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Estimates of Sustainable Aviation Fuel Production Capacity at U.S. Renewable Diesel Plants Through 2026

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In 2021, the Biden Administration announced a "grand challenge" goal of the U.S. producing three billion gallons of sustainable aviation fuel (SAF) by 2030. A number of federal actions were initiated to support reaching this goal, including new and ongoing funding opportunities for SAF projects and fuel producers. Several technologies potentially can be used to produce SAF at the industrial scale needed to meet the grand challenge goal. However, there is only one feasible pathway at the present time for ramping up SAF production quickly. This is through the conversion of part, or all, of the production capacity at existing or soon to be completed renewable diesel plants. Renewable diesel production capacity in the U.S. has exploded in recent years and is estimated to reach 5.2 billion gallons in 2025 (*farmdoc daily*, November 6, 2024). While this represents a large installed base of production capacity, there is limited information available on precisely how much of this capacity could be converted to SAF production. Hence, the purpose of this article is to estimate the volume of renewable diesel production capacity in the U.S. that has the potential to be converted to SAF production through 2026. This is the 20th in a series of *farmdoc daily* articles on the renewable diesel boom (see the complete list of articles here).

Analysis

The vast majority of renewable diesel in the U.S. is fully refined and cracked using HEFA (hydrotreated esters and fatty acids) petroleum refining technology. For a detailed discussion about this production technology, see the *farmdoc daily* article from February 8, 2023). Our latest estimates of HEFA renewable diesel plant capacity in the U.S. are shown in Table 1. Several sources are used. For 2020 through 2023, we use the list of plants and capacities collected by the Energy Information Agency (EIA) in its annual survey of nameplate production capacity. The date of the survey is January 1 of each calendar year (2021-2024). We assume the "as of" date for the survey is December 31 of the previous calendar year to

be consistent with our earlier work where we defined capacity as end-of-year. For example, the capacities listed in the table for December 31, 2020, are reported by the EIA as of January 1, 2021. Several sources are used for the 2024-2026 production capacity estimates, including *Render* and *Biodiesel* magazines, Argus, and other industry sources. If no other data were available, we used the 2023 EIA survey results.

Table 1. Annual Nameplate Production Capacity (million gallons) of HEFA Renewable Diesel Plants in the U.S., Actual for 2020 - 2023 and Projected for 2024 - 2026

Company	City	State	Starting Year	2020	2021	2022	2023	2024	2025	2026
REG-Geismar LLC	Geismar	LA	2010	100	100	101	100	340	340	340
Diamond Green Diesel LLC	Norco	LA	2013	337	982	982	982	982	982	982
Altair Paramount LLC	Paramount	CA	2016	42	42	42	42	42	42	42
East Kansas Agri-Energy Renewable Diesel	Garnett	KS	2017	3	3	-	-	-	-	-
Wyoming Renewable Diesel CO	Sinclair	WY	2018	117	117	117	117	117	117	117
Dakota Prairie Refining LLC	Dickinson	ND	2020	192	192	192	192	192	192	192
Phillips 66 Co	Rodeo	CA	2021	-	120	180	180	800	800	800
Cheyenne Renewable Diesel Company LLC	Cheyenne	WY	2021	-	92	92	92	92	92	92
BP Products North America	Blaine	WA	2021	-	66	111	111	111	111	111
Chervron USA Inc	El Segundo	CA	2021	-	31	31	184	184	184	184
Kern Oil & Refining	Bakersfield	CA	2021	-	6	6	6	6	6	6
Diamond Green Diesel LLC	Port Arthur	TX	2022	-	-	537	537	537	537	537
Montana Renewables LLC	Great Falls	MT	2022	-	-	184	184	230	230	230
HF Sinclair Renewables Holding Co LLC	Artesia	NM	2022	-	-	141	141	141	141	141
CVR Renewables Wynnewood LLC	Wynnewood	OK	2022	-	-	121	121	121	121	121
Seaboard Energy Kansas LLC	Hugoton	KS	2022	-	-	85	85	85	85	85
Shell Oil Products U.S.1	Norco	LA	2022	-	-	54	54	54	54	54
Jaxon Energy, LLC	Jackson	MS	2022	-	-	25	25	25	25	25
Martinez Renewables LLC	Golden Eagle	CA	2023	-	-	-	731	731	731	731
St Bernard Renewables	Chalmette	LA	2023	-	-	-	307	307	307	307
Vertex Renewables LLC	Mobile	AL	2023	-	-	-	115	-	-	-
Monroe Energy LLC 1	Trainer	PA	2023	-	-	-	18	18	18	18
US Oil & Refining Co 1	Tacoma	WA	2023	-	-	-	5	5	5	5
Love's Heartwell Renewables	Hastings	NE	2025	-	-	-	-	-	80	80
Par Pacific	Kapolei	HI	2025	-	-	-	-	-	61	61
Total Nameplate Capacity				791	1,751	3,000	4,329	5,120	5,261	5,261

Notes: Production capacity for 2020-2023 is from annual EIA surveys. The date of the surveys is January 1 of each calendar year. We assume that EIA data are as of December 31 of the previous calendar year in order to be consistent with our previous work where we defined capacity as end of year. For example, the capacities listed in the table for 2020 are reported by the EIA as of January 1, 2021. Several sources were used for the 2024 - 2026 production capacity estimates, including Render and Biodiesel magazines, Argus, and other industry sources. If no other data were available, we used the 2023 EIA survey results.

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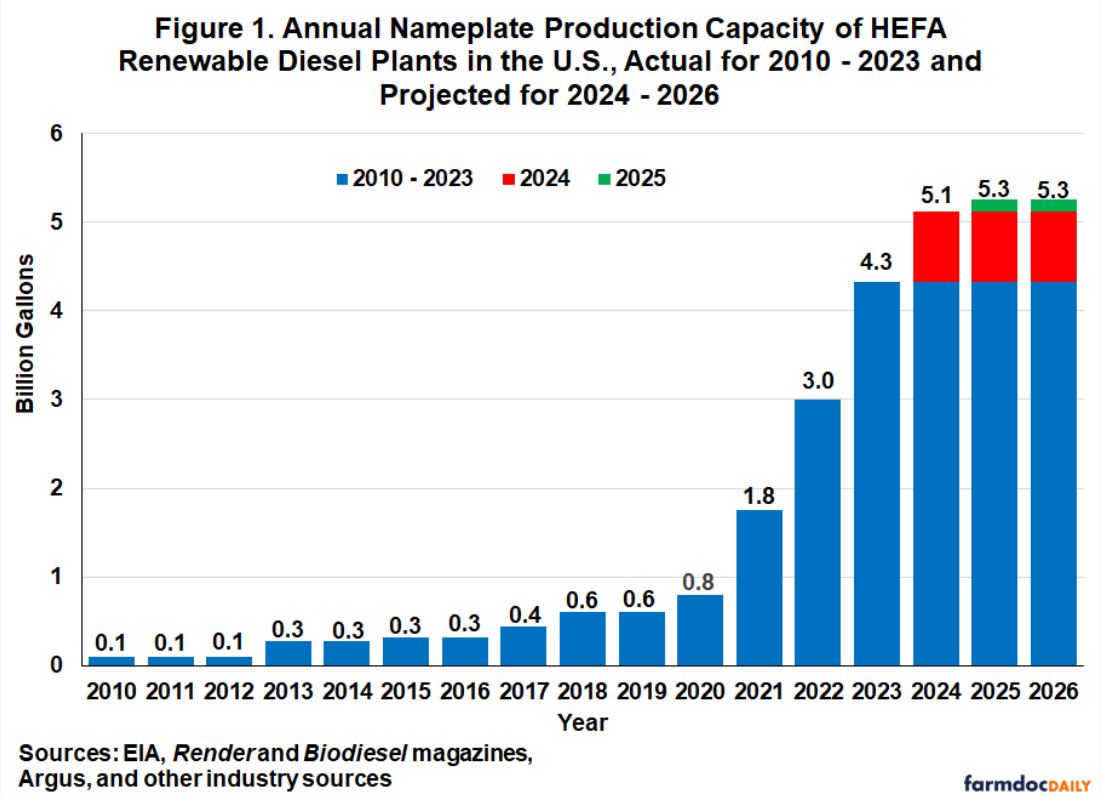
In total, Table 1 shows that there will be 23 renewable diesel plants in operation by the end of 2026 with a total capacity of 5.261 billion gallons. This is one more plant than we included for our previous survey of industry capacity (*farmdoc daily*, November 6, 2024). Since that article was published, we were made aware that the 61-million gallon Par Pacific plant in Kapolei, Hawaii will open in 2025. Two plants have exited the industry. The first is the 3-million gallon East Kansas Agri-Energy plant in Garnett, Kansas which ceased operations in 2022. The second is the 115-million-gallon Vertex Renewables plant at Mobile, Alabama which exited during 2024.

Figure 1 shows total annual nameplate capacity for HEFA renewable diesel plants in the U.S. These totals are the same as those shown in the last row of Table 1. The capacities for 2010 through 2019 were first published in an EIA article (Troderman and Shi, 2023), and the authors generously shared the data with us. The blue bars in Figure 1 represent the EIA production capacity for 2010-2023, and for

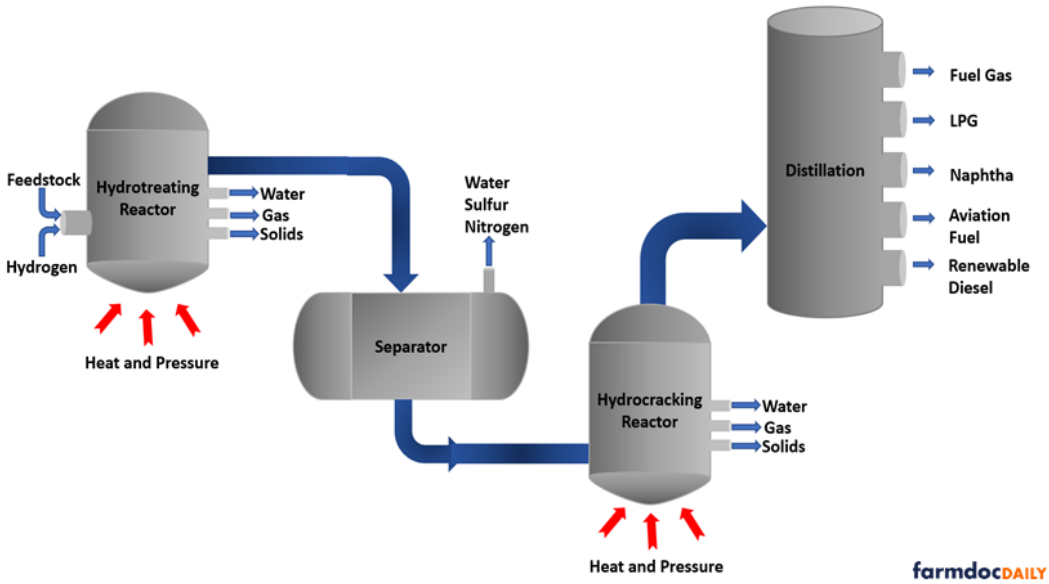
perspective, the 2023 capacity is plotted as the first component of the bars for 2024-2026. The red bars indicate a net capacity expansion of nearly 800 million gallons for 2024. The green bar shows that projected total capacity increases in 2025 by 141 million gallons to a total of 5.3 billion gallons (rounded up from the total shown in Table 1). Total capacity is projected to remain static for 2026.



HEFA renewable diesel plants can be constructed with the option of refining crude oil instead of organic fats and oils. To the best of our knowledge, only one renewable diesel plant has exercised this optionality. The 184-million gallon Chevron USA renewable diesel plant in El Segundo, California announced last year that it was switching to refining crude oil due to poor margins in renewable diesel.

The second optionality that can be built into HEFA renewable diesel plants is to produce SAF. This optionality can range from using a modest part of a plant's capacity to produce SAF to making SAF the main output of the plant. It is important to differentiate this type of optionality from the small amount of SAF that is a normal by-product of renewable diesel production. In addition, the same vegetable oil and animal fat feedstocks are used whether renewable diesel or SAF is produced in the plant. To produce large volumes of SAF, additional technology must be added to a renewable diesel plant, either during construction or after operations begin. Figure 2 provides a schematic of a renewable diesel plant that has installed the technology necessary for producing substantial volumes of SAF. The primary additional technology is the hydrocracking reactor that further refines the hydrocarbon chains before the distillation step. Specifically, the hydrocracking unit shortens the hydrocarbon chains to meet the technical specification for SAF. The investment in additional technology can be substantial, potentially exceeding $100 million for a larger plant.

Figure 2. HEFA Sustainable Aviation Fuel (SAF) Production Process



There are two other important considerations in the decision to exercise SAF optionality for a HEFA renewable diesel plant. First, there is a loss in throughput for each gallon of SAF that is produced. Industry sources indicate that renewable diesel production capacity is lowered by approximately 1.125 gallons for each gallon of SAF produced. For example, consider a plant that has the capacity to produce 100-million gallons of renewable diesel and the option to produce 50 million gallons of SAF. If the plant installs technology to produce 50 million gallons of SAF, this will displace approximately 50 X 1.125 = 56.25 million gallons of renewable diesel production capacity. Consequently, renewable diesel production capacity will be 100 – 56.25 = 43.75 million gallons after the conversion. Second, production of SAF results in higher volumes of lower valued co-products such as naptha and fuel gas.

Table 2 shows our estimates of maximum annual nameplate capacity for SAF production at HEFA renewable diesel plants in the U.S. through 2026. These estimates are based on the same sources as those used for Table 1. We were able to confirm SAF optionality for only six of the renewable diesel plants shown in Table 1. It is important to emphasize at the outset that the capacities listed in Table 2 are maximums and not necessarily current levels of SAF production. The bulk of the optional SAF capacity shown in Table 2 is of quite recent vintage. Before 2024, only two plants had the option to produce SAF and capacity totaled 67.3 million gallons. This jumped sharply to five plants in 2024 with 648.9 million gallons of capacity and then to six plants with 834.4 million gallons in 2025 and 2026. The spread in percentage optionality across the six plants is quite large, ranging from roughly 10 to 88 percent of the plant's original renewable diesel capacity. Note that the SAF optionality of the Montana Renewables Plant in Great Falls, Montana has risen over time. The optionality for the other five plants has remained constant over time. Figure 3 presents the total maximum SAF capacity over time using the same format as Figure 1.

Table 2. Maximum Annual Nameplate Capacity for Sustainable Aviation Fuel (SAF) Production (million gallons) at HEFA Renewable Diesel Plants in the U.S., Actual for 2020 -2023 and Projected for 2024 - 2026

Company	City	State	Starting Year	2020	2021	2022	2023	2024	2025	2026
REG-Geismar LLC	Geismar	LA	2010	-	-	-	-	-	-	-
Diamond Green Diesel LLC	Norco	LA	2013	-	-	-	-	-	-	-
Altair Paramount LLC	Paramount	CA	2016	37.3	37.3	37.3	37.3	37.3	37.3	37.3
East Kansas Agri-Energy Renewable Diesel	Garnett	KS	2017	-	-	-	-	-	-	-
Wyoming Renewable Diesel CO	Sinclair	WY	2018	-	-	-	-	-	-	-
Dakota Prairie Refining LLC	Dickinson	ND	2020	-	-	-	-	-	-	-
Phillips 66 Co	Rodeo	CA	2021	-	-	-	-	306.6	306.6	306.6
Cheyenne Renewable Diesel Company LLC	Cheyenne	WY	2021	-	-	-	-	-	-	-
BP Products North America	Blaine	WA	2021	-	-	-	-	10	10	10
Chervron USA Inc	El Segundo	CA	2021	-	-	-	-	-	-	-
Kern Oil & Refining	Bakersfield	CA	2021	-	-	-	-	-	-	-
Diamond Green Diesel LLC	Port Arthur	TX	2022	-	-	-	-	235	235	235
Montana Renewables LLC	Great Falls	MT	2022	-	-	-	30	60	204.4	204.4
HF Sinclair Renewables Holding Co LLC	Artesia	NM	2022	-	-	-	-	-	-	-
CVR Renewables Wynnewood LLC	Wynnewood	OK	2022	-	-	-	-	-	-	-
Seaboard Energy Kansas LLC	Hugoton	KS	2022	-	-	-	-	-	-	-
Shell Oil Products U.S.1	Norco	LA	2022	-	-	-	-	-	-	-
Jaxon Energy, LLC	Jackson	MS	2022	-	-	-	-	-	-	-
Martinez Renewables LLC	Golden Eagle	CA	2023	-	-	-	-	-	-	-
St Bernard Renewables	Chalmette	LA	2023	-	-	-	-	-	-	-
Vertex Renewables LLC	Mobile	AL	2023	-	-	-	-	-	-	-
Monroe Energy LLC 1	Trainer	PA	2023	-	-	-	-	-	-	-
US Oil & Refining Co 1	Tacoma	WA	2023	-	-	-	-	-	-	-
Love's Heartwell Renewables	Hastings	NE	2025	-	-	-	-	-	-	-
Par Pacific	Kapolei	HI	2025	-	-	-	-	-	41	41
Total Nameplate Capacity				37.3	37.3	37.3	67.3	648.9	834.4	834.4

Notes: Capacity is as of the end of each calendar year. Several sources were used for the 2024 - 2026 production capacity estimates, including *Render* and *Biodiesel* magazines, Argus, and other industry sources.

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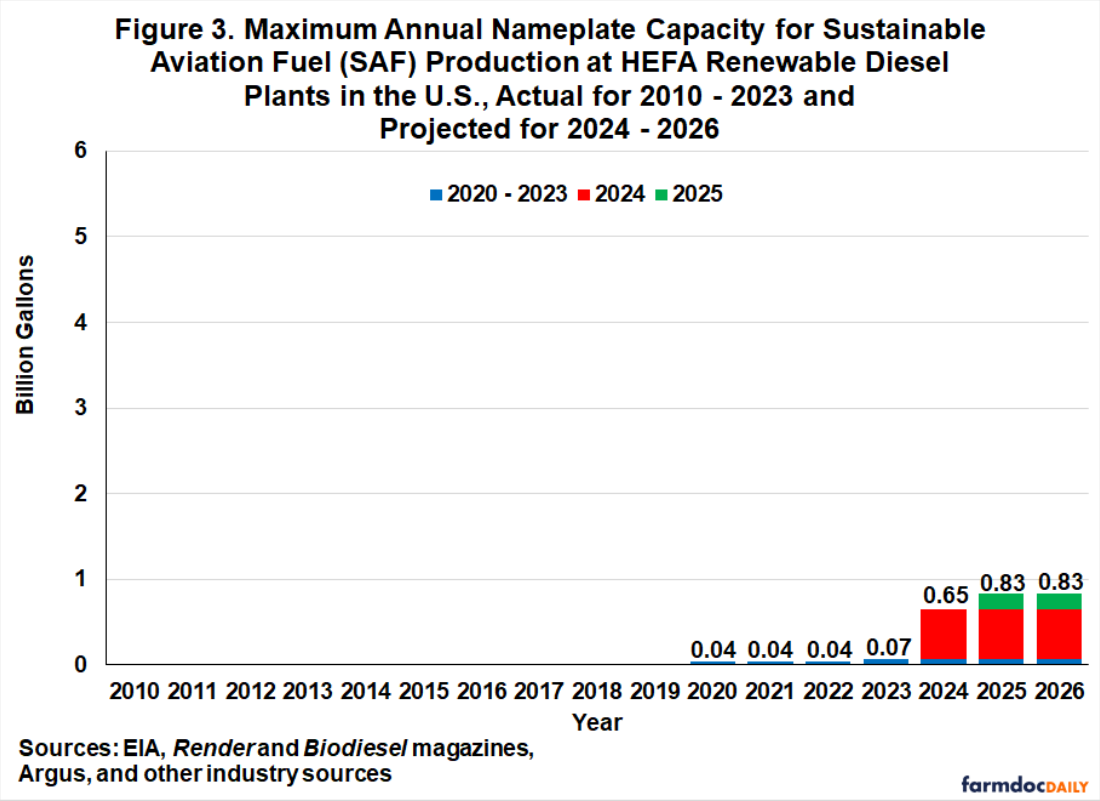

As noted above, converting capacity from renewable diesel to SAF results in a loss of renewable diesel production capacity. Table 3 shows annual nameplate production capacity of HEFA renewable diesel plants in the U.S. after subtracting 1.125 times each plant's reported SAF production capacity through 2026. The data in Table 3 are the same as in Table 1 except for the six renewable diesel plants in Table 2 that have the option to convert capacity to SAF production. In each case, the maximum SAF capacity in Table 2, which assumes each plant produces SAF at their reported capacity, is multiplied by 1.125 to account for the loss in throughput discussed above. This adjusted capacity is subtracted from the original renewable diesel capacity in Table 1 to arrive at the lower renewable diesel capacity shown in Table 3. The net result is that total renewable diesel production capacity tops out at 4.325 billion gallons in 2026. This, of course, assumes that all six plants maximize SAF production.

Table 3. Annual Nameplate Production Capacity (million gallons) of HEFA Renewable Diesel Plants in the U.S. after Subtracting Maximum Sustainable Aviation Fuel (SAF) Production Capacity, Actual for 2020 - 2023 and Projected for 2024 - 2026

Company	City	State	Starting Year	2020	2021	2022	2023	2024	2025	2026
REG-Geismar LLC	Geismar	LA	2010	100	100	101	100	340	340	340
Diamond Green Diesel LLC	Norco	LA	2013	337	982	982	982	982	982	982
Altair Paramount LLC	Paramount	CA	2016	0	0	0	0	0	0	0
East Kansas Agri-Energy Renewable Diesel	Garnett	KS	2017	3	3	-	-	-	-	-
Wyoming Renewable Diesel CO	Sinclair	WY	2018	117	117	117	117	117	117	117
Dakota Prairie Refining LLC	Dickinson	ND	2020	192	192	192	192	192	192	192
Phillips 66 Co	Rodeo	CA	2021	-	120	180	180	455.1	455.1	455.1
Cheyenne Renewable Diesel Company LLC	Cheyenne	WY	2021	-	92	92	92	92	92	92
BP Products North America	Blaine	WA	2021	-	66	111	111	99.8	99.8	99.8
Chervron USA Inc	El Segundo	CA	2021	-	31	31	184	184	184	184
Kern Oil & Refining	Bakersfield	CA	2021	-	6	6	6	6	6	6
Diamond Green Diesel LLC	Port Arthur	TX	2022	-	-	537	537	272.6	272.6	272.6
Montana Renewables LLC	Great Falls	MT	2022	-	-	184	150.3	162.5	0	0
HF Sinclair Renewables Holding Co LLC	Artesia	NM	2022	-	-	141	141	141	141	141
CVR Renewables Wynnewood LLC	Wynnewood	OK	2022	-	-	121	121	121	121	121
Seaboard Energy Kansas LLC	Hugoton	KS	2022	-	-	85	85	85	85	85
Shell Oil Products U.S.1	Norco	LA	2022	-	-	54	54	54	54	54
Jaxon Energy, LLC	Jackson	MS	2022	-	-	25	25	25	25	25
Martinez Renewables LLC	Golden Eagle	CA	2023	-	-	-	731	731	731	731
St Bernard Renewables	Chalmette	LA	2023	-	-	-	307	307	307	307
Vertex Renewables LLC	Mobile	AL	2023	-	-	-	115	0	0	0
Monroe Energy LLC 1	Trainer	PA	2023	-	-	-	18	18	18	18
US Oil & Refining Co 1	Tacoma	WA	2023	-	-	-	5	5	5	5
Love's Heartwell Renewables	Hastings	NE	2025	-	-	-	-	-	80	80
Par Pacific	Kapolei	HI	2025	-	-	-	-	-	18	18
Total Nameplate Capacity				749	1,709	2,958	4,253	4,390	4,325	4,325

Notes; Production capacity for 2020-2023 is from annual EIA surveys. The date of the surveys is January 1 of each calendar year. We assume that EIA data are as of December 31 of the previous calendar year in order to be consistent with our previous work where we defined capacity as end of year. For example, the capacities listed in the table for 2020 are reported by the EIA as of January 1, 2021. Several sources were used for the 2024 - 2026 production capacity estimates, including Render and Biodiesel magazines, Argus, and other industry sources. If no other data were available, we used the 2023 EIA survey results.

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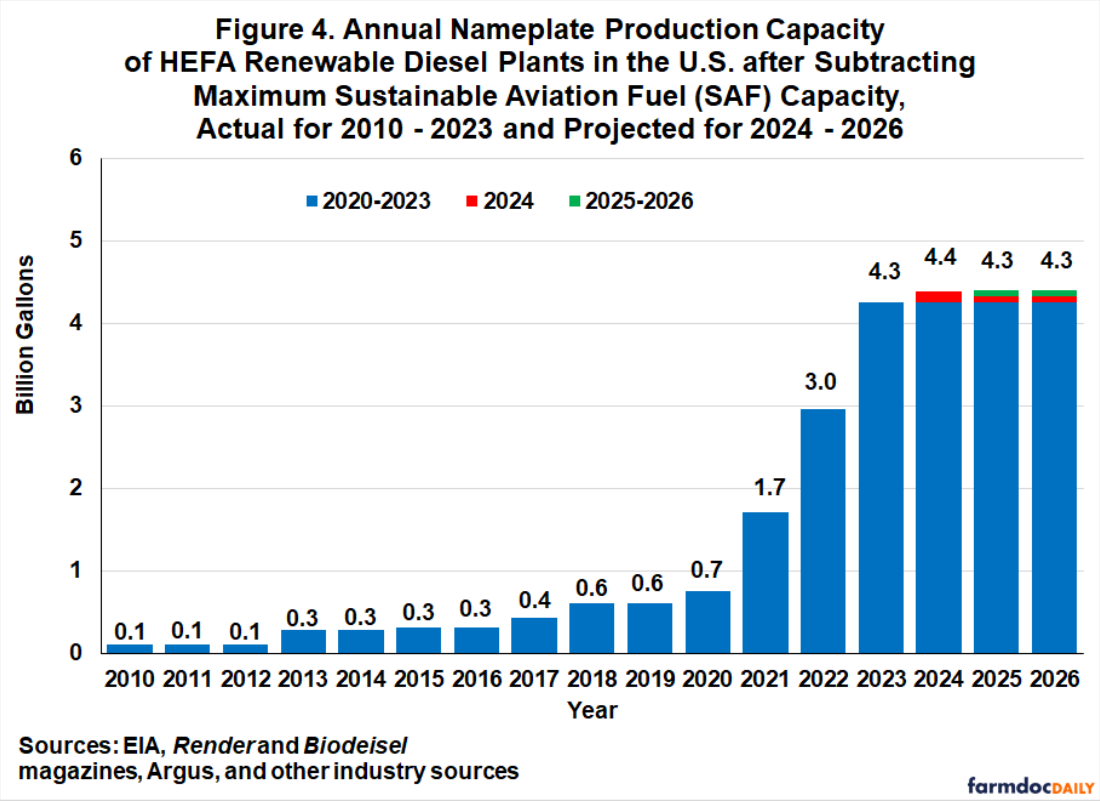
The total annual name plate capacities for renewable diesel after subtracting maximum SAF optionality are shown graphically in Figure 4. Comparing Figures 1 and 4, it is apparent that the impact of SAF optionality on renewable diesel capacity could be substantial starting in 2024. For example, total renewable diesel production capacity in the U.S. in 2025 and 2026 could range from 4.325 billion gallons under the maximum SAF scenario to 5.261 billion gallons under the status quo. If SAF optionality is at the maximum in these two years, projected renewable diesel production capacity would be reduced by nearly 20 percent.



Implications

The U.S government currently has a goal of producing three billion gallons of sustainable aviation fuel (SAF) by 2030. Presently, there is only one feasible pathway for ramping up SAF production that quickly. This is through the conversion of part, or all, of the production capacity at existing or soon to be completed HEFA renewable diesel plants. In this article, we estimate the maximum capacity for producing SAF at renewable diesel plants through 2026. We find that the bulk of optional SAF capacity at renewable diesel plants is of quite recent vintage. Before 2024, only two plants had the option to produce SAF as a primary output and capacity totaled 67.3 million gallons. This jumped sharply to five plants in 2024 with 648.9 million gallons of capacity and then to six plants with 834.4 million gallons in 2025 and 2026. It is noteworthy that total renewable diesel production capacity in the U.S. in 2025 and 2026 could range from 4.325 to 5.261 billion gallons, depending on the level of capacity that is devoted to SAF production. If SAF optionality is at the maximum in these two years, projected renewable diesel production capacity would be reduced by nearly 20 percent.

Disclaimer: *The findings and conclusions in this publication are those of the authors and should not be construed to represent any official USDA or U.S. Government determination or policy. This work was supported in part by the U.S. Department of Agriculture, Economic Research Service.*

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