canolacouncil
OF CANADA

Mike Waugh
Chief, Transportation Fuels Branch
California Air Resources Board
1001 I Street
Sacramento, CA 95812
United States

Via Email
mwaugh@arb.ca.gov

Dear Mr. Waugh

Re: Comments on CARB's GREET Model

Please find attached the comments of the Canola Council of Canada on CARB's proposed GREET 2.0 Model.

Sincerely,

Bruce Jowett
Vice President, Market Development

Attachment

Comments on CA GREET 2.0

The Canola Council of Canada has developed the following comments on the canola biodiesel pathway 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. The Council is not aware if some of the comments have already been addressed in CA GREET 2.0, but since the model is not available we have not been able to confirm some of our comments.

The Council believes that the CARB developed pathways should be as realistic and broad as possible to minimize the requirements for applications for modified pathways just because a biodiesel producer is outside of the geographic coverage of the approved pathway. It is our view that CARB's canola biodiesel pathway should cover biodiesel produced in North America with North American canola. The previous CARB canola biodiesel pathway had the restriction that the biodiesel had to be produced in the United States which required one of the three North American canola biodiesel plants to apply for a 2B pathway that produced essentially the same number as the CARB developed pathway. Given this evidentiary fact we would request that CARB extend the coverage area of its canola biodiesel pathway to cover North America biodiesel production.

The Council also believes that CARB should consider only presenting the results (in g/MJ) to a single decimal point. We don't believe that the underlying data and assumptions in the GREET model support two significant figures.

Canola Production

The significant issue for the CARB canola pathway is that GREET uses European rapeseed production data and the production practices in that region are quite different than in North America. 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. These different agriculture practises between regions result in major carbon intensity differences for canola with North American production having a much lower GHG emissions than European rapeseed. The reference used by the GREET modellers for the rapeseed pathway states;

> *Rapeseed cultivation was assumed to take place predominantly in the United Kingdom (UK) and France based on data from Mortimer and Elsayed (2006), Edwards et al. (2007), Richards (2000) and Prieur et al. (2008). The analysis was supplemented by additional data from Sweden and Denmark from Bernesson et al. (2004) and Schmidt (2007). This was deemed appropriate due to the relative similarity in climate among southern Sweden, Denmark, France and the UK.*

The Canola Council of Canada undertook a survey of 1000 canola producers in 2011 and had 913 valid responses. The data has been used to establish the GHG emissions of Canadian canola production for use under the EU Renewable Energy Directive. The GHG calculations were done by a European consultant and were peer reviewed.

In the following table we have compared the GREET 2013 values and the values from the producer survey.

Parameter	BioOil Sheet Cell	GREET 2013	CCC Producer Survey
Farm Energy, MJ/dry tonne	D27	1,062	542
Distribution of energy by type			
Diesel	AB247	100%	97.4%
Electricity	AB252		2.5%
Natural gas	AB249		0.2%
Nitrogen, kg/dry tonne	AC242	53.8	53.8
Phosphorus, kg/tonne	AD242	15.4	15.6
Potassium, kg/tonne	AE242	14.1	2.7
Herbicides, kg/tonne	AG242	0.75	0.34

The most significant changes are with respect to fuel consumption, potassium and pesticide requirements. The fuel consumption and pesticides are related to the no till practices and the variety of canola grown. The potassium is a regional factor related to soil quality.

The work undertaken by the CCC also used IPCC Tier 2 methods to determine the N_2O emissions and changes in soil carbon. IPCC Tier 2 methods are generally regarded as being superior to the Tier 1 approach that is used in GREET 2013 but they require much more specific data and this data is not always available. In the case of canola this data is available allowing the use of the Tier 2 method. The difference between the GREET values and the IPCC Tier 2 values for two critical parameters are shown in the following table.

Parameter	BioOil Sheet Cell	GREET 2013	CCC Producer Survey
N_2O emission factor	AE289 hard coded	0.01325	0.00958
Soil Carbon change, kg CO_2/dry tonne	Not included, could be included in AC289	0	263

The Canola Council therefore requests the CARB no longer use European rapeseed data in its GREET model for canola biodiesel and use the latest up to date canola production data from Canada. We also request that the GREET model incorporate the use of Tier 2 methods for canola biodiesel as the detailed data is available to support this use.

Canola Oil Extraction

The input used for the GREET 2013 model is 1316 BTU/lb. of Bio Oil and is taken from the same reference as the rapeseed farming data (Stratton et al). Using the oil yield in GREET this is equivalent to 1420 MJ/dry tonne of rapeseed. The information in that report can be traced back to a single soybean oil extraction plant with data from 1981.

A survey of the canola crushing plants in North America was undertaken by the Canadian Oilseed Processors Association for the Canola Council in support of the data supplied to the EPA for their RFS2 process. A total of 10 plants in Canada and the United States participated in the survey. All of the plants used natural gas as their source of thermal energy.

The results from the survey are summarized in the following table.

	Per tonne of Canola crushed	Per tonne of Oil produced
Electricity Purchased, kWh	49	114.5
Natural Gas Purchased, GJ	1.0	2.34
Hexane, GJ	0.054	0.126
Total Energy, GJ	1.23	2.88

This data is far more appropriate than the data that is in GREET. The changes that should be made to GREET are summarized in the following table.

Parameter	BioOil Sheet Cell	Old Value	New Value
Extraction energy	D28	1,316	1,238
Loss factor	D29	4.02	0.0
Natural gas %	AJ249	79.3	81.2
Electricity %	AJ252	13.4	14.4
Hexane %	AJ253	7.3	4.4

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 when up by 7%. They are 1.97 times higher than the standard GREET 2013 model with all of the same inputs.

The Council believes that there is an error in the CARB calculations and requests that this issued be reviewed and the emissions data corrected.

Trans-esterification Default Values

The default values for the biodiesel production stage in GREET1_2013 are all taken from the NBB Energy survey that was done several years ago except the feed requirements. In addition, we believe that one of the values from the survey has been misinterpreted. The NBB survey 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 lb. feedstock per lb. of biodiesel (using the conversion factors in GREET). In GREET1_2013 a value of 1.04 lb. of oil per lb. of biodiesel is used. GREET also has a lower value for tallow feedstock requirements (1.01), whereas the NBB energy survey found that the feedstock requirements for multi-feedstock plants were higher than they were for virgin oil plants. The GREET assumptions are poorly referenced but appear to be based on process models and alternative processes rather than empirical data.

Using the feedstock requirement 0.99 lb./lb makes a change of about 0.6 g CO_2eq/MJ in the CI to the canola biodiesel pathway.

Not all biodiesel plants can convert free fatty acids to biodiesel; some just remove the free fatty acids. This is the reason for the different feedstock conversion rates and vegetable oil feedstocks, with almost no free fatty acids have the best conversion rates.

The NBB reported the consumption of HCl in biodiesel plants but the HCl is consumed diluted to 30 to 38%, the maximum practical concentration. The HCl emissions calculated in GREET are for 100% 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.

Methanol Oxidation

GREET1_2013 includes the oxidation of the methanol in the biodiesel calculations.

The formula for the CO_2 emissions for the esterification step in Cell BI287 on GREET's 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 and these are bolded in in the equation. 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 is accounted for with CARB's additional 3.33 g/MJ in the new GREET calculations. The second factor was not there in GREET 1.8.

It is the Canola Council's view that it is therefore not necessary to add on the extra 3.33 g/MJ outside of the model as this has the effect of double counting adding a carbon intensity penalty to canola.