# PROJECTIONS OF U.S. PRODUCTION OF BIODIESEL FEEDSTOCK

By Wade Brorsen*

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***Executive Summary***

*The EPA has proposed volume mandates for the Renewable Fuel Standard that in 2016 call for increased biomass-based diesel use of between 100M gallons/year and 300M gallons/year depending on how much of the advanced biofuel mandate is filled by biomass-based diesel. Even making some generous assumptions about trends in production and use, the growth in biodiesel feedstock in the United States is projected to be only enough to support an annual increase in biodiesel production of 29M gallons from 2015 to 2016. Thus, the mandates can only be filled by bidding stocks away from other uses. The United States does not have adequate domestic supplies of biodiesel feedstock to meet current needs and so it has had to rely on imports and will have to rely on imports even more if mandates are increased; this is contrary to the goals of energy security and domestic rural development of the Energy Independence and Security Act of 2007. Mandates create an inelastic demand and so these mandates are once again putting us one drought away from a run-up in prices like we had in 2008.*

*Wade Brorsen is Regents Professor and A.J. and Susan Jacques Chair, Department of Agricultural Economics, Oklahoma State University. He previously served as editor of the *American Journal of Agricultural Economics*, is a Fellow of the Agricultural and Applied Economics Association, and is the next President-Elect of the Western Agricultural Economics Association.

## Introduction

The Environmental Protection Agency (EPA) recently announced plans to increase the biomass-based diesel (BBD) mandate of the Renewable Fuel Standard by about 70M gallons in 2015 and 100M gallons in 2016 and the advanced biofuel mandate by 220M gallons in 2015 and 500M gallons in 2016. The advanced biofuel mandate will be mostly filled by either biodiesel (and renewable diesel) or imported sugarcane ethanol. Biodiesel is credited with 1.5 advanced biofuel RINs per gallon, so it would take 480M gallons of biodiesel to meet the two-year advanced biofuel requirement. Due to the E10 blend wall for ethanol, in the short run, much of the advanced biofuel mandate may be filled by biodiesel.

The U.S. has plenty of biodiesel production capacity and there is no issue of a blend wall with biodiesel on a national level. The constraint with biodiesel is adequate feedstock.

The EPA has to determine the quantity of biodiesel that is appropriate. This determination is largely left up to the discretion of the administrator of the EPA. The relevant guidance in the law (see section o.2.B.ii.I https://www.law.cornell.edu/uscode/text/42/7545) is that the volume should be

> *…determined by the Administrator, in coordination with the Secretary of Energy and the Secretary of Agriculture, based on a review of the implementation of the program during calendar years specified in the tables, and an analysis of—*
>
> ***(I)*** *the impact of the production and use of renewable fuels on the environment, including on air quality, climate change, conversion of wetlands, ecosystems, wildlife habitat, water quality, and water supply;*
>
> ***(II)*** *the impact of renewable fuels on the energy security of the United States;*
>
> ***(III)*** *the expected annual rate of future commercial production of renewable fuels, including advanced biofuels in each category (cellulosic biofuel and biomass-based diesel);*
>
> ***(IV)*** *the impact of renewable fuels on the infrastructure of the United States, including deliverability of materials, goods, and products other than renewable fuel, and the sufficiency of infrastructure to deliver and use renewable fuel;*
>
> ***(V)*** *the impact of the use of renewable fuels on the cost to consumers of transportation fuel and on the cost to transport goods; and*
>
> ***(VI)*** *the impact of the use of renewable fuels on other factors, including job creation, the price and supply of agricultural commodities, rural economic development, and food prices.*

In regard to setting the BBD mandate, the key part of the law is section (VI). This report seeks to help EPA determine how much biodiesel can be used that is consistent with these guidelines. What is a reasonable target for biodiesel and advanced biofuels? Where would the feedstock come from? The objective here is to project how much biodiesel feedstock is available without a significant increase in price. Is it consistent with the law to continue to increase the biomass-based diesel and advanced biofuel mandates by 100M and 500M gallons per year for the next several years? The focus is on U.S. production of biodiesel feedstock.

Another concern is that mandates make the demand for biofuel perfectly inelastic. Food and other uses must absorb all of the supply shocks. The mandates make food prices volatile. Mandates contributed to the steep rise of food prices in 2008. Grain prices are relatively low now. We are currently experiencing favorable weather. What happens when we return to less favorable weather conditions?

### Historical Biodiesel Production and Feedstock Use

Table 1 provides U.S. biodiesel supply and disappearance for the most recent five years. Production has grown rapidly over this time period. One concern is the rapid growth in imports in the last two years. Imports in these two years were nearly 18% of total use. This is a concern because if raising the biodiesel mandate only results in increased imports, then it is not meeting the energy security and rural economic development goals of the law. Another thing that Table 1 shows is that increases of 300M gallons a year or even 100M gallons are very large increases.

**Table 1. U.S. Biodiesel Supply and Disappearance (1,000 gallons)**

| | Supply | | | | Disappearance | |
|---|---|---|---|---|---|---|
| Calendar Year | Beginning Stocks | Production | Imports | Total | Total | Ending Stocks |
| 2010 | 29,862 | 343,445 | 23,686 | 396,993 | 368,769 | 28,224 |
| 2011 | 28,224 | 967,481 | 37,396 | 1,033,101 | 948,613 | 84,488 |
| 2012 | 84,488 | 990,712 | 35,826 | 1,111,026 | 1,023,525 | 87,501 |
| 2013 | 87,501 | 1,359,456 | 342,384 | 1,789,341 | 1,600,101 | 189,240 |
| 2014 | 189,240 | 1,239,959 | 212,478 | 1,641,677 | 1,501,329 | 140,348 |

Source: USDA ERS, http://www.ers.usda.gov/data-products/us-bioenergy-statistics.aspx, Table 4

Note: These are calendar year values. Marketing years show a more consistent trend.

Table 2 shows the inputs to U.S. biodiesel production during the last five years. Soybean oil dominates as it provides over half of the feedstock. The other three large sources are canola oil, corn oil, and yellow grease. The report will next consider each of these four input sources as well as other sources.

**Table 2. U.S. Inputs to Biodiesel Production (Million pounds)**

| | | | | Calendar Year | | |
|---|---|---|---|---|---|---|
| Category | Input | 2010 | 2011 | 2012 | 2013 | 2014 |
| Vegetable oils | Canola oil | 246 | 847 | 790 | 646 | 1,046 |
| | Corn oil | 112 | 304 | 646 | 1,068 | 970 |
| | Cottonseed oil | W | W | - | - | - |
| | Palm oil | W | W | W | 632 | 63 |
| | Soybean oil | 1,141 | 4,153 | 4,042 | 5,507 | 4,802 |
| | Other | W | W | W | W | 96 |
| Animal fats | Poultry | 100 | 240 | 176 | 160 | 173 |
| | Tallow | 170 | 431 | 385 | 465 | 355 |
| | White grease | 333 | 533 | 408 | 468 | 427 |
| | Other | 42 | 85 | 48 | W | 30 |
| Recycled | Yellow grease | 246 | 471 | 670 | 1,046 | 1,074 |
| | Other | 40 | 195 | 289 | 310 | 186 |
| | Algae | - | - | - | (s) | 1 |
| Other | | 33 | 27 | 1 | W | 151 |

Source: U.S. Energy Information Administration Table 3
- = No data reported
W = Withheld to avoid disclosure of individual company data.
(s) = Value is less than 0.5 of the table metric, but value is included in any associated total.
Totals may not equal the sum of components due to independent rounding.
Note: It takes roughly 7.7 pounds of oil to produce 1 gallon of biodiesel (USDA 2002).
The totals in this table are roughly 7.6 pounds for each gallon produced in Table 1.

**Prediction Method for Soy and Canola Oil**

The same method was used to predict future soy oil and canola oil production. The method was not used for other categories either due to lack of data or in the case of corn oil that the capacity for expansion was limited. Forecast literature shows that a combination of forecast methods often beats a single forecast method (Bates and Granger 1969). Two forecast methods were used and the final forecast is the average of the two forecasts. Both methods use the most recent twelve years of data. One method is a linear trend model. The other method is an autoregressive integrated moving average (ARIMA) model. The model used was an ARIMA(1,1,0) so that it was in first differences and used one lag. Time series models like ARIMA models have been shown to produce more accurate forecasts than large econometric models (Allen 1994).

**Soy Oil**

Soybean oil has historically been one of the cheaper vegetable oils and this along with the large quantities produced has contributed to its extensive use as feedstock for biodiesel. As a legume, soybean production has the advantage of not requiring added nitrogen. Soy oil is the only domestic source of vegetable oil that has production large enough to support much growth in biodiesel.

The problem with soy oil is that supply and demand are not very responsive to price. Soybeans are only 18-20% oil, so the price of soybeans and the value of crushing them is determined more by soybean meal prices than by oil prices. In a review of multiple studies, Okrent and Alston (2011) find that food demand as a whole is inelastic and the conditional demand for fats and oils is inelastic. Soy oil is a small part of the price of many dishes and so it is difficult to bid away soy oil away from food consumption. All soy oil is currently being consumed either in food or a variety of other products such as cosmetics and is not freely available for biodiesel production. With population increases, soy oil consumption for uses other than biodiesel can be expected to increase.

Another limitation to expanding soy oil production is that the mandates for corn ethanol are also increasing. Corn and soybeans are typically grown in a rotation where corn is grown either every other year or two out of three years. The corn ethanol program creates an incentive to grow more corn and less soybeans. Further, the dried distiller's grain (DDG) that is a byproduct of corn distilling is 30-35% protein and so feeding DDGs reduces the demand for soybean meal.

Exports of soy oil are expected to be 2,000 million pounds in 2015. This amount would translate into 260M gallons of biodiesel. The soy oil that is currently exported would have to be bid away from its current use and so would not be available without a significant increase in price. Reducing exports does provide a potential source of domestic biodiesel feedstock and so they are relevant to the issue of adequate domestic supply. Even if the entire amount of soy exports could be diverted to domestic biodiesel production, it would only provide a one-time increase in feedstock supply and would not support increasing biodiesel production in future years.

Table 3 provides historical U.S. production of soy oil and a projection of soy oil production out to 2019. Soy oil production has been relatively constant over the last twelve years, but does have a slight upward trend. The projection is based on this upward trend continuing.

The projection is that soy oil production will increase at approximately 0.94% a year. With U.S. population only increasing at a rate 0.77% a year, soy oil offers a small source of increased feedstock for biodiesel production. This 0.17% difference in growth rates can provide growth of about 5M gallons of biodiesel a year.

**Table 3. U.S. Soybean Oil Balance Sheet Data (million pounds)**

| Crop Year | Production | Imports | Domestic Use | Biodiesel | Exports |
|---|---|---|---|---|---|
| 2004 | 19,360 | 26 | 17,439 | 445 | 1,324 |
| 2005 | 20,387 | 35 | 17,959 | 1,555 | 1,153 |
| 2006 | 20,489 | 37 | 18,574 | 2,761 | 1,877 |
| 2007 | 20,580 | 65 | 18,335 | 3,245 | 2,911 |
| 2008 | 18,745 | 90 | 16,265 | 2,069 | 2,193 |
| 2009 | 19,615 | 103 | 15,814 | 1,680 | 3,359 |
| 2010 | 18,888 | 159 | 16,794 | 2,737 | 3,233 |
| 2011 | 19,740 | 149 | 18,310 | 4,874 | 1,464 |
| 2012 | 19,820 | 196 | 18,687 | 4,689 | 2,164 |
| 2013 | 20,130 | 165 | 18,958 | 5,010 | 1,877 |
| 2014 | 20,905 | 225 | 19,000 | 5,000 | 1,900 |
| 2015 | 21,270 | 175 | 19,300 | 5,100 | 2,000 |
| 2016 | 21,030 | | | | |
| 2017 | 21,228 | | | | |
| 2018 | 21,424 | | | | |
| 2019 | 21,621 | | | | |

Source: USDA Economic Research Service, http://www.ers.usda.gov/data-products/us-bioenergy-statistics.aspx for 2004-2013. The July 2015 WASDE report is used for 2014 and 2015. The years 2016-2019 are projected.

**Canola Oil**

Canola is approximately 40 percent oil and 60 percent meal, and the price of canola oil was 3.72 times that of canola meal from 2011 to 2013 (USDA, 2013). Canola oil price is higher than that of soy oil. Canola meal is less valuable than soybean meal due to its lower protein content. So canola oil has a much larger effect on the price of canola than soy oil does on the price of soybeans. Canola is often grown on the same land as wheat. With wheat prices low, there is a potential to bid land away from wheat production and into canola. There is perhaps more potential to increase the production of canola oil than any other feedstock.

All biodiesels do poorly in cold weather, but biodiesel from canola does better than the others. Since it produces a superior biodiesel, canola oil price will remain above the price of soy oil. Canola is a heavy user of nitrogen fertilizer, but because of its high oil content, it still has an energy balance sufficient to qualify as an advanced biofuel.

While production of canola oil has been growing rapidly, about two-thirds of domestic consumption is imported. Biodiesel use is already more than half of domestic production.

As Table 4 shows, canola oil production is expected to continue to grow over the next five years at an average rate of 73M pounds a year. About 12M pounds a year are needed to cover population growth; if all of the remaining growth were used for biodiesel, it would support an increase of about 8M gallons a year.

**Table 4. U.S. Canola Oil Balance Sheet Data (million pounds)**

| Crop Year | Production | Imports | Domestic Use | Exports |
|---|---|---|---|---|
| 2004 | 832 | 1,133 | 1,660 | 269 |
| 2005 | 928 | 1,598 | 1,919 | 471 |
| 2006 | 932 | 1,568 | 1,985 | 630 |
| 2007 | 1,015 | 2,241 | 2,923 | 349 |
| 2008 | 1,105 | 2,315 | 2,833 | 549 |
| 2009 | 1,078 | 2,351 | 2,854 | 553 |
| 2010 | 1,154 | 3,131 | 3,669 | 511 |
| 2011 | 1,115 | 3,289 | 3,851 | 664 |
| 2012 | 1,269 | 2,761 | 3,602 | 475 |
| 2013 | 1,591 | 3,391 | 4,584 | 262 |
| 2014 | 1,712 | 3,651 | 5,221 | 165 |
| 2015 | 1,718 | | | |
| 2016 | 1,808 | | | |
| 2017 | 1,897 | | | |
| 2018 | 1,986 | | | |
| 2019 | 2,076 | | | |

Source: USDA Economic Research Service, http://www.ers.usda.gov/data-products/us-bioenergy-statistics.aspx for 2004-2014. The years 2015-2019 are projected.

The U.S. and Canadian markets are closely linked so it is useful to examine Canadian canola oil production. Canada is the world's largest producer of canola. The United States is the second largest importer of Canadian canola oil with China being the largest. Due to poor crop conditions, production of canola in Canada in 2015 is projected to drop for the second year in a row (FAS 2015). In contrast, Canadian canola oil production has been steady over the last three years (Table 5). Canadian canola oil is not projected to be a ready source of increased biodiesel feedstock.

**Table 5. Canada Canola Oil Balance Sheet (million pounds)**

| Marketing Year | Production | Imports | Exports | Domestic Consumption | Ending Stocks |
|---|---|---|---|---|---|
| 2013/14 | 6,832 | 186 | 5,260 | 1,445 | 5,840 |
| 2014/15 | 6,854 | 168 | 5,376 | 1,490 | 5,114 |
| 2015/16 | 6,899 | 168 | 5,533 | 1,557 | 3,799 |

Source: FAS (2015)
http://apps.fas.usda.gov/psdonline/psdReport.aspx?hidReportRetrievalName=Table+12%3a+Rapeseed+and+Products%3a+World+Supply+and+Distribution&hidReportRetrievalID=711&hidReportRetrievalTemplateID=11

**Corn Oil**

Corn oil production has shown tremendous growth, but has leveled off in the last few years. The numbers in Table 6 include both edible and inedible corn oil. Edible corn oil requires a more expensive refining process and so edible corn oil is not used for biodiesel. Much of the growth has been in inedible corn oil as corn ethanol plants have adopted processes that allow extracting inedible corn oil. The competing use of inedible corn oil is animal feed. Much of the adoption of corn oil extraction at ethanol plants has already taken place (Jessen 2013) and that is why growth has leveled off.

Using the same growth rate as the last four years, gives a predicted growth of 10M pounds, which could support growth in biodiesel production of 1M gallons a year.

**Table 6. U.S. Corn Oil Balance Sheet Data (million pounds)**

| Crop Year | Production | Imports | Domestic Use | Exports |
|---|---|---|---|---|
| 2004 | 2,396 | 49 | 1,653 | 789 |
| 2005 | 2,483 | 45 | 1,685 | 799 |
| 2006 | 2,560 | 43 | 1,832 | 793 |
| 2007 | 2,507 | 45 | 1,756 | 769 |
| 2008 | 2,418 | 43 | 1,568 | 814 |
| 2009 | 2,485 | 37 | 1,895 | 774 |
| 2010 | 3,850 | 48 | 3,005 | 792 |
| 2011 | 4,225 | 46 | 3,342 | 1,003 |
| 2012 | 4,125 | 60 | 3,160 | 1,025 |
| 2013 | 4,500 | 42 | 3,543 | 1,000 |
| 2014 | 4,450 | 40 | 3,690 | 800 |
| 2015 | 4,459 | | | |
| 2016 | 4,469 | | | |
| 2017 | 4,478 | | | |
| 2018 | 4,487 | | | |
| 2019 | 4,497 | | | |

Source: USDA Economic Research Service, http://www.ers.usda.gov/data-products/us-bioenergy-statistics.aspx for 2004-2014. The years 2015-2019 are projected.
Note: These data include both edible and inedible corn oil and only inedible corn oil is normally used for biodiesel production.

**Other Oils**

Other oils could add small amounts to biodiesel feedstock. Table 2 shows 96M pounds of other oils used in 2014. It also shows no cottonseed oil. Sunflower oil is produced in the United States. But, its price is double that of soy oil so it is not going to be a major source of biodiesel. Information on these other oils is limited. If a 3% growth rate is used that would add feedstock for about 0.5M gallons of biodiesel a year. Even if these grow much faster, they are not going to be a major source of supply.

## Yellow Grease

Yellow grease is mostly used cooking oils. It has less than 15% free fatty acids. The free fatty acids complicate the distillation process (Van Gerpen 2014), but the problem has been solved sufficiently that substantial quantities are being used to produce biodiesel. Collecting used cooking oils from restaurants is not new. Van Gerpen argues, "used cooking oil is not really a waste product" and "there is already a market for used cooking oil." These recycled oils have mostly been used in animal feed.

As Table 7 shows, the production of yellow grease has been relatively steady over time. Much cooking oil is used at home and the economies of size needed to collect such a low value product is not present. Certainly, there are examples of cities that collect used oils at recycling centers and other efforts to collect used cooking oils, but so far they are not having enough impact to move the total volume of yellow grease. We cannot expect much of the cooking oil used at home to be used to produce biodiesel.

Yellow grease is a mature market. It may not have that much more room to grow. Biodiesel currently uses half of yellow grease produced (EIA; Swisher 2015). This amount of yellow grease is enough to produce about 140M gallons of biodiesel. While yellow grease use in biodiesel production has grown quickly, it is unlikely to continue this rate of growth. An 8%/year increase would provide feedstock for an increase of 11M gallons of biodiesel a year. This increase would come from reducing the amount of yellow grease going to animal feeds. The amount going to biodiesel may continue to increase, but the size of these increases is going to tail off as it becomes difficult to bid yellow grease away from other uses.

## Animal Fats

Animal fats have been a major contributor to biodiesel with a total of 986M pounds of feedstock in 2014. Animal fats are a small part of animal value, so there is not going to be much price response. Per capita consumption of meat in the United States continues to trend downward (ERS 2015). Consistent with this, Table 7 shows a slight downward trend in the rendering of animal fats. There is little potential for increasing the total quantity of animal fats, so biodiesel would have to bid animal fats away from other uses. These other uses include livestock feed (especially poultry), pet foods, and the oleochemical industry as well as edible products (Swisher 2015). Swisher describes pet foods and aquaculture, where fats and oils are replacing fish meal, as growth areas for the rendering industry. If we generously assume that the total quantity of animal fats stays the same and that the proportion devoted to biodiesel increases 3%/year that would provide for a growth rate of about 4M gallons of biodiesel. Animal fats are an unlikely area for much growth.

**Table 7. U.S. Production, Consumption, and Export of Rendered Products, 2009-2014 (M lbs.)**

| Category | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|
| **Production** | | | | | | |
| Inedible tallow | 3,375 | 3,332 | 3,278 | 3,204 | 3,179 | 2,991 |
| Edible tallow | 1,837 | 1,825 | 1,955 | 1,790 | 1,776 | 1,627 |
| Yellow grease | 1,924 | 1,915 | 1,998 | 1,950 | 1,986 | 2,054 |
| White grease | 1,293 | 1,263 | 1,280 | 1,310 | 1,302 | 1,282 |
| Poultry fat | 1,010 | 1,039 | 1,048 | 1,047 | 1,062 | 1,076 |
| **Total Production** | 9,440 | 9,373 | 9,559 | 9,300 | 9,306 | 9,030 |
| **Methyl Esther** | | | | | | |
| White grease | 334 | 333 | 533 | 408 | 468 | 427 |
| Tallow | 531 | 170 | 431 | 385 | 452 | 355 |
| Poultry fat | 135 | 100 | 240 | 176 | 160 | 174 |
| Other animal fat | 69 | 42 | 85 | 48 | NA | 30 |
| Yellow grease | 156 | 246 | 471 | 670 | 977 | 1,074 |
| Other recycled oil | 14 | 40 | 195 | 289 | 304 | 186 |
| **Total Methyl Esther** | 1,239 | 931 | 1,955 | 1,976 | 2,361 | 2,246 |
| **Total Use** | 6,623 | 5,432 | 5,102 | 5,362 | 5,350 | 5,198 |
| **Exports** | 2,817 | 3,192 | 2,672 | 2,294 | 1,898 | 1,802 |

Source: Swisher (2015) *Render* magazine

### Other Recycled Feeds

Table 2 and Table 7 show 186 M pounds of other recycled feeds. This category had some growth, but fell substantially in 2014. Somewhere in this category is trap grease. Trap grease would be a desirable feedstock as its alternative use is to be taken to a landfill. Trap grease has greater than 15% free fatty acids and often has impurities. The cost of collecting and refining trap grease is what has caused it to be taken to the landfill in the past (Van Gerpen 2014). A number of efforts are underway to collect and process more trap grease. There is considerable uncertainty about the potential to increase the use of trap grease for biodiesel production. It has not happened yet on any large scale. This category may continue to grow. If we assume that it grows at 3%/year that would provide for a growth in biodiesel production of about 1M gallons/year.

### Imports

As argued in the discussion so far, there are really only two places to get the feedstock to increase biodiesel production by 100M or 300M gallons even in a single year: soy oil and imports. In recent years, more of the imports have been in the form of biodiesel rather than feedstock. Whether future imports are biodiesel or feedstock will depend on policies in the United States as well as other countries. The three countries providing the most biodiesel imports are Argentina, Indonesia, and Canada.

One criteria that EPA must consider is "adequate domestic supplies." Table 8 provides a summary of how much will need to be imported to meet the proposed biodiesel mandates (the deficit). As Table 8 shows, the United States already does not have adequate domestic supplies of biodiesel feedstock to meet domestic use as well as biodiesel mandates. The U.S. already imports considerable canola oil and biodiesel. The numbers in Table 8 may even overestimate available stocks as the exports of edible corn oil and some of the rendered products are too valuable to be used for biodiesel. The imports required to meet the mandates would continue to grow. As Table 8 shows the United States does not have adequate domestic supplies of biodiesel feedstock to meet the proposed biodiesel mandates. If biodiesel fills the advanced biofuel mandates as expected, the deficit will rise even more. For example, if biodiesel must fill the advanced mandates projected in Table 9, the deficit would be 4,872 M lbs. in 2016 and would grow to 11,448 M lbs. for 2019.

**Table 8. Summary of Projected Availability of Biodiesel Feedstock (M lbs)**

| | Soy, Canola, and Corn Oil[a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Calendar Year | Production | Non-biofuel use | Available for biodiesel | Rendered Products[b] | Other[c] | Total Availability for biodiesel | Biomass-Based Diesel Mandate[d] | Deficit |
| 2015 | 27,353 | 20,414 | 6,938 | 4,048 | 255 | 11,242 | 13,090 | 1,848 |
| 2016 | 27,341 | 20,586 | 6,755 | 4,048 | 263 | 11,067 | 13,860 | 2,793 |
| 2017 | 27,529 | 20,734 | 6,794 | 4,048 | 271 | 11,114 | 14,630 | 3,516 |
| 2018 | 27,824 | 20,884 | 6,940 | 4,048 | 279 | 11,268 | 15,400 | 4,132 |
| 2019 | 28,119 | 21,034 | 7,085 | 4,048 | 287 | 11,421 | 16,170 | 4,749 |

[a]Data for marketing years was converted to calendar years using a weighted average.

[b]The rendered products column is the sum of biodiesel use and exports in 2014 from Table 6. It includes yellow grease and animal fats. It is held constant here.

[c]The other category includes the Table 2 categories Other, Other Vegetable Oils, and Algae. These are assumed to grow at a rate of 3 percent.

[d]Mandated biomass-based diesel volumes in 2018 and 2019 are assumed here to follow the trend of EPA's proposal for 2015-2017.

**Summary of Predicted Feedstock Availability**

This study set out to answer the question: How much feedstock is available to be used for biodiesel production without a substantial increase in price. The real answer to this question is none. So, the question answered instead is: if past production trends continue, how much feedstock could be available for biodiesel production? Under some generous assumptions, the answer is enough to increase biodiesel production by 29M gallons in 2016, but annual growth in feedstock availability is projected to decrease in following years. Table 9 shows the shortages that would need to be filled under alternative mandate levels if past trends in increased production and use continue. Effects of the mandates in the short run will be moderated as there are sources such as a reduction in exports of soy oil, available stocks, and carryover RINs.

Drought conditions will return some time in the next few years. Even without a drought, the only way to meet the mandate is higher prices to bid stocks away from other uses and to provide an incentive to import biodiesel or biodiesel feedstock.

**Table 9. Summary of EPA Mandates and Available Feedstock**

| Year | Mandated Cumulative Biodiesel Growth above 2014 Volumes (M Gal)[b] | Available Feedstock from Growth (M Gallons): Soy Oil | Canola | Corn Oil | Yellow Grease | Other | Total Growth in Feedstock Availability above 2014 | Deficit: Million Gallons | M lbs. Oil[a] |
|---|---|---|---|---|---|---|---|---|---|
| **Biodiesel Mandate** | | | | | | | | | |
| 2015 | 70 | 5 | 8 | 1 | 11 | 5 | 30 | 40 | 308 |
| 2016 | 170 | 10 | 16 | 2 | 20 | 11 | 59 | 111 | 855 |
| 2017 | 270 | 15 | 24 | 3 | 26 | 16 | 84 | 186 | 1,432 |
| 2018 | 370 | 20 | 32 | 4 | 31 | 22 | 109 | 261 | 2,010 |
| 2019 | 470 | 25 | 40 | 5 | 35 | 27 | 132 | 338 | 2,603 |
| **Advanced Mandate** | | | | | | | | | |
| 2015 | 140 | 5 | 8 | 1 | 11 | 5 | 30 | 110 | 847 |
| 2016 | 440 | 10 | 16 | 2 | 20 | 11 | 59 | 381 | 2,934 |
| 2017 | 740 | 15 | 24 | 3 | 26 | 16 | 84 | 656 | 5,051 |
| 2018 | 1040 | 20 | 32 | 4 | 31 | 22 | 109 | 931 | 7,169 |
| 2019 | 1340 | 25 | 40 | 5 | 35 | 27 | 132 | 1,208 | 9,302 |

Note: A portion of the advanced mandate is assumed to be filled by other advanced biofuels. The numbers used here are derived using the expected changes. For yellow grease and other, these trends include increased use for biodiesel. Table 8, however, only includes expected production.

[a]One gallon of diesel is assumed to require 7.7 pounds of oil (USDA 2002).

[b]Mandated biomass-based diesel volumes in 2018 and 2019 are assumed here to follow the trend of EPA's proposal for 2015-2017.

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