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RFS Standards Beyond 2017—Biodiesel or Bust?

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In the *farmdoc daily* article of May 26, 2016, we reviewed the EPA's final rule making for the Renewable Fuels Standards (RFS) for 2014-16 and the preliminary rulemaking for 2017 to determine if the implied conventional biofuels (ethanol) mandates represented a "push" beyond the E10 blend wall. The magnitude of the push is calculated as the difference between the implied conventional mandate and the expected level of consumption of conventional (non-advanced) ethanol. We concluded that the EPA policy of establishing mandates high enough to provide a push revealed in the November 2015 final rulemaking for 2014-2016 was continued in the 2017 preliminary rulemaking. Based on projections of domestic gasoline consumption that exceed EPA projections, we calculated that the magnitude of the push for conventional ethanol exceeds 500 million gallons for both 2016 and 2017. To date, the conventional ethanol gap has been filled primarily by increasing the use of biodiesel and renewable diesel. At the same time, the EPA raised the biomass-based diesel ("biodiesel") mandate from 1.9 billion gallons in 2016, to 2.0 billion gallons in 2017, and 2.1 billion gallons in 2018. Additionally, the EPA has reduced the total advanced biofuels mandate by less than the reduction in the cellulosic mandate, resulting in increased mandates for undifferentiated advanced biofuels which include biodiesel and renewable diesel.

The current pattern of RFS mandates, if continued beyond 2017, raises important questions about the size of the conventional ethanol gap, the magnitude of the advanced gap above the biodiesel mandate, the likely requirement for biodiesel and renewable diesel filling both gaps, and the requirements for biodiesel feedstocks. Here, we make projections of gasoline and diesel use and RFS mandates through 2022 in order to address these questions. A key assumption is that the EPA continues to set the RFS standards in a manner consistent with the recent pattern.

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

Calendar		Advanced				
Year	Total	Cellulosic	Biodiesel(a)	Undifferentiated	Total	Conventional
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 biomass-based biodiesel is assumed to receive 1.54 gallons credit towards RFS

* minimum of 1.0 billion gallons

Table 2. Gasoline Use, E10 Blend Wall, Total Ethanol Use, Diesel Use, and Biomass-based Diesel (Biodiesel) Use under EPA

Calendar	Gasoline		Total Ethanol	Total Ethanol	Diesel	Total Biodiesel	Total Biodiesel
Year	Use(a)	E10 Blend Wall	Use(b)	Inclusion Rate	Use(a)	Use(b)	Inclusion Rate
2014	136.480	13.648	13.420	9.83%	55.670	1.550	2.78%
2015	140.152	14.015	13.940	9.95%	55.212	1.760	3.19%
2016	143.656	14.366	14.350	9.99%	54.297	1.530	2.82%
2017	145.811	14.581	14.600	10.01%	55.823	2.350	4.21%
2018	147.269	14.727	14.746	10.01%	56.000	2.500	4.46%
2019	148.005	14.801	14.820	10.01%	56.000	2.600	4.64%
2020	148.745	14.875	14.894	10.01%	56.000	2.700	4.82%
2021	149.489	14.949	14.968	10.01%	56.000	2.800	5.00%
2022	150.236	15.024	15.043	10.01%	56.000	2.900	5.18%

(a) petroleum and renewable

(b) domestic only

Table 3. Implementation of U.S. Renewable Fuels Standard under EPA Final Rulemaking for 2014-2016, EPA

Calendar		Advanced				
Year	Total	Cellulosic	Biodiesel(a)(b)	Undifferentiated	Total	Conventional
2014	16.274	0.033	1.630	0.127	2.670	13.604
2015	17.073	0.123	1.730	0.093	2.880	14.193
2016	18.340	0.230	1.900	0.454	3.610	14.730
2017	18.996	0.312	2.000	0.608	4.000	14.996
2018	19.500	0.337	2.100	0.929	4.500	15.000
2019	20.000	0.362	2.200	1.250	5.000	15.000
2020	20.100	0.387	2.300	1.171	5.100	15.000
2021	20.200	0.412	2.400	1.092	5.200	15.000
2022	20.500	0.437	2.500	1.213	5.500	15.000

(a) each gallon of biomass-based biodiesel is assumed to receive 1.54 gallons credit towards RFS

(b) EPA preliminary proposal also included biomass-based diesel volume for 2017

Table 4. Write Down of U.S. Renewable Fuels Standard under EPA Final Rulemaking for 2014-2016, EPA

Calendar		Advanced				
Year	Total	Cellulosic	Biodiesel	Undifferentiated	Total	Conventional
2014	1.876	1.717	0.000	1.873	1.080	0.796
2015	3.427	2.877	0.000	2.407	2.620	0.807
2016	3.910	4.020	0.000	2.546	3.640	0.270
2017	5.004	5.188	0.000	2.892	5.000	0.004
2018	6.500	6.663	0.000	3.071	6.500	0.000
2019	8.000	8.138	0.000	3.250	8.000	0.000
2020	9.900	10.113	0.000	3.329	9.900	0.000
2021	12.800	13.088	0.000	3.408	12.800	0.000
2022	15.500	15.563	0.000	3.787	15.500	0.000

Table 5. Fractional U.S. Renewable Fuels Standard under EPA Final Rulemaking for 2014-2016, EPA Proposal for

Calendar	Petroleum Gasoline		Advanced			
Year	and Diesel Use	Total	Cellulosic	Biodiesel(a)	Total	Conventional
2014	177.140	9.19%	0.019%	1.41%	1.51%	7.68%
2015	179.665	9.52%	0.069%	1.49%	1.62%	7.90%
2016	182.073	10.10%	0.128%	1.59%	2.01%	8.09%
2017	184.683	10.29%	0.169%	1.62%	2.17%	8.12%
2018	186.023	10.48%	0.18%	1.74%	2.42%	8.06%
2019	186.585	10.72%	0.19%	1.82%	2.68%	8.04%
2020	187.151	10.74%	0.21%	1.89%	2.73%	8.01%
2021	187.721	10.76%	0.22%	1.97%	2.77%	7.99%
2022	188.293	10.89%	0.23%	2.04%	2.92%	7.97%

(a) converted to ethanol equivalents using 1.54 conversion factor

Table 6. Conventional Gaps under EPA Final Rulemaking for 2014-2016, EPA Proposal for 2017, and Continuation for 2018-2022--Billion Gallons

Calendar	Conventional	Total	Advanced	Conventional	Conventional
Year	Mandate	Ethanol Use	Ethanol Use	Ethanol Use	Mandate Gap
2014	13.604	13.420	0.091	13.329	0.275
2015	14.193	13.940	0.117	13.823	0.370
2016	14.730	14.350	0.130	14.220	0.510
2017	14.996	14.600	0.156	14.444	0.552
2018	15.000	14.746	0.156	14.590	0.410
2019	15.000	14.820	0.156	14.664	0.336
2020	15.000	14.894	0.156	14.738	0.262
2021	15.000	14.968	0.156	14.812	0.188
2022	15.000	15.043	0.156	14.887	0.113

Table 7. Advanced Gaps under EPA Final Rulemaking for 2014-2016, EPA Proposal for 2017, and Continuation for 2018-2022--Billion Gallons

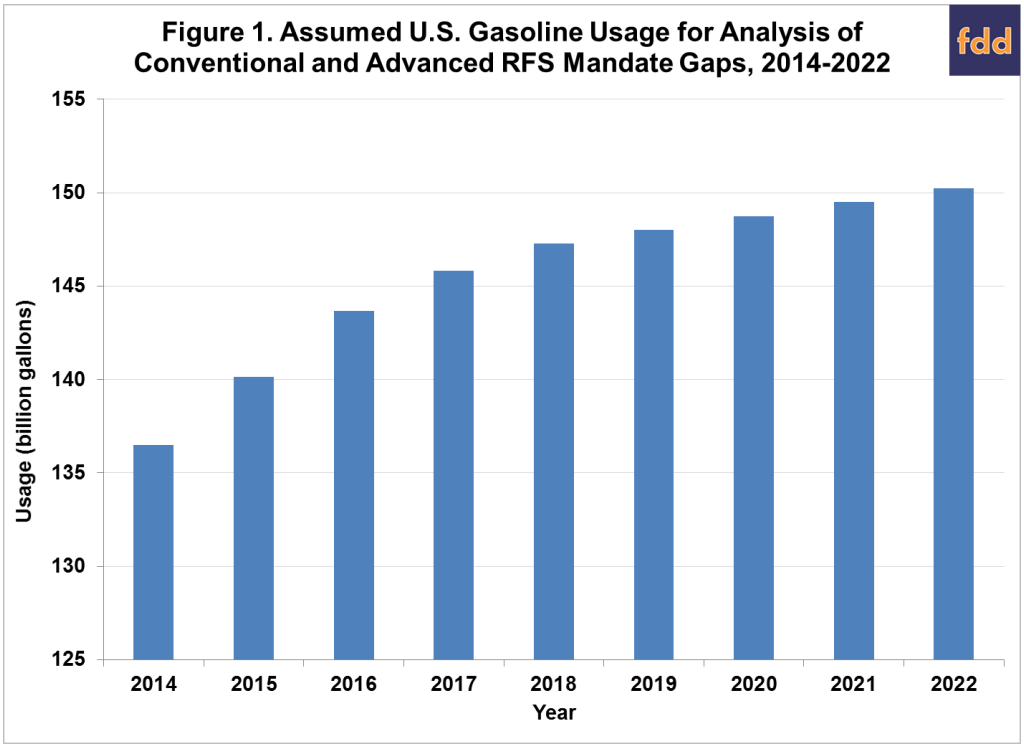
Calendar		Cellulosic	Cellulosic		Undifferentiated	Undifferentiated	Undifferentiated	Advanced
Year	Total	Ethanol	Biogas	Biodiesel(a)(b)	Brazilian Ethanol	Domestic Ethanol	Non-Ethanol	Mandate Gap
2014	2.670	0.001	0.032	1.630	0.064	0.026	0.053	0.000
2015	2.880	0.002	0.121	1.730	0.089	0.026	0.033	0.000
2016	3.610	0.004	0.226	1.900	0.100	0.026	0.027	0.301
2017	4.000	0.030	0.282	2.000	0.100	0.026	0.030	0.452
2018	4.500	0.030	0.292	2.100	0.100	0.026	0.034	0.784
2019	5.000	0.030	0.302	2.200	0.100	0.026	0.034	1.120
2020	5.100	0.030	0.312	2.300	0.100	0.026	0.034	1.056
2021	5.200	0.030	0.322	2.400	0.100	0.026	0.034	0.992
2022	5.500	0.030	0.332	2.500	0.100	0.026	0.034	1.128

(a) each gallon of biomass-based biodiesel is assumed to receive 1.54 gallons credit towards RFS

(b) EPA preliminary proposal also included biomass-based diesel volume for 2018

Projections

The projections and assumptions for the analysis are detailed in Tables 1 through 7. The format of the tables is similar to that used in several previous *farmdoc daily* articles on implementation of the RFS (e.g., February 19, 2015; June 17, 2015). We start in Table 1 with a summary of the statutory RFS requirements for 2014 through 2022 that were briefly described in the May 26 *farmdoc daily* article. The total RFS biofuels requirements are divided between advanced biofuel requirements and what we refer to as implied conventional (ethanol) requirements, which is the difference between the total and advanced requirements. Our projections of annual domestic gasoline and diesel consumption, the calculation of the size of the E10 blend wall, projections of annual ethanol and biodiesel consumption, and biofuel inclusion rates are presented in Table 2. The projections of U.S. gasoline consumption through 2017 are those presented in the May 26 article under our "Alternative Scenario," which included increases of 2.7, 2.5, and 1.5 percent for 2015, 2016, and 2017, respectively. Conservatively, gasoline consumption is projected to increase by 1.0 percent in 2018 and by 0.5 percent each year thereafter. The projections for the level of U.S. gasoline consumption are presented in Figure 1. It is interesting to observe that gasoline consumption is projected to increase from the depressed level of 138.5 billion gallons in 2014 back to 150 billion gallons in 2022, with most of the recovery in 2015-2018. This is mainly due to the drop in crude oil prices since 2014, which highlights the importance of the level of crude oil prices to our analysis. Sharply higher or lower crude prices would necessitate substantial adjustments.



Projections of U.S. diesel consumption are made difficult since historic estimates made by the EPA show unusually large annual variation. The variation reflects the wide variation in the annual estimates of consumption by ocean-going vessels which is subtracted from total diesel consumption to derive estimates of domestic surface transportation consumption. The projections of U.S. diesel consumption through 2017 are those presented in the May 26 *farmdoc daily* article under our "Alternative Scenario." Lacking any better information, we project diesel consumption at a fixed 56 billion gallons annually for 2018-2022.

The assumptions for the EPA implementation of the RFS for 2017 reflect rules in the recent preliminary rulemaking. For 2018-2022 (2019-2022 for biodiesel) it is assumed that the cellulosic mandate is continually reduced to very low, but marginally increasing levels and the total advanced biofuels mandate is reduced by less than the reduction in the cellulosic mandate. The biodiesel mandate is increased by 100 million gallons per year, following the recent pattern for 2017-2018. The implied conventional mandate is assumed to be at the statutory level for 2017-2022. The magnitude of the annual write down from statutory to actual or assumed mandates is summarized by category of biofuel in Table 4.

Since the EPA blending mandates are enforced fractionally rather than volumetrically, we calculate the annual implied fractional mandate by category of biofuel based on the assumed volumetric mandate and the projections of domestic gasoline and diesel consumption. Those fractional mandates are summarized in Table 5. Note that the fractional conventional ethanol mandate listed in Table 5 for 2017 is slightly lower than in the preliminary EPA rulemaking released last month. We assume that the final EPA rulemaking will incorporate enough of a higher projection of gasoline consumption for 2017 that the statutory mandate level of 15 billion gallons can be reached with a slightly lower fractional mandate.

In Table 6 the conventional ethanol gap is calculated as the assumed volumetric mandate minus projected total ethanol consumption from Table 2 minus projected consumption of cellulosic ethanol, Brazilian ethanol, and undifferentiated domestic ethanol in Table 7. The calculation of the conventional gap presented here reflects the projection of increasing domestic gasoline consumption and the assumption that the EPA's fractional mandate is established to reflect those projected increases. Note that the magnitude of the conventional gap declines after 2017 and becomes quite small by 2022. Regardless of the path, the gap has to be filled by a combination of a drawdown in existing ethanol and advanced RINs stocks, expansion of consumption of higher ethanol blends such as E15 and E85, or the use of one or more categories of advanced biofuels above the levels projected in Table 7. Given the constraints on expansion of higher ethanol blends (e.g., *farmdoc daily*, June 19, 2013), biodiesel is likely the only fuel that will be available in large enough quantities to fill the conventional gap. In this sense, biodiesel is likely to be the "marginal gallon" to fulfill the conventional mandate.

Table 7 summarizes the actual or assumed annual advanced RFS, the projections of consumption of advanced biofuels by category, and the resulting advanced biofuels mandate gap. The projection of biodiesel consumption is at the assumed mandated level while the projections for other categories reflect the assumption of no growth beyond 2017 except for marginal growth in cellulosic biogas. Note that each gallon of biodiesel use is assumed to result in 1.54 gallons of credit towards the RFS due to the higher conversion factors for renewable diesel. The magnitude of the advanced mandate gap is the difference between the total advanced mandate and the projection of total advanced biofuel use. This gap has to be filled by drawdown in advanced RINs stocks and/or additional usage of the advanced biofuel categories shown in Table 7. The size of the calculated gap becomes large in the current year and is near or above one billion gallons for 2019-2022.

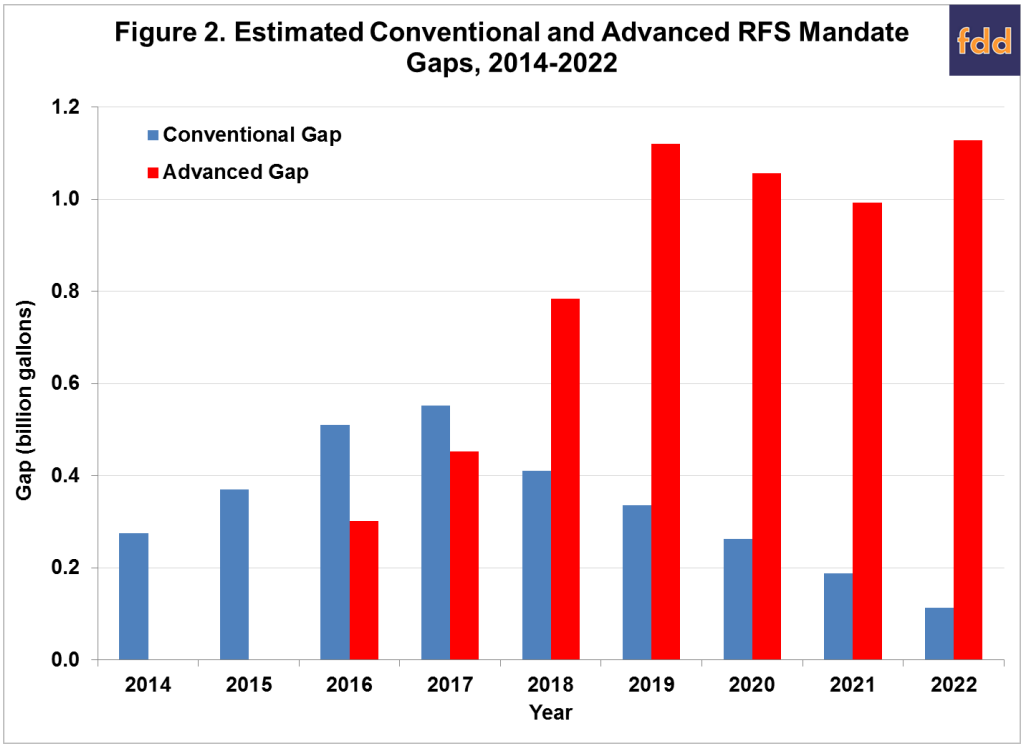
Analysis

The EPA has signaled that the RFS will be enforced in a manner that will include a push for conventional ethanol use above the E10 blend wall, expansion of the biodiesel mandate, and an increase in the requirement for undifferentiated advanced biofuels. Our projections discussed in the previous section assume this policy trajectory through 2022. The key point is that this policy trajectory will likely create a gap between the magnitude of the mandate and expected (or required) use of conventional and advanced biofuels. Figure 2 summarizes our projections of the conventional and advanced gaps over 2014-2022. The divergence in the pattern of the gaps is striking. Driven by the projected increases in gasoline consumption, the size of the conventional ethanol gap peaks in 2017 at 552 million gallons and then begins to recede fairly quickly, falling all the way back to 113 million gallons in 2022. In contrast, the advanced gap starts at zero in 2014 and 2015 and then increases very rapidly, reaching 1 billion gallons in 2019 and essentially staying at that level or higher through 2022. The reason the advanced gap increases so much by 2019 is the increase in the undifferentiated advanced mandate (Table 1). This represents the minimum level for the advanced mandate after waiver of the cellulosic mandate, and it increases from 2 billion gallons in 2014 to 4.5 billion gallons in 2019.

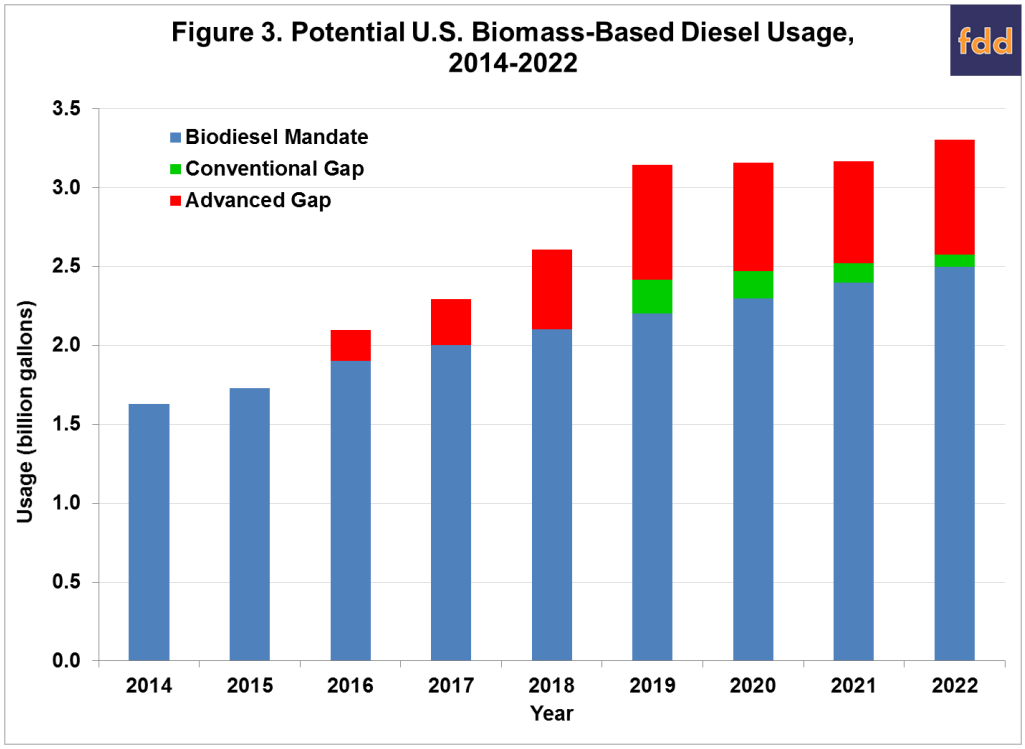
The projections summarized in Figure 2 may be surprising to many, in that the total size of the conventional gap over 2014-2022 is predicted to be only 3.02 billion gallons, a major turnaround from projections in the last couple of years. For example, in the *farmdoc daily* article of June 17, 2015 we projected the total size of the conventional gap over 2014-2022 to be 9.1 billion gallons. So, our projection of the size of the total conventional gap over 2014-2022 has fallen by about two-thirds in just one year. This demonstrates the dramatic impact on the conventional gap of increasing gasoline consumption in the face of falling crude oil and gasoline prices.

Another perspective on the more manageable size of the conventional gap is to compare the size of the projected total gap over 2014-2022 to the current stock of RINs. In this *farmdoc daily* article (March 3, 2016) Nick Paulson estimated the stock of conventional and advanced RINs to be 2.1 billion gallons at the end of 2015 (the EPA estimated 1.7 billion gallons in its 2017 preliminary rulemaking). So, the total

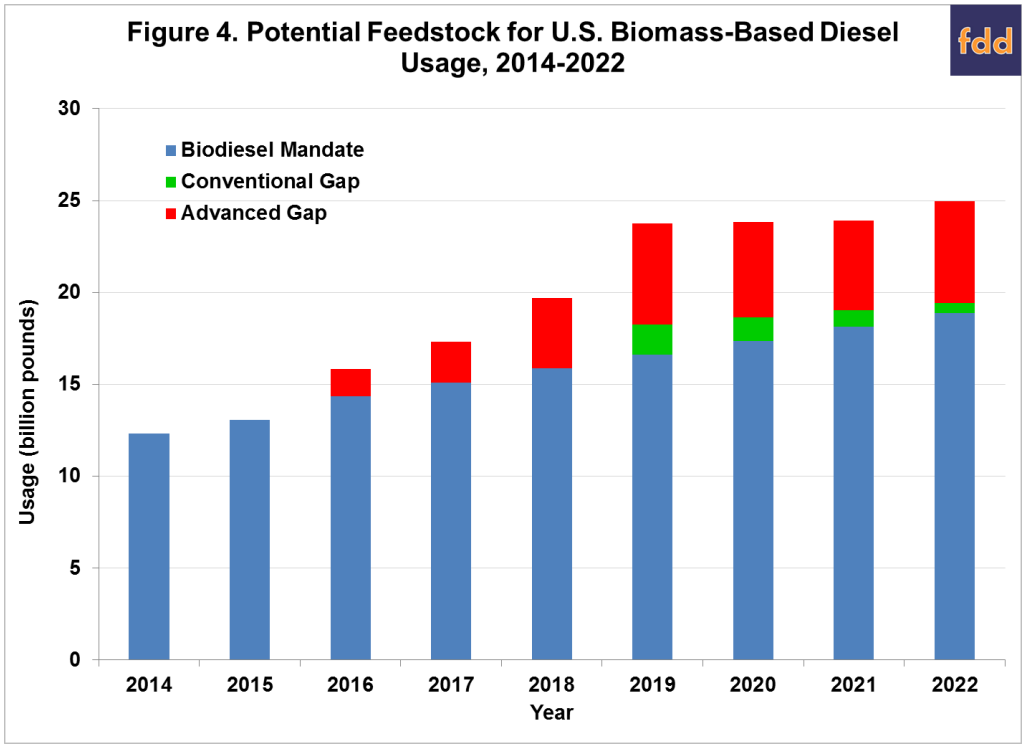
size of the conventional gap over 2014-2022 is only about 1 billion gallons more than the current inventory of conventional and advanced RINs (advanced RINs can be used for conventional compliance). Stated differently, current RINs stocks are sufficient to meet the projected conventional gap over 2014-2018. Then, an average of only 225 million gallons of additional RINs would be needed each year over 2019-2022 to fill the conventional gap. The relatively small size of the gap in the out years could put downward pressure on D6 ethanol RINs prices relative to D4 biodiesel RINs prices, particularly if the consumption of E15 or E85 expands more rapidly than assumed here.



The rapid rise in the advanced mandate gap in the next few years raises the question of what will fill this other gap. As noted in the previous section, the advanced gap can be filled by the drawdown in advanced RINs stocks and/or additional usage of advanced biofuels. To date, the advanced gap has been filled mainly by biodiesel and that seems to be the most likely pathway moving forward. The other possible pathway is Brazilian sugarcane ethanol, which qualifies as an advanced biofuel. Substantial expansion of consumption of Brazilian ethanol would require increased use of higher ethanol blends here in the U.S. and the availability of large exportable surpluses from Brazil. Both of these face substantial headwinds—in the form of infrastructure constraints for higher blends in the U.S. and higher required ethanol blend rates within Brazil. With that background, we project biodiesel use based on: i) the assumption that the biodiesel mandate continues to increase by 100 million gallons per year; ii) the projections of the advanced mandate gap presented in Figure 2 are met with biodiesel; and iii) RINs stocks are used to meet the conventional gap through 2018 and biodiesel is used thereafter to meet the conventional gap. Annual projections of biodiesel use under these assumptions are summarized in Figure 3. Total biodiesel use for the biodiesel mandate, advanced gap, and conventional gap would increase from an estimated 1.63 billion gallons in 2014 to 3.31 billion gallons in 2022. Note how quickly total biodiesel use increases starting in 2018, when the projected total is 2.875 billion gallons. The total then crosses 3 billion gallons in 2019. These requirements could be met from a combination of existing foreign and domestic production capacity, but would require a substantial increase in capacity to transport and blend biodiesel.



The increases in biodiesel production would obviously require a large increase in biodiesel feed stock. Assuming 7.55 pounds of feed stock (vegetable oil or animal fat) is required for each gallon of biodiesel, feedstock requirements would increase from an estimated 12.31 billion pounds in 2014 to almost 25 billion pounds in 2022. For perspective, the projected 2022 feedstock requirement is equivalent to the soybean oil production from about 50 million acres of soybeans. While these projections reflect the debatable assumption that projected mandate gaps are filled entirely by biodiesel, they underscore the potential growth in the biodiesel industry that would result from a continuation of the current EPA pattern of implementing the RFS.



Implications

The EPA established a clear direction for implementing the RFS in its final rulemaking for 2014-2016 released last November and its preliminary rulemaking for 2017 released last month. That direction included a push for conventional ethanol use above the E10 blend wall, expansion of the biodiesel mandate, and an increase in the requirement for undifferentiated advanced biofuels. We analyzed the longer-term implications of continuing this policy direction for the RFS through 2022 and reached several interesting conclusions. First, the conventional ethanol mandate gap (difference between mandate and conventional ethanol use) peaks in 2017 and then declines fairly rapidly. This is a major turnaround from projections in the last couple of years and demonstrates the importance of increasing gasoline consumption in the face of falling crude oil and gasoline prices. Second, in contrast to the conventional gap becoming more manageable, the advanced gap (approximately the difference between the total advanced and biodiesel mandates) grows very rapidly starting in 2018, is projected to exceed 1 billion gallons in 2019, and remains at about 1 billion gallons or higher each year through 2022. Third, even after consideration of the use of the current stock of RINs, biodiesel (and renewable diesel) usage grows very rapidly from 1.63 billion gallons in 2014 to 3.31 billion gallons in 2022. This reflects the assumption that the biodiesel mandate will continue to grow in a linear fashion and biodiesel will continue to be the marginal gallon in filling the conventional and advanced gaps, as it has been in recent years. This would require a substantial increase in capacity to transport and blend biodiesel, as well as a doubling of total feed stock requirements.

Biodiesel requirements could ultimately be increased even more if the results of ongoing litigation require "backfilling" of recent RFS mandates that were below statutory requirements. That total shortfall could represent as much as an additional 1.2 billion gallons of biodiesel. It is no wonder then that the EPA emphasized in the preliminary rulemaking for 2017 the potential infrastructure and usage constraints associated with expanded biodiesel consumption. The EPA appears to be setting the stage for application of the general RFS waiver authority ("inadequate domestic supply") to cutting the advanced mandate beyond the cellulosic waiver if the EPA deems it necessary. This raises the stakes even further in the current legal battle over the authority of the EPA to waive the RFS mandates.

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