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What if the EPA Implements RFS Mandates for Renewable Fuels at Statutory Levels?

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No shortage of ink has been spilled discussing the potential problems in implementing the Renewable Fuels Standards (RFS) due to the gap between the implied mandate for renewable biofuels (ethanol) and the E10 blend wall. The EPA announced preliminary rule making for 2014 on November 15, 2013, and the proposal signaled a significant shift in EPA policy. The most controversial aspect of the proposal was the write down of the renewable mandate for 2014 from 14.4 to 13 billion gallons. The substantial "roll back" from the statutory mandates resulted in the EPA receiving over 15,000 comments and was met with the threat of legal challenges. A final rule making for 2014 had been expected shortly after the 2014 U.S. elections, but the EPA surprised virtually everyone by announcing on November 21, 2014 that the final 2014 rules would be delayed until sometime in 2015 and the 2015 and 2016 rules would likely be released at the same time.

There continues to be much speculation about the likely timing and content of the long-delayed final EPA rule making for the 2014, 2015, and 2016 RFS. While the outcome of the rule making is uncertain, there has been a general consensus for some time that the final rule making will likely include larger mandates for the renewable fuels category (*farmdoc daily*, February 19, 2014; March 5, 2014; August 8, 2014). The expectation of a larger mandate mainly reflects higher estimates of the E10 blend wall because gasoline consumption has increased since the preliminary rule making. We argued in late 2014 (*farmdoc daily,* December 4, 2014) that the final rulemaking may actually be near if not at the statutory levels. Indicators of movement in this direction included: i) public comments from ethanol and petroleum industry participants, ii) significant questions about the legality of the "inadequate domestic supply" argument used to justify the preliminary roll back decision, and iii) an uptick in RINs prices. The recent EPA approval of additional Argentine biodiesel imports to qualify under the RFS may be another indicator if imports are being eyed as a way to partially meet RFS mandates at statutory levels. Consequently, the purpose of today's article is to examine the implications of implementing the statutory requirements for the renewable biofuels category. This is an update of the analysis in a series of *farmdoc daily* articles we have written on scenarios for implementing the RFS in light of the challenges presented by the E10 blend wall (May 24, 2012; September 26, 2012; November 2, 2012; February 13, 2013; April 10, 2013; September 5, 2013; December 4, 2013).

Background

The RFS statutes required the EPA to establish biofuel volume requirements in four categories for each year from 2008 through 2022: cellulosic biofuel, biomass-based diesel, total advanced biofuel (which includes biomass-based diesel), and renewable fuel. The difference between the total advanced mandate and the total of the cellulosic and biodiesel mandate is referred to as the undifferentiated mandate and can be satisfied by a combination of qualified advanced biofuels. Renewable biofuels is generally assumed to be corn-based ethanol but this is actually not explicitly required by the RFS legislation. Instead, corn-based ethanol has been the cheapest alternative for this category that also meets the environmental requirements of the RFS. In addition, the renewable portion of the mandate can also be satisfied with discretionary blending of advanced biofuels, so we refer to the renewable mandate as an implied mandate. Cellulosic biofuels have been in very limited supply, so the EPA has written down the cellulosic mandate to near zero each year. The biodiesel mandate was established as a minimum of one billion gallons per year from 2012 through 2022, with larger amounts subject to EPA approval. That mandate has been set at 1.28 billion gallons beginning in 2013. The statutory requirements for each of the biofuels categories for each year from 2014 through 2022 are presented in Table 1.

EPA's 2014 preliminary rulemaking compared to the statutory requirements (in billions of gallons with volumes in ethanol equivalents, except biomass-based biodiesel which are in actual gallons) are as follows:

	2014 RFS	EPA preliminary
Cellulosic	1.75	0.017
Biomass-based dies	>1.00	1.28
Total advanced	3.75	2.21
Total Biofuels	18.15	15.21
Implied renewable	14.4	13

The implied mandate for renewable biofuels was "rolled back" for 2014 in recognition of the hurdles to blending quantities of renewable fuel in the domestic motor fuel supply beyond the E10 blend wall, variously forecast at 13 to 13.2 billion gallons for 2014. This was by far the most surprising and controversial aspect of the preliminary rulemaking.

Renewable Fuels Mandates at Statutory Levels

Here, we examine the implications of implementing the RFS for 2014 through 2022 under the assumptions that: (1) the implied renewable mandate is at the statutory level of 14.4 billion gallons in 2014 and 15 billion gallons in each subsequent year, (2) the cellulosic, and therefore the total advanced mandate, continue to be written down, and (3) the biomass-based diesel mandate remains at 1.28 billion gallons. The assumed mandates by category under these assumptions are summarized in Table 2.

For 2014, the total advanced mandate is assumed to be 2.21 billion gallons, which is equal to the mandate in the preliminary rule making. The cellulosic mandate is assumed to be .025 billion gallons, which equals estimated production in 2014. Since each gallon of biomass-based diesel receives 1.5 gallons of credit toward the RFS, 1.28 billion gallons satisfies 1.92 billion gallons of the total advanced mandate, requiring 0.265 billion gallons of undifferentiated advance biofuels. For years 2015 through 2022, it is assumed that the write down in the total advanced biofuels mandate is equivalent to the write down in the cellulosic mandate. The magnitude of the write down becomes quite large for the out years and is based on the expectation that the capacity to produce cellulosic biofuels will not expand beyond 0.08 billion gallons,

which is slightly more than the total nameplate capacity of the three commercial-scale cellulosic plants currently online or under construction. As a result, the difference between the statutory mandates (Table 1) for advanced and total biofuels and the assumed mandates for this analysis (Table 2) become quite large. The magnitude of those differences, or the assumed write downs, by category of fuel are summarized in Table 3.

Next, we consider how the advanced biofuels mandates might be satisfied in each year through 2022 (Table 4). A portion of the total advance mandate would be satisfied by the assumed level of cellulosic ethanol production and 1.28 billion gallons of biomass-based biodiesel (equivalent to 1.92 billion ethanol-equivalent gallons). Imported Brazilian ethanol that qualifies as advanced biofuel would also satisfy a portion of the undifferentiated advance mandate. Based on EPA reports of RINs generation, those imports totaled .0645 billion gallons in 2014. Imports are assumed at that level each year through 2022. Finally, part of the advanced mandate would be satisfied by domestic ethanol production from feed stocks such as sorghum that qualifies as advanced biofuels. Again based on RINs data, production in that category was at .079 billion gallons in 2014. We assume that increases to .100 billion gallons for 2015 and beyond, partly based on the assumption that sorghum based ethanol production will increase as sorghum exports moderate. The last column in Table 4, labeled "D4/D5 Advanced RINs Gap" reflects the difference between the total advanced biofuels mandate and the sum of the total supply of advanced ethanol and the minimum supply of biomass-based diesel (1.28 billion actual gallons or 1.92 billion gallons of ethanol equivalent). That gap, then, would have to be filled by a combination of blending of additional quantities of advanced biofuels and the retirement of some existing RINs stocks. Under the assumptions made here, that gap grows substantially over time, reaching 2.9 billion gallons in 2022.

Finally, we consider the magnitude of the likely gap in blending of renewable fuel (ethanol) in combination with the magnitude of the advanced gap. The size of the renewable blending gap is the difference between the magnitude of the implied renewable mandate and the capacity to blend renewable fuel in the domestic fuel supply, or the so called blend wall. The magnitude of the blend wall will be determined by the total domestic consumption of motor fuel and the rate of increase in consumption of motor fuels that are blended with more than 10 percent ethanol. We estimate the blend wall at 13.5 billion gallons for 2014 and at 13.75 billion gallons each year after that. For calculating the blend wall for renewable fuel, however, the size of the blend wall is effectively reduced by the minimum amount of advanced ethanol that is expected to be blended in the fuel supply. Those estimates come from Table 4 and total 0.168 billion gallons for 2014 and 0.245 billion gallons each year after that. The D6 renewable gap is calculated at 1.068 billion gallons in 2014 and 1.495 billion gallons each year after that. The magnitude of the expected D6 renewable gap, the expected D4/D5 advanced gap, and the total RFS gap are shown in Table 5. Under the assumptions made for this analysis, the total RFS gap is 1.19 billion gallons in 2014 and increases each year to 4.41 billion gallons in 2022.

Filling the Gaps at Statutory Mandate Levels

There are a number of ways that the calculated RFS gaps could be narrowed or filled. First, and most obviously, the gaps could be narrowed by retiring the existing stock of RINs that has been accumulated by previous discretionary blending. The most recent estimates by Nick Paulson (*farmdoc daily*, December 12, 2014) imply that about 1.3 billion gallons of RINs will remain after 2014 compliance at the statutory mandate levels in Table 2. However, as indicated in Table 5, the total RFS gap for 2015 is calculated at 1.91 billion gallons. Retiring all the RINs stocks, then, would not address the total RFS gaps much beyond mid-year in 2015.

Second, the D6 renewable gap could be narrowed or closed by expanding the domestic ethanol blend wall beyond that assumed here. The blend wall could be expanded by way of increased motor fuel consumption. We project a modest increase in the E10 blend wall due to increased gasoline consumption brought about by the drop in crude oil prices. This may be a conservative estimate of the consumption response but this could also be easily offset by increasing fuel efficiency of the car and truck fleet and changing driving habits. The blend wall may also be increased through consumption of higher ethanol blends, such as E15 and E85. The potential for expansion of higher blends has been much discussed here (e.g., *farmdoc daily*, June 19, 2013) and by other writers (e.g., Babcock and Pouliot, 2014). While there is

certainly room for debate about the longer-term potential, infrastructure, legal, and regulatory limitations make it highly unlikely that adoption of higher blends would be sufficient to substantially narrow the D6 renewable gap through at least 2016. Regardless of the way the blend wall could be expanded, domestic ethanol production capacity is thought to be near 15 billion gallons and a combination of domestic consumption of 14.275 billion gallons and net exports of fuel ethanol near the 2014 level of 0.725 billion gallons would exhaust this capacity without completely filling the D6 renewable gap. Assuming no expansion in ethanol production capacity, exports would have to fall precipitously or it would be difficult to produce sufficient domestic quantities of ethanol to completely fill the D6 gap using higher ethanol blends.

Third, the D4/D5 advanced gap and possibly the D6 renewable gap could be narrowed with large increases in production and blending of advanced ethanol. Increased blending of cellulosic ethanol will in all likelihood be constrained by the very small production capacity. Increased blending of advanced Brazilian and domestic advanced ethanol may also be constrained by production capacity both in Brazil and here in the U.S. Brazil has never exported more than about 1 billion gallons of ethanol to the U.S. in a single year and there are real questions about Brazil's capacity to ship the large volumes of ethanol implied by the D4/D5 advanced gap given their domestic incentives for ethanol consumption. Even if large enough quantities were available from Brazil there is the additional issue of the ethanol blend wall. Without a more rapid expansion of the blend wall here in the U.S., increased blending of advanced ethanol increases the D6 renewable gap. So, this pathway would require two fairly uncertain events to occur simultaneously—importation of historically unprecedented volumes of advanced ethanol from Brazil and large-scale expansion of higher ethanol blends here in the U.S.

Fourth, the D4/D5, D6, and total RFS blending gaps could be narrowed with increased production and blending of biomass-based diesel, which includes both conventional biodiesel and renewable diesel (*farmdoc daily*, December 13, 2014). Since each gallon of biodiesel generates 1.5 gallons of ethanol credit (1.6 or 1.7 in the case of renewable diesel), the total calculated RFS gap for 2014 of 1.19 billion gallons could be filled with 0.793 billion gallons of biodiesel. The entire 2015 gap could be filled with 1.273 billion gallons. The primary issue with biomass-based biodiesel, however, is domestic production capacity. This analysis assumes that 1.28 billion gallons of biodiesel is being produced each year to fill that specific mandate. To fill the total RFS gap, then, production would need to be 2.073 billion gallons in 2014, 2.553 billion gallons in 2015, and 4.22 billion gallons by 2022. Even if the entire RINs stock was depleted first, production would need to total 2.887 billion gallons by 2016 and 3.22 billion gallons by 2017. In its most recent Biodiesel Production Report, the EIA estimated domestic production capacity at 2.1 billion gallons. Some capacity is known to be idle or under-used so that effective capacity in even the short-term may exceed that estimate, but capacity is likely less than the calculated requirement to fill the total RFS gap.

Finally, the RFS gap could be narrowed by increased imports of qualifying biomass-based biodiesel. It is well documented that there is substantial excess production capacity in Europe and Argentina. The amount of biodiesel feedstock required to implement the RFS at statutory levels with increased biodiesel production, whether domestically produced or imported, would increase dramatically. Assuming 7.55 pounds of feedstock are required per gallon of biodiesel, feedstock requirements would increase from about 12.77 billion pounds in 2015 to 31.86 billion pounds in 2022.

Implications

If the RFS mandates are set at statutory levels, and that still remains a big if, two substantial "gaps" will be created. The first is the renewable gap, the result of renewable (ethanol) mandates being set above the E10 blend wall. The second is the advanced gap, which we define as the amount advanced mandates exceed a biodiesel mandate of 1.28 billion gallons and a small amount of other domestic and non-U.S. advanced ethanol. We estimate that the sum of these two gaps is slightly less than 2 billion gallons in 2015, grows to nearly 3 billion gallons by 2017, and then tops out at about 4.5 billion gallons in 2022. The gaps could be filled through the use of existing stocks of RINs credits, expansion of higher ethanol blends like E15 and E85, or increased biodiesel consumption. RINs stocks would likely be the first to be used, but we project that retiring all RINs would not fill the gaps much past mid-2015. Expansion of higher ethanol blends would certainly be incentivized to some degree by mandates at the statutory levels, but legal, regulatory, and infrastructure constraints would in all likelihood restrict this pathway for at least a year or two. In the

short-run, then, the odds highly favor biodiesel as the favored pathway for filling the gaps once the stock of RINs is exhausted. Further down the road, the gaps would likely be filled by some combination of higher ethanol blends and biodiesel.

The analysis in this article only considers potential physical pathways to meeting the RFS mandates at statutory levels. We did not consider the cost of the different pathways. That is a task we leave for future *farmdoc daily* articles. We are confident in reaching the following conclusions—there are no easy solutions to meeting the RFS mandates at statutory levels, particularly in the short-run, even after writing down the cellulosic mandates close to zero and all solutions will be costly in terms of producing and blending biofuels. There may well be offsetting social benefits in terms of greenhouse gas emissions and energy security but those benefits have to be weighed against the additional transportation fuel costs. The intense political battle over the fate of the RFS is unlikely to abate anytime soon.

Table 1. U.S. Renewable Fuels Standard for 2014-2022--Billion Gallons

Calendar		Advanced				
Year	Total	Cellulosic	Biodiesel(a)	Undifferentiated	Total	Renewable
2014	18.150	1.750	*	2.000	3.750	14.400
2015	20.500	3.000	*	2.500	5.500	15.000
2016	22.250	4.250	*	3.000	7.250	15.000
2017	24.000	5.500	*	3.500	9.000	15.000
2018	26.000	7.000	*	4.000	11.000	15.000
2019	28.000	8.500	*	4.500	13.000	15.000
2020	30.000	10.500	*	4.500	15.000	15.000
2021	33.000	13.500	*	4.500	18.000	15.000
2022	36.000	16.000	*	5.000	21.000	15.000

(a) each gallon of biodiesel receives 1.5 gallons credit towards RFS

* minimum of 1.0 billion gallons

Table 2. Implementation of U.S. Renewable Fuels Standard for 2014-2022 under Cellulosic and Advanced Only Write Down--Billion Gallons

Calendar		Advanced				
Year	Total	Cellulosic	Biodiesel(a)	Undifferentiated	Total	Renewable
2014	16.610	0.025	1.280	0.265	2.210	14.400
2015	17.580	0.080	1.280	0.580	2.580	15.000
2016	18.080	0.080	1.280	1.080	3.080	15.000
2017	18.580	0.080	1.280	1.580	3.580	15.000
2018	19.080	0.080	1.280	2.080	4.080	15.000
2019	19.580	0.080	1.280	2.580	4.580	15.000
2020	19.580	0.080	1.280	2.580	4.580	15.000
2021	19.580	0.080	1.280	2.580	4.580	15.000
2022	20.080	0.080	1.280	3.080	5.080	15.000

(a) each gallon of biodiesel receives 1.5 gallons credit towards RFS

Table 3. Write Down of U.S. Renewable Fuels Standard for 2014-2022 under Cellulosic and Advanced Only Write Down--Billion Gallons

Calendar		Advanced				
Year	Total	Cellulosic	Biodiesel(a)	Undifferentiated	Total	Renewable
2014	1.540	1.725	0.000	1.735	1.540	0.000
2015	2.920	2.920	0.000	1.920	2.920	0.000
2016	4.170	4.170	0.000	1.920	4.170	0.000
2017	5.420	5.420	0.000	1.920	5.420	0.000
2018	6.920	6.920	0.000	1.920	6.920	0.000
2019	8.420	8.420	0.000	1.920	8.420	0.000
2020	10.420	10.420	0.000	1.920	10.420	0.000
2021	13.420	13.420	0.000	1.920	13.420	0.000
2022	15.920	15.920	0.000	1.920	15.920	0.000

(a) each gallon of biodiesel receives 1.5 gallons credit towards RFS

* minimum of 1.0 billion gallons

Table 4. Advanced RFS for 2014-2022--Billion Gallons

Calendar				Undifferentiated	Undifferentiated	D4/D5 Advanced
Year	Total	Cellulosic	Biodiesel(a)	Brazilian Ethanol	Domestic Ethanol	RINs Gap
2014	2.210	0.025	1.280	0.065	0.079	0.122
2015	2.580	0.080	1.280	0.065	0.100	0.416
2016	3.080	0.080	1.280	0.065	0.100	0.916
2017	3.580	0.080	1.280	0.065	0.100	1.416
2018	4.080	0.080	1.280	0.065	0.100	1.916
2019	4.580	0.080	1.280	0.065	0.100	2.416
2020	4.580	0.080	1.280	0.065	0.100	2.416
2021	4.580	0.080	1.280	0.065	0.100	2.416
2022	5.080	0.080	1.280	0.065	0.100	2.916

(a) Each gallon of biodiesel receives 1.5 gallons of credit toward meeting RFS mandates.

Table 5. D6 Renewable, D4/D5 Advanced Gap, and Total RFS Gap for 2014-2022--Billion Gallons

Calendar	Renewable	Ethanol	D6 Renewable	D4/D5 Advanced	Total RFS
Year	Mandate	Blend Wall	Gap(a)	Gap	Gap
2014	14.400	13.500	1.068	0.122	1.190
2015	15.000	13.750	1.495	0.416	1.910
2016	15.000	13.750	1.495	0.916	2.410
2017	15.000	13.750	1.495	1.416	2.910
2018	15.000	13.750	1.495	1.916	3.410
2019	15.000	13.750	1.495	2.416	3.910
2020	15.000	13.750	1.495	2.416	3.910
2021	15.000	13.750	1.495	2.416	3.910
2022	15.000	13.750	1.495	2.916	4.410

(a) D6 renewable gap is increased slightly to reflect ethanol that generates advanced RINs but reduces the total generation of D6 RINs due to the E10 blend wall constraint.

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February 19, 2015 note: *This article has been modified from the original version published earlier today. There was a small error regarding the entries for "Undifferentiated Domestic Ethanol" in Table 4. Corrected values result in slight changes to the estimates for the renewable and advanced gaps but no change in the total RFS gaps as the renewable and advanced gap changes offset one another.*