earlier versions of the model were used in several previous articles that analyze RINs pricing (e.g., *farmdoc daily*, July 19, 2013; September 23, 2015). The model of the ethanol market without an RFS volumetric mandate is presented in Figure 2. It represents the supply of ethanol producers and demand from gasoline blenders at the wholesale level on an annual basis. Retail demand at the consumer level is implicitly represented by a simple percentage markup of the wholesale demand shown in Figure 2. The first segment of the demand curve is assumed to be flat (perfectly elastic) up to the blend wall for ethanol prices equal to CBOB gasoline prices. We had previously assumed the breakeven ethanol price was 110 percent of the CBOB price based on Department of Energy research about the value of ethanol as an octane enhancer in gasoline blends. Our own research (*farmdoc daily*, March 15, 2017) shows that the octane benefit of ethanol in gasoline blends approximately offsets the energy penalty for ethanol, and hence, the new assumption of a breakeven price equal to the CBOB price. The second segment of the demand curve is vertical, reflecting the E10 "blend wall," which is the physical limit of 10 percent ethanol blends in the gasoline supply. The third segment has a small amount of price sensitivity to reflect the demand for the higher ethanol blends, namely E15 and E85. This segment adds at most a few hundred million gallons to ethanol consumption because infrastructure constraints are assumed to restrict the ability to expand consumption of these higher ethanol blends. Note also that imports and exports of ethanol are ignored in the model for simplicity. This does not affect the main conclusions drawn from the model.

**Figure 2. The Ethanol Market without a Conventional Ethanol Mandate**




The ethanol market equilibrium shown in Figure 2 has two key features. First, the position of the supply curve results in ethanol consumption at the E10 blend wall but no consumption of higher ethanol blends. This resembles market reality in recent years. Second, the equilibrium ethanol price is below the price of CBOB gasoline, which means that adding ethanol up to 10 percent in gasoline blends ultimately lowers the cost of gasoline at the pump to consumers (assuming the lower cost of ethanol is fully passed on to consumers). Again, this appears to mirror market reality in recent years.

Figure 3 now adds to the model a non-binding conventional ethanol mandate. The mandate is "non-binding" because the mandated quantity, $Q_{CL}$, is lower than the market equilibrium quantity, Q*. The only change to the model is the creation of another perfectly inelastic (vertical) segment of the demand curve above the price of CBOB at the mandated quantity. Since the mandate is non-binding and does not affect the market price or quantity of ethanol, the price of D6 ethanol RINs credits for compliance with the RFS mandate is zero. The reason is that blenders are assumed to make a normal economic profit blending Q* gallons of ethanol and this more than meets the mandate quantity of ethanol under the RFS. Hence, D6 RIN credits have no economic value. This is essentially the market situation that existed before 2013. As shown in Figure 1, D6 RINs generally traded for only a few cents prior to 2013.

**Figure 3. The Ethanol Market with a Non-Binding Conventional Ethanol Mandate**

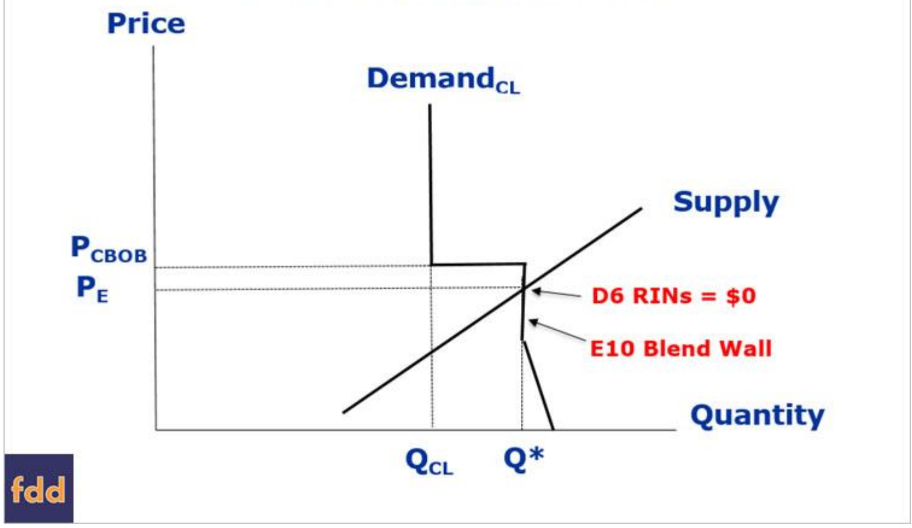
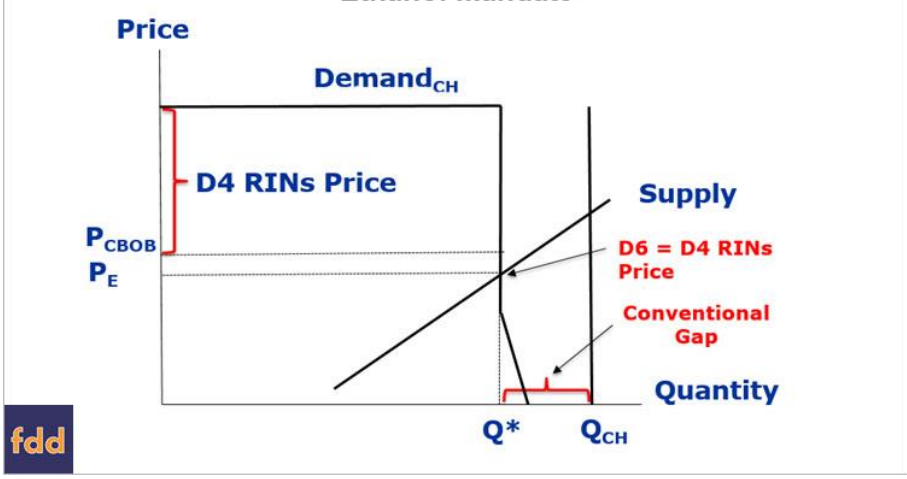



Figure 4 illustrates what happens when the conventional ethanol mandate $Q_{CH}$, is set higher than the market equilibrium quantity, Q*, and becomes binding. Intriguingly, the equilibrium price and quantity of ethanol are unchanged because ethanol consumption is stuck at the E10 blend wall given the assumed position of the ethanol supply curve. The conventional ethanol mandate must still be met even though it is physically impossible to do so with E10 consumption. This creates the “conventional gap” in Figure 4, which equals $Q_{CH}$ - Q*. Something has to fill the conventional gap or obligated parties under the RFS would be out of compliance. The rules of the RFS anticipate this sort of situation and allow higher ranked RINs to be used to meet lower ordered mandates if necessary. As shown in Figure 4, the RINs required to fill the conventional gap would need to be non-ethanol and higher ranked. This perfectly describes D4 biomass-based diesel RINs (biodiesel RINs for short).

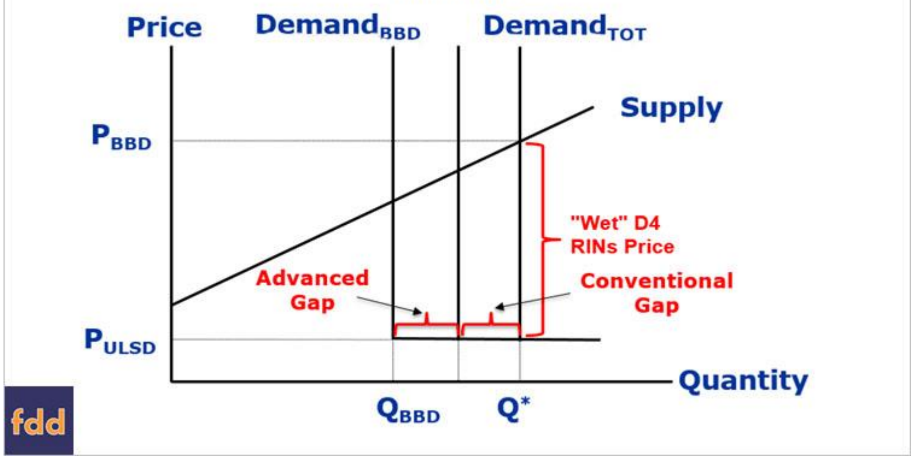
**Figure 4. The Ethanol Market with a Binding Conventional Ethanol Mandate**




The use of D4 biodiesel RINs to fill the conventional gap means that the “marginal gallon” for filling the conventional ethanol mandate is biodiesel not ethanol and this has two important implications for ethanol market dynamics. First, when biodiesel is the marginal gallon for filling the ethanol mandate the price of a D6 ethanol RINs equals the price of a D4 biodiesel RINs. This makes sense because biodiesel is the cheapest alternative for meeting the ethanol mandate at the margin (last gallon in). Second, the breakeven price for ethanol increases by an amount equal to the price of a D4 biodiesel RINs. With a binding conventional ethanol mandate, blenders demand ethanol at the level of the E10 blend wall until the point where the price of ethanol equals the CBOB price plus the D4 price. The result is that the perfectly inelastic segment of the ethanol demand curve becomes much larger, and in situations where the supply curve shifts substantially upward (say, due to a drought) the price of ethanol has to be driven much higher before ethanol consumption is reduced.

The implications of a binding conventional ethanol mandate for pricing ethanol RINs would not be so profound if the market economics of biodiesel mirrored that of ethanol shown in Figure 2. The very different economics of biodiesel is represented in Figure 5. This model has been used in numerous other articles on the biodiesel market, the RFS, and RINs pricing (e.g., *farmdoc daily*, August 23, 2017). In this case, the breakeven price of biodiesel is the price of ultra low sulpher diesel after adjusting for the lower energy content of biodiesel. As shown in Figure 5, the diesel price is lower than the *y*-intercept of the supply curve for biodiesel, which means that the market solution is to produce zero gallons of biodiesel in the U.S. Three different L-shaped demand curves for biodiesel are shown in Figure 5. The one furthest to the left represents demand via the RFS biodiesel mandate itself. The middle one adds to the biodiesel mandate the gap between the total advanced mandate and the biodiesel mandate, which has largely been filled by biodiesel in recent years. The one furthest to the right simply sums the conventional gap from Figure 4, the biodiesel mandate, and the advanced gap. The price of a “wet” D4 RINs is then the difference between the biodiesel price necessary to incentivize the total RFS mandate requirement for biodiesel and the price of diesel. Conversion from the “wet” D4 RINs price to an ethanol-equivalent price requires dividing by 1.5. For simplicity, the impact of the biodiesel tax credit is ignored.

**Figure 5. The Biomass-Based Diesel Market with Binding Conventional Ethanol, Biomass-Based Diesel, and Advanced Mandates**




Returning to Figure 1, the full story of D6 ethanol prices to date can now be told. Previous to 2013, the conventional ethanol mandate was non-binding and D6 RINs traded for a few cents while the binding RFS total requirement for biodiesel incentivized high biodiesel prices relative to diesel prices, and consequently, high D4 RINs prices. At the peak in 2011, biodiesel prices reached almost $6 per gallon while diesel prices were only around $3 per gallon. The result was D4 prices (in ethanol equivalents) almost reaching $2 per gallon. Once the conventional ethanol mandate began to exceed the E10 blend wall in 2013 the price of D6 RINs quickly shot up to the much higher level of D4 RINs, reflecting the changed reality of a positive conventional ethanol gap and biodiesel becoming the marginal gallon for meeting the ethanol mandate. D6 RINs prices have closely tracked D4 RINs prices for the last five years, with the exception of a few brief interludes when it appeared that cuts to the conventional ethanol mandate might substantially reduce or eliminate the conventional gap. The behavior of both D4 biodiesel and D6 ethanol RINs prices for the last decade is fully consistent with the predictions of the model presented in this section. In that sense, the RINs market appears to be quite rational.

**Looking Ahead**

Before looking ahead, it is helpful to summarize the results in the previous section: (1) if the RFS conventional ethanol mandate is less than or equal to the E10 blend wall, the D6 ethanol RINs price is zero, and (2) if the RFS conventional ethanol mandate exceeds the E10 blend wall, the D6 ethanol RINs price equals the D4 biodiesel RINs price because biodiesel is the marginal fuel for complying with the conventional ethanol mandate; or, equivalently: (1) if the conventional gap is 0 or negative, the ratio between D6 and D4 RINs prices is 0, and (2) if the conventional gap is positive, the ratio between D6 and D4 RINs prices is 1. This highlights the critical role that the conventional gap plays in D6 ethanol RINs pricing, which has been at the center of the most heated political controversies swirling around the RFS.

With that background, we can examine where the conventional ethanol gap has been and where it might be headed in the future. Table 1 presents estimates of the conventional ethanol gap for 2013-2019. Line (1) shows the statutory level of the (implied) conventional ethanol mandate. Note that the level of the conventional mandate actually implemented by the EPA in 2014-2016 was less than the statutory level by a total of 2.24 billion gallons. We use the statutory levels here to emphasize the trend in the conventional gap based on what is specified in the RFS statute rather than what was ultimately implemented (of course, there is still some uncertainty over the final conventional mandate for 2016 since a federal appeals court vacated and remanded the first rulemaking). Line (2) shows actual total domestic ethanol use in the U.S. for 2013-2017 and projected use for 2018-2019. Total use is the sum of E10, E15, and E85. The original data are drawn from the February 2018 EIA STEO and reduced slightly to reflect Alaska's opting out of the RFS. Lines (3) and (4) present advanced ethanol consumption that is not used for compliance with the conventional ethanol mandate. The estimates for 2013-2017 are from the EPA's EMTS database, while 2018-2019 are projected. Line (5) reports conventional ethanol use and it is computed as the difference between total ethanol use and advanced uses. Line (6) is the estimated conventional ethanol gap and it is simply the difference between the statutory mandate in line (1) and conventional ethanol use in line (5).

**Table 1. Conventional Ethanol Mandate Gap under Statutory Mandates for 2013-2019**

| Item | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|
| (1) Statutory Conventional Ethanol Mandate | 13.800 | 14.400 | 15.000 | 15.000 | 15.000 | 15.000 | 15.000 |
| (2) Total Ethanol Use [(3)+(4)+(5)] | 13.193 | 13.431 | 13.928 | 14.323 | 14.513 | 14.709 | 14.833 |
| (3) Cellulosic Ethanol Use | 0.000 | 0.001 | 0.002 | 0.004 | 0.010 | 0.012 | 0.015 |
| (4) Other Advanced Ethanol Use | 0.458 | 0.090 | 0.114 | 0.061 | 0.099 | 0.100 | 0.100 |
| (5) Conventional Ethanol Use | 12.735 | 13.340 | 13.812 | 14.258 | 14.404 | 14.597 | 14.718 |
| (6) Conventional Ethanol Gap [(1)-(5) if >0] | 1.065 | 1.060 | 1.188 | 0.742 | 0.596 | 0.403 | 0.282 |

Notes: All values stated in terms of billion gallons. Statutory conventional ethanol mandates for 2014-2016 as first implemented by the EPA were reduced a total of 2.24 billion gallons. The 2016 mandate rulemaking was vacated and has to re-proposed.

The conventional ethanol gap estimates in Table 1 started out at just over 1 billion gallons in 2013, rose to almost 1.2 billion gallons in 2015, and declined steadily thereafter. It is easy to overlook just how big the conventional gap could have become if crude oil prices had not crashed in the second half of 2014 and the rate of economic growth had not picked up, both of which stimulated gasoline usage. With conventional ethanol consumption seemingly stuck around 13.3 billion gallons in 2014, it was not unreasonable to project that the conventional gap would exceed 1.5 billion gallons per year well into the future. But, crude oil prices did crash and the U.S. economic growth rate also picked up; a combination that stimulated total and conventional ethanol use substantially. For example, the EIA currently projects that total ethanol use in 2018 will exceed use in 2014 by 1.3 billion gallons, or 9.5 percent. With the statutory conventional ethanol mandate fixed at 15 billion gallons, the growth in ethanol use has led to a sharp decline in the magnitude of the conventional gap. In particular, the latest ethanol use estimate from the EIA for 2019 implies a conventional gap of a little less than 300 million gallons. This gap is so small that an increase in projected ethanol use for 2019 of just two percent would erase the gap completely.

The bottom-line from this analysis is that the conventional ethanol gap is well on its way to being eliminated in the next few years, even without a large expansion in the use of higher ethanol blends such as E15 and E85. If this does occur, the impact on D6 ethanol RINs prices could be almost as profound as what we witnessed in 2013, but in exactly the opposite direction. It is not out of the realm of possibility for the price of D6 RINs to go back to their pre-2013 level of just a few cents. Of course, this assumes that the conditions that have been driving ethanol consumption upward do not change. Even if conditions do change, the size of the conventional gap is much more manageable than just a few years ago and opens the door for very modest increases in E15 and/or E85 to close the conventional gap. For example, a 300 million gallon conventional gap could be eliminated with an increase in E15 consumption of just 2 billion gallons, or about 1.3 percent of total gasoline consumption. Finally, gaps of this magnitude could also largely be met through 2022, when the RFS volumes reset, from the existing stock of RINs (*farmdoc daily*, February 8, 2018).

### Implications

The political battle over the RFS has centered on the high price of ethanol RIN credits that are used to comply with the RFS conventional ethanol mandate. Independent "merchant" refiners claim that large RINs costs have materially harmed their profitability. We show in this article that high D6 RINs prices can be directly traced to conventional ethanol mandates that exceed the E10 blend wall, creating a gap that has to be filled by biodiesel. When biodiesel takes on the role of the "marginal gallon" for filling the conventional ethanol mandate, this forces the price of a D6 ethanol RINs to equal the much higher price of a D4 biodiesel RINs. This is essentially the story of the RFS and the resulting political battles since 2012. What has received little notice is how rapidly the conventional ethanol gap has shrunk since 2014 due to the combination of: (1) the crash in crude oil prices stimulating gasoline consumption, and (2) an improving economy. For example, the latest ethanol use estimate from the EIA for 2019 implies a conventional ethanol gap of a little less than 300 million gallons. This gap is so small that an increase in projected ethanol use for 2019 of just two percent would erase the gap completely. This means it is not out of the realm of possibility for D6 RINs prices to fall back their pre-2013 level of just a few cents without making any changes to the RFS. In this sense, "fixing" the RFS is getting easier and easier.

### References


Coppess, J. "Three Little Words All Over Again: EPA Revisits Inadequate Domestic Supply." *farmdoc daily* (7):182, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, October 5, 2017.

Coppess, J. "Upon Further Review: the Decision on EPA's RFS Waiver Authority." *farmdoc daily* (7):151, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, August 18, 2017.

Coppess, J., and S. Irwin. "Another Wrinkle in the RFS: The Small Refinery Exemption." *farmdoc daily* (7):224, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, December 6, 2017.

Coppess, J., and S. Irwin. "The Biodiesel Waiver Provision in the RFS." *farmdoc daily* (7):192, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, October 19, 2017.

Coppess, J., and S. Irwin. "The Other General Waiver: RFS and Severe Economic Harm." *farmdoc daily* (7):187, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, October 12, 2017.

Department of Energy. "Department of Energy Analyses in Support of the EPA Evaluation of Waivers of the Renewable Fuel Standard." November 2012.http://ethanolrfa.3cdn.net/1c8f40b533c12645b1_ubm6i6l9b.pdf

Irwin, S. and D. Good. "How to Think About Biodiesel RINs Prices under Different Policies." *farmdoc daily* (7):154, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, August 23, 2017.

Irwin, S. and D. Good. "EPA Interpretation of the "Inadequate Domestic Supply" Waiver for Renewable Fuels Ruled Invalid: Where to from Here?" *farmdoc daily* (7):144, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, August 9, 2017.

Irwin, S., and D. Good. "On the Value of Ethanol in the Gasoline Blend." *farmdoc daily* (7):48, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, March 15, 2017.

Irwin, S., and D. Good. "Why Isn't the Price of Ethanol RINs Plummeting?" *farmdoc daily* (5):175, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, September 23, 2015.

Irwin, S. and D. Good. "RINs Gone Wild?" *farmdoc daily* (3):138, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, July 19, 2013.

Irwin, S., and J. Coppess. "Still Another Wrinkle in the RFS: A RINs Price Cap." *farmdoc daily* (7):233, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, December 21, 2017.

Paulson, N. "2017 Year End RIN Update." *farmdoc daily* (8):21, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, February 8, 2018.

Renshaw, Jarret. "U.S. refiner PES pins bankruptcy plan hopes on biofuel costs." *Reuters*, January 22, 2018. https://www.reuters.com/article/us-philadelphia-energy-solutions-bankrup/u-s-refiner-pes-pins-bankruptcy-plan-hopes-on-biofuel-costs-idUSKBN1FB26M

"Department of Energy Analyses in Support of the EPA Evaluation of Waivers of the Renewable Fuel Standard." Renewable Fuels Association. http://ethanolrfa.3cdn.net/1c8f40b533c12645b1_ubm6i6l9b.pdf

U.S. Energy Information Administration. "Short -Term Energy Outlook (STEO)." February 2018. https://www.eia.gov/outlooks/steo/pdf/steo_full.pdf