



Biodiesel Production Profitability in 2018: Did Headwinds or Tailwinds Dominate?

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The U.S. biodiesel industry faced strong headwinds in 2018 due to the demand destruction wreaked by small refinery exemptions (SREs). A recent *farmdoc daily* article ([March 14, 2019](#)) estimated that SREs reduced biomass-based diesel (biodiesel and renewable diesel) demand by over 700 million gallons in 2017 and by nearly a billion gallons in 2018 (assuming the same amount of SREs were awarded for 2018 as in 2017). At the same time, biodiesel producers benefited from the strong tailwinds provided by import duties on biomass-based diesel imports from Argentina and Indonesia. The purpose of this article is to estimate biodiesel production profits for 2018 and determine which of these two factors had the most influence on profitability.

Analysis

As in earlier *farmdoc daily* articles (e.g., [March 1, 2017](#); [March 28, 2018](#)), a model of a representative Iowa plant is used to assess biodiesel production profitability. The model is a modified version of the [representative plant model](#) developed by Don Hofstrand at Iowa State University. The version used here incorporates several key assumptions:

- 30 million gallon annual biodiesel production capacity.
- Plant construction cost of \$1.57 per gallon of nameplate capacity.
- 50 percent debt and 50 percent equity financing.
- 8.25 percent interest on 10-year loan for debt financing. Loan paid off in 2017.
- Plant operates at 100 percent of nameplate capacity.
- Plant only processes soybean oil into biodiesel.
- Conversion factor of 7.55 pounds of soybean oil per gallon of biodiesel.
- 0.9 pounds of glycerin co-product per gallon of biodiesel.
- 7 cubic feet of natural gas per gallon of biodiesel.
- 0.71 pounds of methanol per gallon of biodiesel.

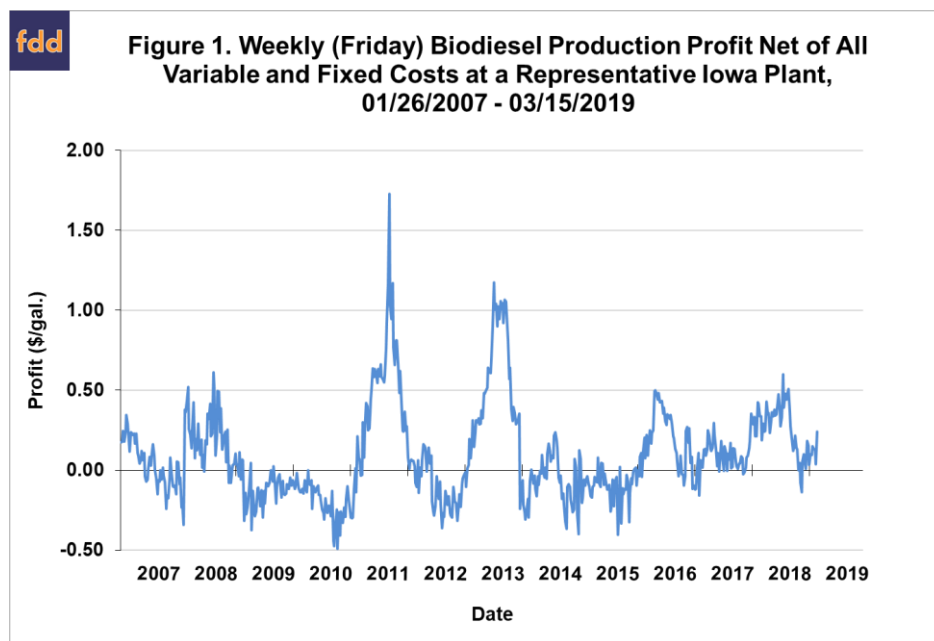
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- Other variable input costs of 25 cents per gallon of biodiesel.
- Total fixed costs of 26 cents per gallon of biodiesel.

This model is meant to be representative of an “average” plant constructed in 2007 to process soybean oil into biodiesel. There is certainly substantial variation in capacity, production efficiency, and feedstock across the industry and this should be kept in mind when viewing profit estimates from the model. However, limiting the feedstock to soybean oil is reasonable since it represents about half of the feedstock used to produce biodiesel in the U.S. and feedstock prices tend to be highly correlated.

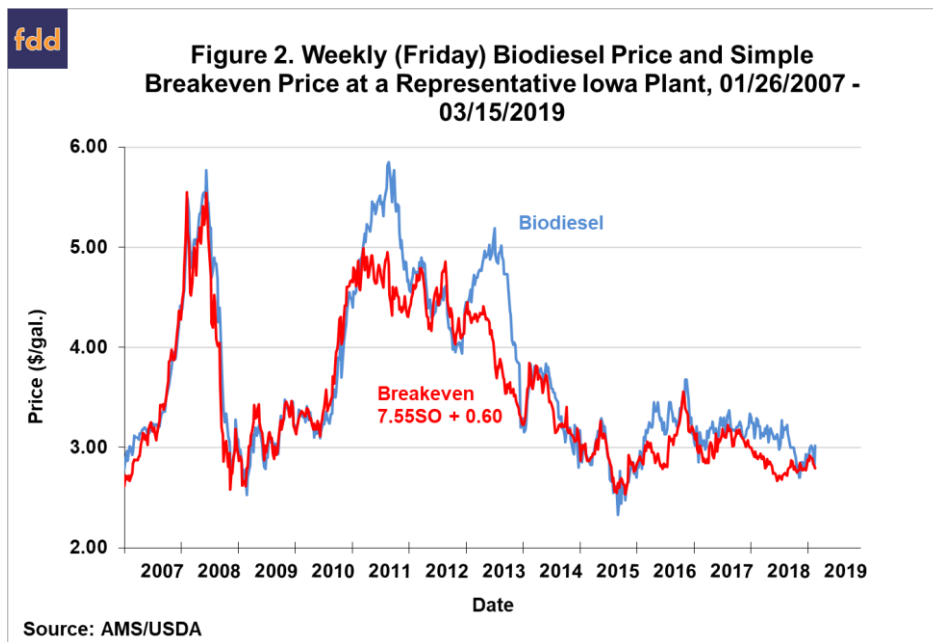
To track plant profitability over time, weekly biodiesel and soybean oil prices at [Iowa plants](#) from the Agricultural Marketing Service (AMS) were collected starting in 2007. Natural gas costs through 2013 are estimated based on monthly data from the Energy Information Agency (EIA). Due to a change in the EIA price series, natural gas costs are estimated as one percent of the nearby NYMEX natural gas futures price starting in January 2014. Glycerin and methanol prices were obtained from OPIS. It is important to note that our profit estimates do not take into account revenue from retroactively reinstated biodiesel tax credits. We have previously shown (*farmdoc daily*, [March 29, 2017](#)) that this additional tax credit revenue, garnered through sharing agreements with blenders, can yield a dramatically more positive picture of the profitability of U.S. biodiesel production. Unfortunately, we do not have comprehensive data on the actual prevalence and terms of the sharing agreements, so we do not take this potential part of revenue into account.

Figure 1 presents the weekly (pre-tax) estimates of biodiesel profits over January 26, 2007 through March 15, 2019 based on the prices and model assumptions. Two enormous spikes in 2011 and 2013 dominate the weekly profitability estimates, when profits exceeded \$1 per gallon. There were also spikes in profitability in 2016 and 2018, but the peaks were smaller, reaching about \$0.50 per gallon, but still notable. The average level of profits in 2011, 2013, 2016, and 2018 was \$0.43, \$0.50, \$0.19, and \$0.28 per gallon, respectively. The average level of profits in 2018 was the third highest since 2007, suggesting a relative strong year for biodiesel plant profitability.



Additional insight about biodiesel profits is provided in Figure 2. Here, the biodiesel price at Iowa plants is plotted versus a simplified breakeven profit relationship between soybean oil and biodiesel prices. Since soybean oil represents over 80 percent of the variable operating costs of the representative plant, all other costs are lumped into the constant term of 0.60, or 60 cents per gallon of biodiesel produced. The 7.55 slope is just the number of pounds of soybean oil assumed to produce a gallon of biodiesel. The breakeven relationship tracks the biodiesel price very closely in 9 of the 13 years in the sample. The exceptions are 2011, 2013, 2016, and 2018. Outside of these years, the market generally priced biodiesel based on the cost of soybean oil, a partial markup for other variable and fixed costs, and zero profits. Implicit in this formulation is the idea that soybean oil prices lead (or cause) biodiesel prices at the

weekly time horizon (*farmdoc daily*, [September 10, 2015](#)). We have also argued that the norm of losses in most years could be traced to over-capacity in the U.S. biodiesel industry (*farmdoc daily*, [February 11, 2016](#)).



The spike in profitability during 2011, 2013, and 2016 can be directly traced to the race by diesel blenders to take advantage of the \$1 per gallon blender tax credit that expired at the end of those calendar years. The key is that blenders face a binding RFS biodiesel mandate, and it is rational to effectively purchase biodiesel at a discount in the current year, due to the tax credit, in order to meet mandates in later years. Once the tax credit expires, the incentive to push up prices, profits, and production disappears and the biodiesel industry in the past returned to a norm of losses. This cycle, of course, depends on blenders perceiving there is substantial uncertainty whether the tax credit will be reinstated or not for the following year.

An obvious question at this point is why biodiesel profits in 2018 (and to a lesser extent 2017) did not follow the well-established pattern of losses in years without an expiring biodiesel tax credit. This is especially interesting given the BBD demand destruction associated with SREs that has been ongoing on since early 2017. Table 1 helps shed light on the situation. The table presents estimates of biomass-based diesel (BBD) supply on annual basis for 2011 through 2018 based on EPA/EMTS data. We utilize the EMTS data because, at least in theory, it should be a virtual census of domestic production and imports of BBD and the EMTS data allow imports of BBD from two different pathways to be fully accounted for in the estimates. See the *farmdoc daily* article from [July 19, 2017](#) for full details on the use of EMTS data to estimate BBD supply.

The table shows several distinct trends. First, total supply peaked in 2016 at 2.8 billion gallons and then dropped to about 2.5 billion gallons in 2017 and 2018. The decline in total supply makes sense given the surge in production and imports in 2016 due to the expiring biodiesel tax credit and the reduction in BBD requirements in 2017 and 2018 due to SREs. Second, total net imports peaked in 2016 at 929 million gallons and then declined sharply to 387 million gallons in 2018. The U.S. Department of Commerce filed [an antidumping and countervailing duty petition](#) with the International Trade Commission against Argentine and Indonesian biodiesel producers in March 2017. The U.S. subsequently won the case and consequently imposed import duties that ranged from 54.36 to 70.05 percent of the value of Argentinian biodiesel and from 50.71 percent for Indonesian biodiesel. The impact of the duties on BBD imports was dramatic. Third, domestic BBD production increased from 1.872 billion gallons in 2016 to 2.137 million gallons in 2018. Fourth, the combination of declining imports and increasing domestic production meant that domestic producers increased production in both absolute and relative terms at the expense of importers. After reaching a low of 67 percent of total supply in 2016, domestic production jumped to 85 percent of total supply in 2018.

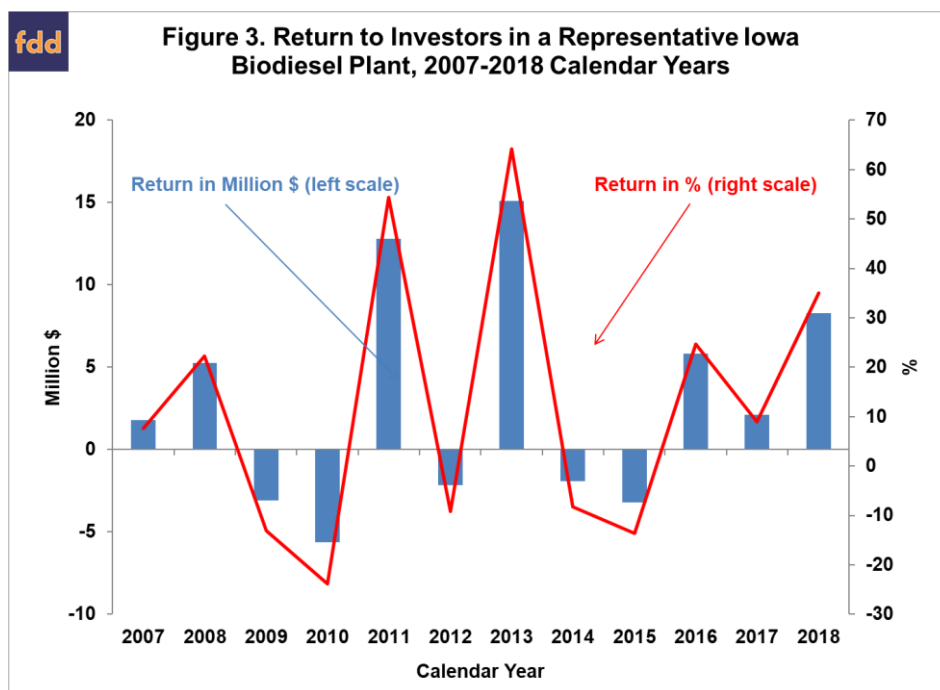
Table 1. Estimates of U.S. Biomass-Based Diesel Supply, 2011-2018

	Domestic Production	D4 Pathway Imports	D6 Pathway Imports	Total Net Imports	Total Supply	Percent Domestic
2011	1.078	0.044	0.003	0.014	1.092	99%
2012	1.056	0.091	0.000	0.019	1.075	98%
2013	1.451	0.344	0.146	0.413	1.864	78%
2014	1.456	0.307	0.204	0.423	1.880	77%
2015	1.426	0.397	0.282	0.582	2.008	71%
2016	1.872	0.746	0.290	0.929	2.800	67%
2017	1.843	0.662	0.156	0.676	2.519	73%
2018	2.137	0.372	0.118	0.387	2.525	85%

Notes: Billion gallons except percent domestic which is reported as a percentage of total supply. Total net imports are net of RIN retirements for exports of biomass-based diesel.

It should now be clear that the tailwind provided to U.S. biodiesel producers by import duties in 2018 overpowered the headwind provided by SRE demand destruction. While it is true that SREs reduced biodiesel demand in 2018 (and 2017), the import duties more than offset this negative effect and allowed domestic producers to capture a large enough share of total supply that the absolute level of their production actually increased in 2018. Hence, we can conclude that the import duties were the main driver of the historically high profits of domestic biodiesel producers in 2018. Of course, the profits would have been even higher without the demand destruction caused by SREs, assuming the import duties remained in place.

Finally, it is helpful to aggregate the profit margins over an annual horizon in order to see broader trends in estimated biodiesel production profits. Figure 3 shows total annual (pre-tax) profits net of variable and fixed costs for each calendar year between 2007 and 2018. Profits are presented in terms of both total pre-tax net returns and percent return to equity. The total profit of the representative biodiesel plant in 2018 was \$8.3 million, or 35.1 percent. This was the third consecutive year of positive annual profits, the first time a three-year run of profits occurred in this sample period. We can also use the average net profit for the representative plant to make a rough estimate of the profit for the entire U.S. biodiesel industry in 2018. Assuming all plants in the industry earned a net profit of \$0.28 per gallon, then, total biodiesel production (including renewable diesel) for the U.S. in 2018 of 2.137 billion gallons implies aggregate industry (pre-tax) profits of \$600 million. Again, it is important to emphasize that this estimate does not account for revenue that may eventually be earned via a retroactively reinstated biodiesel tax credit.



The average percent return to equity holders provides useful information on the attractiveness of investment in biodiesel plants relative to other investments. The average return was 12.4 percent over 2007-2018 and the standard deviation, a measure of risk, was 28.2 percent. By comparison, the average return for the stock market over this period, [as measured by the S&P 500](#), was 8.7 percent and the associated standard deviation was 17.7 percent. The ratio of average return to standard deviation provides one measuring stick of an investment's return-risk attractiveness, and on this measure the ratio for biodiesel investment, 0.44, is only slightly lower than the stock market as a whole, 0.49.

Implications

Headlines about the biofuels industry in 2018 were dominated by the bitter debate over the impact of small refinery exemptions (SREs) on demand. While this undoubtedly created a substantial headwind for biodiesel producers, at the same time, import duties created a substantial tailwind for these producers. We examine the profitability of biodiesel production in this article to determine whether the headwind or the tailwind dominated in 2018. The total profit of a representative biodiesel plant in 2018 is estimated to be \$8.3 million, or 35.1 percent. This is the third highest annual profit for the representative plant since 2007, which indicates that the tailwind provided by import duties dominated the headwind provided by SRE demand destruction. Of course, biodiesel production profits would have been even higher without the demand destruction caused by SREs, assuming the import duties remained in place.

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