National Biodiesel Board
605 Clark Ave.
PO Box 104898
Jefferson City, MO 65110-4898
(800) 841-5849 *phone*
(573) 635-7913 *fax*

National Biodiesel Board
1331 Pennsylvania Ave., NW
Suite 505
Washington, DC 20004
(202) 737-8801 *phone*
biodiesel.org | *nbb.org*

September 15, 2014

Katrina Sideco
Staff Lead
LCFS Reconsideration Team
California Air Resources Board
Submitted via electronic mail to katrina.sideco@arb.ca.gov

Re: Official written comments from the National Biodiesel Board on Low Carbon Fuel Standard Reconsideration: CA-GREET Model Update

Dear Ms. Sideco:

We appreciate the presentation of preliminary carbon intensity values that Air Resources Board staff presented in the August 22 workshop. We have produced the following comments on the biodiesel pathways based on the presentation from the August 22, 2014 workshop, the more detailed comparison of the biodiesel pathways that CARB made available to us, and our review of the GREET1_2013 model. GREET 2.0 has not been made fully available, so we are not able to confirm or comment on elements that we have been unable to review. We are able to provide the following observations and suggestions for improvement of the CARB analysis. As you likely anticipate, it is problematic for the industry to comment on modeling that are not made fully available. The comments below identify specific errors that we have identified in the preliminary numbers. The dramatic increases in carbon intensity values for biodiesel feedstocks indicate to us that there are additional errors either in the Argonne data or the CARB adaptation of that data. We urge ARB to release the full modeling data. Among other things, we will be completing a review of the energy requirements for rendering and processing feedstocks, including tallow and used cooking oil. We urge ARB to review the embedded data components cautiously before announcing net increases in biodiesel carbon intensities.

<u>Methanol Oxidation</u>

GREET1_2013 includes the oxidation of the methanol in the biodiesel calculations and it is therefore not necessary to add on the extra 3.33 g/MJ outside of the model, as CARB has done.

CARB appears to have double-counted the emissions from methanol in the biodiesel production process for soybean oil-based biodiesel as well as other biodiesel pathways. The formula for the CO_2 emissions for the esterification step in Cell BI287 on the BioOil sheet is

=((BI$258*($L$226*EF!$M14+Petroleum!$B232*Petroleum!$I$218+Petroleum!$I232)+BI$259*($L$227*EF!$Q14+$L$228*EF!$R14+$L$229*EF!$S14+Petroleum!$B232*Petroleum!$J$218+Petroleum!$J232)+BI$260*(EF!$V14+Petroleum!$B232*Petroleum!$D$218+Petroleum!$D232)+BI$261*($L$231*EF!$G14+$L$232*EF!$D14+$L$233*EF!$B14+$L$234*EF!$C14+NG!$B94)+BI$262*($L$235*EF!$AC14+Coal!$B76)+BI$263*(EF!$Z14+Inputs!$G$121*(Petroleum!$B232*Petroleum!$H$218+Petroleum!$H232)+Inputs!$F$121*(NG!$R94*NG!$S$80+NG!$S94))+BI$264*(Electric!$B184+Electric!$C184)+**BI$266*('MeOH&FTD'**

!$B146*'MeOH&FTD'!$C$132+'MeOH&FTD'!$C146))/1000000+(BI$268*Enzymes_Yeast!$F78+BI$270*Ag_Inputs!$BC92+BI$271*Ag_Inputs!$G92)/T2g+BI$269*('MeOH&FTD'!$B146*'MeOH&FTD'!$C$132+'MeOH&FTD'!$C146)/1000000)+**BI$266/Fuel_Specs!$B$24*Fuel_Specs!$E$24*Fuel_Specs!$F$24/Fuel_Specs!$B$94**+BI$269/Fuel_Specs!$B$24*Fuel_Specs!$E$24*Fuel_Specs!$F$24/Fuel_Specs!$B$94

The methanol quantity is BI266. There are two places in the equation where the methanol comes into play. These are bolded the in the equation above. The first string calculates the emissions for producing the methanol. The second portion is the CO_2 from the oxidation of the methanol. That is the factor that CARB has accounted for with the additional 3.33 g/MJ in the new calculations. The second factor was not there in GREET 1.8.

This factor is a confirmed issue in the soy, canola and tallow biodiesel pathways. The used cooking oil pathway does not exist in GREET1_2013 and we have not seen CA GREET 2.0 to confirm whether this problem persists in that pathway, as well. We advise correction of this factor in all biodiesel pathways.

Trans-esterification Default Values

The default values for the biodiesel production stage in GREET1_2013 are all consistent with the best data available from the industry production survey, **except** the feedstock requirements. The 2009 survey of biodiesel production plants conducted by NBB remains the only publicly available source of data on actual biodiesel plant performance. The feedstock requirement on the NBB survey for plants that processed vegetable oils was 0.99 pounds of feedstock per pound of biodiesel (using the conversion factors in GREET). In GREET1_2013, a value of 1.04 pounds of feedstock per pound of biodiesel is used. The value of 1.04 pound of feedstock per pound of biodiesel is consistent with the industry average number (averaging all feedstock yield ratios) reported by NBB. However, that number is not consistent with the reported performance of actual plants processing virgin oils. For a feedstock-specific pathway for soybean oil and canola oil, CARB should use the 0.99 conversion rate. Not all biodiesel plants can convert free fatty acids found in some waste feedstocks into biodiesel. Some just remove the free fatty acids. This is the reason for the different feedstock conversion rates depending on feedstock quality and individual plant performance. This makes a change of about 0.6 g CO_2eq/MJ in the CI to the soybean biodiesel pathway and should also impact the canola pathway.

In addition, we believe that one of the values from the actual industry data has been misinterpreted. The NBB reported the consumption of HCl in biodiesel plants, but the HCl is consumed diluted to 30 to 38 percent, the maximum practical concentration. The HCl emissions calculated in GREET are for 100 percent HCl. The input value for HCl should be changed from 19.68 g/lb. Biodiesel to 7.5 g/lb. (assuming all plants use the most concentrated form available). This makes a difference of about 1.5 g/MJ to the CI.

Soybean Extraction Requirements

Most of the model parameters in GREET for the soybean oil extraction appear to come from the data produced by the National Oilseed Processors Association in 2009. The one exception is the lipid content.

However, as long as mass allocation is used, then the oil content of the soybean does not impact the results.

GREET appears to have assumed that the NOPA data was presented as the higher heating values and it was then converted to a lower heating value basis for use in GREET. This would involve increasing the energy use by 6 to 11 percent. We did check with the people who collected the original data and they believe the original data was on a LHV basis, but this can't be confirmed at this time. It is possible that the emissions will be lower if GREET did the HHV to LHV conversion on data that was already LHV.

Canola Biodiesel

In addition to the issues described above relating to methanol, feedstock conversion rate, and HCL; there are some issues specific to the canola pathway. The CARB reported emissions for the canola oil extraction are very different than they are in GREET 2013, even though the input data are the same. They are 2.4 times higher than the previous CARB canola pathway even though the energy consumed only went up by 7 percent. They are 1.97 times higher than the standard GREET 2013 model with all of the same inputs.

The larger issue for the canola pathway is that GREET models European rapeseed production and the production practices are quite different. European rapeseed is almost all winter rapeseed, whereas North America canola production is almost all summer rapeseed. European crops are planted almost exclusively with full conventional tillage and North America canola is predominately cultivated with reduced or no tillage practices. We know that both the major differences will lead to higher predicted GHG emissions than actual emissions for North American canola production. Data on North American canola production is available and it should be used in the CA GREET model.

Tallow Biodiesel

The tallow biodiesel pathway has the same methanol and HCL issue as the soy and canola pathways, but there are other problems with this pathway.

Tallow rendering energy use has been increased in GREET 2013 and is based on a sample of 23 US rendering plants, about 10 percent of the population. GREET uses the data from the rendering plant survey which was reported as MJ/kg of rendered product and appears to report it as BTU/lb of fat without adjusting for the meal production or the unit conversions. In addition there are differences between the reported total thermal energy and the sum of the components providing the thermal energy. The ratio of total rendered product (including meal) to fat output is 1.8 to 1. Failing to adjust for the meal production overstates the energy used to render fat by 80 percent. This overestimation of rendering energy is currently what is used by CARB.

CARB is using a different energy requirement for the biodiesel production process as the GREET 2013 model shows 11.5 g CO_2/MJ for the biodiesel production for this stage. The GREET 2013 inputs are not based on actual plant data but on process model studies; and, in at least one case, a different process

than is typically used in the industry. The GREET values are quite high. Actual production plant data should be used to determine this energy usage.

The proposed methanol used per unit of biodiesel produced from tallow and used cooking oil are too high. CARB has suggested that the methanol usage for tallow (and UCO) biodiesel production is higher than for biodiesel made from vegetable oil. There is no stoichiometric reason that methanol use would be different based on feedstock differences. Any difference suggested by the aggregated survey data is an artifact of other production plant differences, and should not be attributed to the feedstock. CARB should use the same methanol consumption rate as is used for vegetable oil based biodiesel.

The tallow biodiesel pathway in GREET 2013 needs to be thoroughly reviewed. We can provide more comments once we have a chance to review the actual CA GREET 2.0 model.

Used Cooking Oil Biodiesel

There is not a used cooking oil biodiesel pathway in GREET 2013 so it is more difficult to provided comments. From the information that CARB has presented it would appear that the methanol issue and the HCl issue described above also exist in this pathway.

CARB has suggested that the biodiesel production energy requirements are about 50 percent higher for used cooking oil than they are for vegetable oils and 10 percent lower than for tallow. The review that is possible at this time suggests that CARB has overstated the energy required to produce biodiesel from used cooking oil relative to other biodiesel feedstocks. The energy use should be the same as it is for tallow.

General Comments

CARB should consider presenting the results in all pathways (in g/MJ) only to a single decimal point. The underlying data and assumptions in the GREET model do not support two significant figures beyond the decimal point.

We suggest that the CARB developed pathways be as realistic and broad as possible to minimize the need for applications for modified pathways. This includes geographic coverage and other elements that may make CARB pathways overly specific.

Consistent transportation assumptions should be used for all pathways. Perhaps two sets are required, one for out of state production and one for in state production. However, the values chosen should be consistent with the petroleum diesel assumptions. The current distance used by CARB for diesel is 50 miles from the terminal to the refueling station. Biodiesel is set to 90 miles. This inconsistency should be reconciled.

Presented below is a summary table of our suggestions that can be quantified at this time with some placeholders for review that is required to identify the correct values.

Vegetable Oil	GREET 2013/CARB	NBB Recommendation
Methanol oxidation	3.33 g/MJ	0 g/MJ

Yield	1.04	0.99
HCl	19.68	7.5

Tallow	GREET 2013/CARB	NBB Recommendation
Methanol oxidation	3.33 g/MJ	0 g/MJ
Energy for Rendering	7100 BTU/lb	Review GREET assumptions and data from original papers.
Energy for Transesterification	2068 BTU/lb	Review the inconsistency with UCO pathway

We look forward to improving the accuracy of all biodiesel pathway assessments. We welcome any question you have about these comments or requests for further clarifying data.

Sincerely,

Don Scott
Director of Sustainability
National Biodiesel Board
dscott@biodiesel.org
800-841-5849