THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

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July 27, 2015

RE: International Council on Clean Transportation comments on "Renewable Fuel Standard Program: Standards for 2014, 2015, and 2016 and Biomass-Based Diesel Volume for 2017" Notice of Proposed Rulemaking (EPA–HQ–OAR–2015-0111; FRL–9927-28-OAR)

These comments are submitted by the International Council on Clean Transportation (ICCT). The ICCT is an independent nonprofit organization founded to provide unbiased research and technical analysis to environmental regulators. Our mission is to improve the environmental performance and energy efficiency of road, marine, and air transportation, in order to benefit public health and mitigate climate change. We promote best practices and comprehensive solutions to increase vehicle efficiency, increase the sustainability of alternative fuels, reduce pollution from the in-use fleet, and curtail emissions of local air pollutants and greenhouse gases (GHG) from international goods movement.

The ICCT welcomes the opportunity to provide comments on the U.S. EPA Renewable Fuel Standard (RFS) program. We commend the agency for its continuing efforts to promote a cleaner, lower-carbon transportation sector that uses less petroleum-based fuels. As we have commented before, the RFS program has set strong standards with thorough, comprehensive scientific analyses and rigorous life-cycle emission accounting. This proposed rule builds upon the impressive steps EPA has undertaken to promote low-carbon biofuels. The comments below offer a number of technical observations and recommendations for EPA to consider in its continued efforts to strengthen the program and maximize the program's benefits in mitigating the risks of climate change and reducing petroleum use.

We would be glad to clarify or elaborate on any points made in the below comments. If there are any questions, EPA staff can feel free to contact Dr. Stephanie Searle (stephanie@theicct.org) and Dr. Chris Malins (chris@theicct.org).

Nic Lutsey

Program Director

International Council on Clean Transportation

Summary of comments

ICCT commends EPA for its commitment to strengthening the RFS2 program and getting it back on schedule despite challenges experienced due to the slower than hoped-for development of cellulosic biofuel production and the practical limits imposed by the E10 blend wall. While in general we support EPA's approach to determining annual volumes for the RFS2, we would recommend the following changes to the proposed rule, which we believe would strengthen the program.

Firstly, we believe that it would be appropriate for EPA to use a less conservative methodology in setting cellulosic volumes for 2015 and 2016, particularly with respect to cellulosic biogas. The RFS2 program should play a key role in supporting growth in the cellulosic biofuel industry. The current proposal applies the same formula for expected future production to biogas CNG/LNG production as to expected production of other cellulosic fuels. However, the technology required to supply cellulosic biogas into the transport market is well demonstrated, and therefore less conservatism is necessary when assessing claims from these producers. The cellulosic category is the most important for driving deep greenhouse gas reductions through the RFS2, and it is therefore vital that EPA should not be excessively conservative in setting future volume mandates.

Secondly, the proposed mandate volumes for biomass-based diesel (BBD) for 2015-2017 are inconsistent with likely availability of biomass-based diesel feedstock in that period. Analysis by Brorsen (2015) of the expected growth in BBD feedstock availability to 2017 shows that domestic supplies will not be adequate to meet the proposed growth rates. EPA is required by statute to consider the effect of BBD volumes on the supply and price of agricultural commodities in the U.S. Brorsen finds that, even given generous assumptions about growth in oils and fats, projected supply of BBD feedstock will be insufficient to meet EPA's proposed BBD volumes without having a significant negative impact on supplies and prices of these commodities. It would therefore be appropriate for the rate of growth in BBD volumes to be revised to reflect likely feedstock supply. The proposed advanced biofuel and renewable fuel volumes would very likely require higher levels of BBD consumption than the actual BBD mandate. We therefore suggest reducing the proposed advanced biofuel and renewable fuel volumes further by applying the entire cellulosic waiver to advanced biofuel and making a corresponding reduction in renewable fuel. This would maintain the intended level of support for the penetration of higher blends of ethanol without jeopardizing oil and fat supplies in the U.S.

Our suggested adjustments to the proposed volumes are shown in Table S-1.

Table S-1: Suggested RFS2 annual volumes in billion gallons per year for 2015 and 2016 and biomass-based diesel volume for 2017 (compared to EPA's proposed volumes).

FUEL CATEGORY	2015	2016	2017
Cellulosic biofuel	0.106+* (0.106)	0.206+* (0.206)	N/A
Biomass-based diesel	1.66 (1.70)	1.689 (1.80)	1.714 (1.90)
Advanced biofuel	2.606 (2.90)	3.206 (3.40)	N/A
Renewable fuel	16.006 (16.30)	17.206 (17.40)	N/A

**We suggest EPA use a less conservative methodology for estimating cellulosic biogas volumes.*

Finally, we also strongly support EPA's proposal to clarify that the existing RFS2 pathway for algal biofuels applies only to photosynthetically grown (autotrophic) algae. Biofuels from heterotrophic algae may have significantly different lifecycle greenhouse gas emissions, given in particular that the carbon intensity of the feedstock fed to heterotrophic algae should be included in the lifecycle assessment, and so should be assessed under a different pathway.

Cellulosic volumes

EPA has analyzed the likely production ranges for groups of cellulosic biofuel producers and has proposed to use the 50th percentile for commercial-scale facilities and the 25th percentile for facilities that have not yet achieved commercial-scale production. A very large fraction of expected cellulosic biofuel production is biogas (for instance, 86% of the high end of the EPA range for 2016), which is an established technology facing significantly less technology risk than is faced by production of cellulosic ethanol and synthetic fuels.

The proposal notes that:

> *In previous years EPA has gathered information, including volume production projections, from companies with the potential to produce cellulosic biofuel. Each of these companies supported these projections with successful pilot and demonstration-scale facilities as well as other supporting documentation. In each of these cases the companies were unable to meet their own volume projections, and in many cases were unable to produce any RIN-generating cellulosic biofuel.*
>
> *The inability of cellulosic biofuel producers in previous years to achieve their projection production targets does not provide a sufficient basis for completely discounting production of cellulosic biofuel in future years, either for these same facilities that were previously unable to achieve their target projections or from new facilities expected to start-up in 2015 or 2016. Each of these companies is an individual case, with their own production technologies, construction and operations staffs, and financial situations, and we do not believe it is appropriate to dismiss all future potential cellulosic biofuel production because of the failure of several facilities to successfully operate at commercial scale. We do believe it strongly suggests that we should view the individual company projections as something other than the most likely outcomes.*

This context of disappointing performance against companies' own production goals is used in setting the predicted production for established facilities at the 50th percentile of the EPA predicted range, and for new companies at the 25th percentile. However, biogas facilities do not face these same barriers to ramp up and commercialization, as noted by Dallas Burkholder in his memo to EPA "Assessment of Cellulosic Biofuel Production from Biogas":

> *The vast majority of "new" facilities generating RINs for CNG/LNG derived from biogas already have a significant history of producing CNG/LNG for non-transportation markets. All that is necessary for many of these companies to begin generating RINs is to register the facilities and demonstrate that the CNG/LNG being produced is from approved sources and is used as transportation fuel. They do not face the same ramp-up schedule or uncertainties as newly constructed facilities operating new technologies.*

While we agree that there remains uncertainty associated with the capacity of new facilities to access the transport fuel market and start generating RINs, we do not agree that it is appropriate to set the same percentile expectations for new cellulosic technologies as for biogas supply. The cellulosic RIN represents a substantial incentive to supply biogas into the transport market, and the biogas industry has demonstrated its ability to rapidly scale up supply to take advantage of the RIN since it became available. We therefore believe that the 75th percentile of the EPA determined range is a more appropriate production estimate for the biogas facilities identified as already delivering RINs on a commercial scale, and that the 50th percentile would be appropriate for biogas facilities without that track record. Undue conservatism in the assessment of RIN generation by CNG/LNG could trigger a vicious circle in which commercialization of truly new technologies for cellulosic biofuel is undermined by low mandates and strong biogas supply, and in which low expectations become a self-fulfilling prophecy. We agree that it will be appropriate to reassess the percentiles used for future production projections when setting mandates in future years.

Biomass-based diesel volumes

EPA has proposed volumes for biomass-based diesel (BBD) for 2014-2017 that increase by about 100 million biodiesel-equivalent gallons each year. This rate of increase in volumes is faster than could be supported by domestic feedstock availability, and therefore would imply increased imports with attendant disruption to existing markets. The mandated volumes should be revised downward to be more consistent with projected BBD feedstock supply.

EPA is required by statute to set BBD volumes at one billion gallons or greater for all years after 2012, and in setting these volumes, to consider a variety of factors. Section 202 (a) (2) (B) (ii) of EISA (2007), which applies to BBD volumes under the RFS, reads as follows (our emphasis):

> *"OTHER CALENDAR YEARS.—For the purposes of subparagraph (A), the applicable volumes of each fuel specified in the tables in clause (i) for calendar years after the calendar years specified in the tables shall 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."*

A recent study by economist Wade Brorsen (2015; included as an Appendix to these comments) provides new information relevant to the assessment of the impact on the price and supply of agricultural commodities. Brorsen examines the supply and demand of U.S. BBD feedstocks, and projects quantities that may be available for increased BBD production without causing a significant increase in prices or unduly affecting other uses of these feedstocks. This study covers all major BBD feedstocks, including: soy oil, canola oil, inedible corn oil, yellow grease, and other recycled feeds. The study projects supply growth of soy and canola oil from past trends and USDA forecasts, and allows growth in supply of "waste" fats and oils. These growth assumptions on waste oil availability may tend to the generous side. For example, Brorsen allows for 8% annual growth in used cooking oil collection, but the study is not able to provide evidence to confirm that such increases would be economically feasible. Brorsen concludes that annual growth in total BBD feedstock availability will be 30 million gallons in 2015, 29 million gallons in 2016, and 25 million gallons in 2017 (Table 9 from Brorsen, 2015).

Brorsen finds that EPA's proposed BBD volumes would result in a feedstock deficit of 186 million biodiesel-equivalent gallons in 2017 and a cumulative deficit of 337 million gallons over 2015-2017 (shown in Figure 1). The reason that feedstock availability is not great enough to support the proposed increases in BBD production is that these oils and fats have existing uses as food, animal feed, soaps, and other industrial uses. Brorsen argues that demand for food is particularly inelastic and it will be difficult to bid oils and fats away from food consumption without a significant increase in prices. On the waste oils side, Brorsen notes that used cooking oil collection from restaurants is a mature market with the recycled oils used for animal feed (where not already being used as BBD feedstock). Brorsen quotes Van Gerpen (2014), who notes that "used cooking oil is not really a waste product," and "there is already a market for used cooking oil." Brorsen argues that there is little room for expansion of collection of used cooking oil and other waste fats like trap grease because it is not currently economically viable to collect such a low value product from the disparate sources (e.g. households) available. In order to meet the proposed volumes, BBD production would have to bid feedstocks away from other uses, significantly impacting the supply of oils and fats in the U.S. for other uses and increasing prices of these commodities.

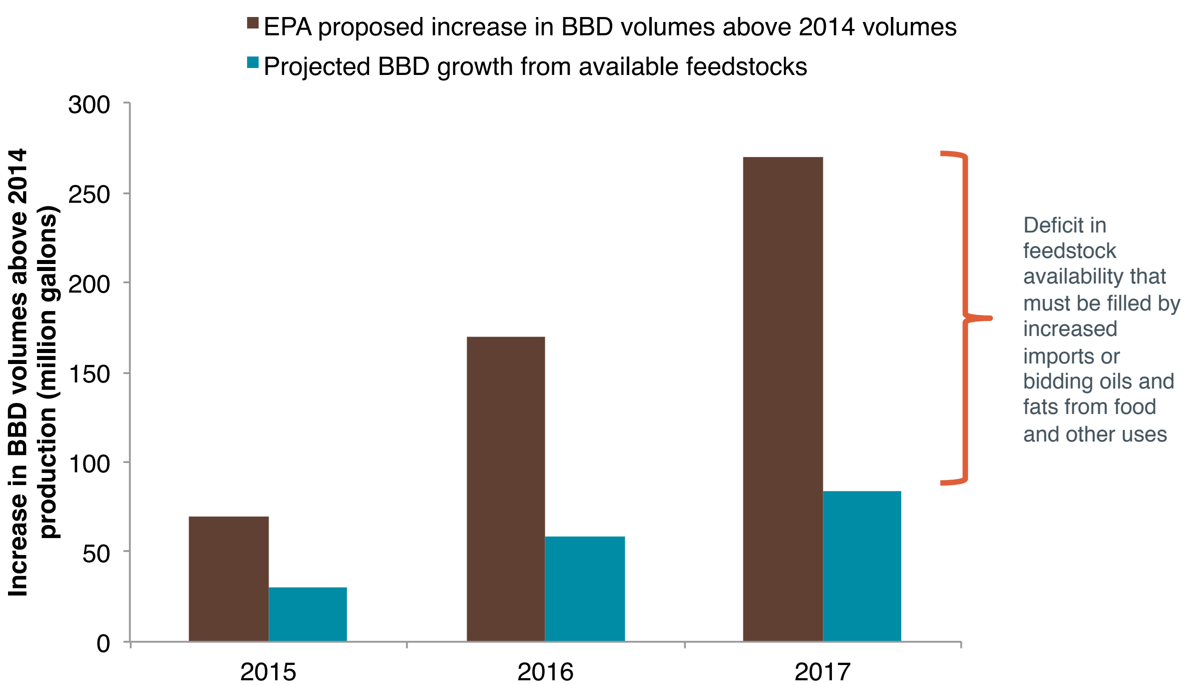

Figure 1: EPA's proposed increase in BBD volumes compared to volumes that can be supported by growth in available feedstock from Brorsen (2015) (million gallons).

The difference between EPA's proposal and Brorsen's projections of feedstock availability is even larger when taking into account the possibility that BBD will also be used to comply with the non-ringfenced part of the advanced biofuel mandate. EPA expects much of the gap between the BBD mandate and the advanced mandate (700 million ethanol equivalent gallons or 467 million biodiesel equivalent gallons) to be met with even more BBD. The exact level of BBD supply anticipated varies depending on levels of E85 penetration in the year 2016, but all but one of the scenarios for how the advanced mandate could be filled include higher BBD production than required for the BBD mandate alone. In other words, when taking the proposed BBD mandate and advanced mandate for 2016 as a package, the demand from RFS2 for BBD could be as high as 2,131 million gallons. That would imply 442 million gallons feedstock demand beyond what Brorsen expects to be available (Figure 2). This gap is on the order of 15% of all soy oil production in the U.S. Diverting such a large volume of BBD feedstock from existing oil and fat uses would inevitably have significant impacts on supply and price.

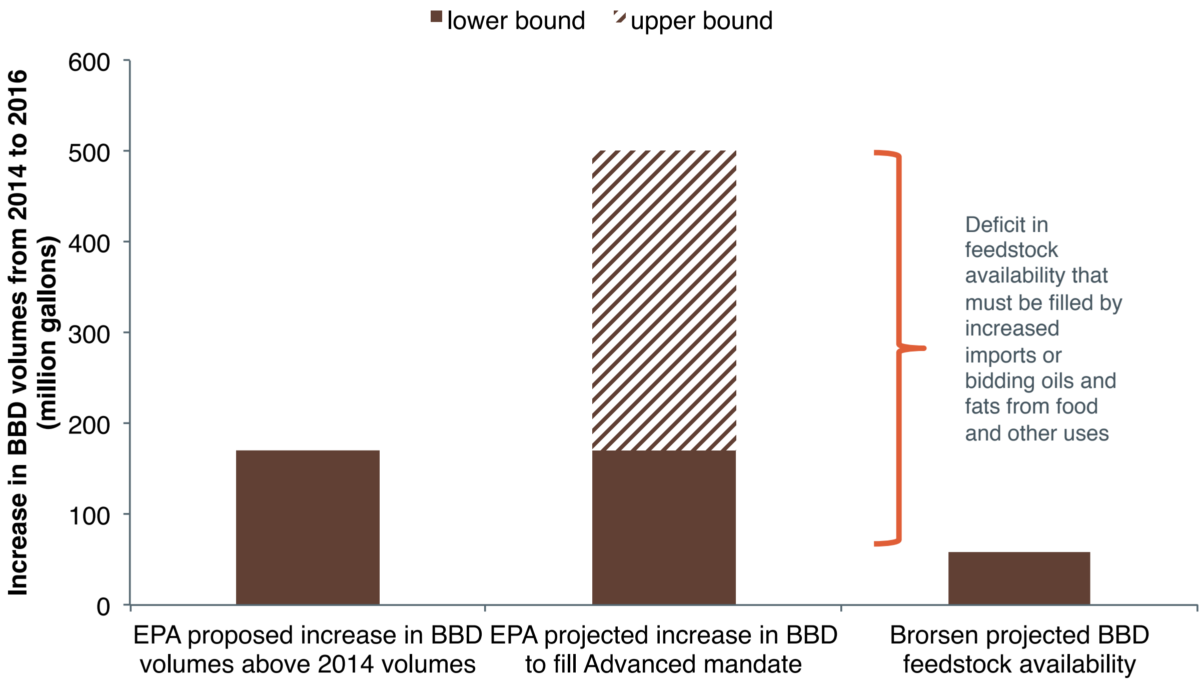

Figure 2: Increase in BBD volumes from 2014 to 2016 in the proposed rule

EPA's range in the quantity of BBD expected to be used in their scenarios to fill the advanced mandate; and BBD volume increase that can be supported by feedstock growth from Brorsen (2015) (million gallons).

Given the limit on BBD feedstock supply, we would suggest that the proposed BBD volumes for 2015-2017 should be revised to be consistent with realistic growth potential. Alternative volumes based on Brorsen's analysis are shown in Table 1.

Table 1: EPA's proposed BBD volumes in billion gallons per year for 2015-2017, compared to ICCT suggested volumes based on projected feedstock growth in Brorsen (2015) in billion gallons.

	2015	2016	2017
EPA's proposal	1.70	1.80	1.90
ICCT suggestion	1.66	1.689	1.714

The RFS2 was designed to allow flexibility in compliance. Reducing the mandated BBD volumes does not prevent higher consumption of BBD in the event that feedstock is indeed available beyond the limits identified by Brorsen. As in previous years, BBD would still be able to compete with other options within the non-BBD part of the advanced mandate.

Advanced biofuel volumes

EPA has proposed using its cellulosic waiver authority to reduce advanced biofuel volumes from those specified in the statute for 2014-2016. This decision is necessary in the circumstances, in particular given the very substantial shortfall between expected cellulosic biofuel production and the volumes set out in the statute. As EPA notes, it is not possible to meet the statutory advanced volume given current advanced biofuel supply and infrastructure. While we believe that the decision to use this waiver is correct, we believe that given limits on availability of non-cellulosic advanced biofuels and advanced biofuel feedstocks that it would be appropriate for the EPA to utilize its full waiver authority to reduce advanced biofuel volumes further than currently proposed, by the same amount as the reduction in the cellulosic volume. Given the proposed cellulosic volume mandate, this would result in a requirement for 2.606 and 3.206 billion gallons of advanced biofuel in 2015 and 2016, respectively, compared to the proposal for 2.9 and 3.4 billion gallons in 2015 and 2016.

Making these adjustments to the advanced mandate would reduce the likelihood of the following situations: increases to BBD production much larger than intended by EPA, resulting in very large impacts on the US vegetable oil market; and very high demand for limited supplies of Brazilian sugarcane ethanol, bidding up the price to little environmental benefit. As noted in the above section, all but one of EPA's scenarios for how the advanced mandate could be filled include higher BBD production than the BBD mandate. The only scenario given in which BBD demand would be limited to the BBD mandate would be a combination of high use of sugarcane ethanol and high use of grandfathered conventional biodiesel, "likely to be made from palm oil.[1]" Indeed, there is no scenario presented to meet the proposed advanced and renewable biofuel mandates that does not require one or more of:

- Excessive pressure on vegetable oil markets;
- Excessive pressure on sugarcane ethanol imports;

[1] Given that palm oil biodiesel does not have a pathway under the RFS, and may well result in emissions increases rather than reductions, it is felt that an outcome in which grandfathered palm oil imports are forced to rise is undesirable.

- High consumption of conventional biodiesel imports, likely meaning grandfathered palm oil that is not expected to deliver a 20% emissions reduction.

In contrast, applying the entire cellulosic waiver to the advanced mandate would allow for appropriate expansion of BBD as well as flexibility in meeting the advanced mandate, and allow compliance scenarios to be developed with a much reduced risk of these negative impacts. This in turn would reduce pressure on oil and fat prices and non-fuel uses. This approach would maintain support for increased E85 deployment as a substantial amount of E85 would still be needed to meet the advanced and renewable mandates. It would also still leave room for BBD to compete with advanced ethanol and other fuels in the non-BBD part of the advanced mandate in the event that additional BBD feedstock becomes available.

We note that in order to avoid driving a market in grandfathered palm oil biodiesel, it would be necessary to reduce the renewable mandate by the same amounts as our suggested reductions in the advanced biofuel volumes (see below).

Reducing the mandated volumes of advanced fuels by the same amount as any future waiver to the cellulosic volumes would be an appropriate starting point when considering advanced volume mandates in all future years of the RFS2 program. Larger advanced mandates than this should only be considered if there is a clear supply scenario that would be consistent with the goals of the RFS and not result in negative unintended consequences.

Renewable fuel volumes

We believe that the proposal to apply both the cellulosic waiver and the general waiver to the renewable fuel volumes for 2014-2016 is appropriate. As described above in our comments on the advanced biofuel volumes, we suggest that EPA consider reducing the renewable fuel volumes further, to reflect the reduced advanced volumes suggested above. As noted above, this would maintain support for E85 deployment without adding substantial pressure on BBD production and U.S. oil and fat supplies, or forcing high imports of conventional biodiesel with questionable environmental performance.

This approach that would be an appropriate starting point when considering renewable volume mandates in all future years of the RFS2 program. Larger renewable mandates than this should only be considered if there is a clear supply scenario that would be consistent with the goals of the RFS and not result in negative unintended consequences.

Algal biofuel pathway

EPA’s proposal to clarify that the existing RFS pathway for biofuels from algal oils applies only to photosynthetically grown algae is consistent with the basis of the algal oil pathway analysis. Heterotropic algae, for example fed with sugar from sugarcane, will have a very different lifecycle carbon footprint than photosynthetically grown algae. Emissions from the sugarcane production and associated land use change would need to be included in the assessment, and this is a significant difference from the photosynthetic algal pathway assessment EPA has already completed.

Conclusions

ICCT commends EPA for its commitment to strengthening the RFS2 program and getting it back on schedule despite challenges in cellulosic biofuel production and issues related to the E10 blendwall. We believe that the following revisions to the proposed volumes would strengthen the proposal and be more consistent with the statutory requirement for EPA to be mindful of impacts on agricultural commodity supply and prices:

- Use a less conservative methodology for determining cellulosic biofuel volumes for 2015 and 2016.
- Utilize recent technical analysis on growth in BBD feedstock supply (Brorsen, 2015) to set BBD volumes for 2015-2017 and all future years of the program.
- Apply the entire cellulosic waiver to advanced biofuel volumes and make a corresponding reduction to the proposed renewable fuel volumes.

Following these principles, we suggest EPA use the volumes in Table 2 in finalizing this rulemaking.

Table 2: ICCT suggestion for RFS2 annual volumes in billion gallons per year for 2015 and 2016 and biomass-based diesel volume for 2017 (compared to EPA's proposed volumes).

FUEL CATEGORY	2015	2016	2017
Cellulosic biofuel	0.106+* (0.106)	0.206+* (0.206)	N/A
Biomass-based diesel	1.66 (1.70)	1.689 (1.80)	1.714 (1.90)
Advanced biofuel	2.606 (2.90)	3.206 (3.40)	N/A
Renewable fuel	16.006 (16.30)	17.206 (17.40)	N/A

***** *We suggest EPA use a less conservative methodology for estimating cellulosic biogas volumes.*

We also support EPA's proposal to clarify that the existing algal biofuel pathway applies only to photosynthetically grown algae.

Literature cited

Brorsen, W. (2015). Projections of U.S. Production of Biodiesel Feedstock. Report attached as Appendix to these comments.

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USDA (2014). Global Agricultural Information Network Report: Brazil, Biofuels Annual. Prepared by Sergio Barros. Available at: http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Biofuels%20Annual_Sao%20Paulo%20ATO_Brazil_7-25-2014.pdf

USDA (2015). ERS "Table 1—Fuel ethanol supply and disappearance, calendar year." Available at: http://www.ers.usda.gov/data-products/us-bioenergy-statistics.aspx

Appendix to ICCT comments on "Renewable Fuel Standard Program: Standards for 2014, 2015, and 2016 and Biomass-Based Diesel Volume for 2017" Notice of Proposed Rulemaking (EPA–HQ–OAR–2015-0111; FRL–9927-28-OAR)

PROJECTIONS OF U.S. PRODUCTION OF BIODIESEL FEEDSTOCK

By Wade Brorsen*

July 2015

Report prepared for Union of Concerned Scientists and The International Council on Clean Transportation

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.

ICCT comments on docket no. EPA–HQ–OAR–2015-0111

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]					Total	Biomass-	
Calendar Year	Production	Non-biofuel use	Available for biodiesel	Rendered Products[b]	Other[c]	Availability for biodiesel	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)					Total Growth in Feedstock Availability above 2014	Deficit	
		Soy Oil	Canola	Corn Oil	Yellow Grease	Other		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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