RENEWABLE FUELS ASSOCIATION

September 15, 2014

Wes Ingram
Manager, Fuels Evaluation Section
California Air Resources Board
1001 “I” Street
Sacramento, CA 95812

Dear Mr. Ingram,

The Renewable Fuels Association (RFA) appreciates the opportunity to provide comment on the California Air Resources Board’s (CARB) proposal to migrate to the CA-GREET2.0 model for the purposes of assigning direct carbon intensity (CI) values under the Low Carbon Fuel Standard (LCFS). Model version migration issues and preliminary CA-GREET2.0 results were the subject of a stakeholder workshop held August 22, 2014.

In general, RFA supports CARB’s decision to revise and update its CA-GREET model based on the Argonne National Laboratory GREET1_2013 model. We believe Argonne’s GREET1_2013 model contains a number of important improvements and updated inputs that more accurately reflect the current CI performance of corn ethanol and many other fuel pathways. Much has changed since CARB released the original CA-GREET model more than six years ago; ethanol and feedstock producers have rapidly adopted new technologies and practices that have significantly reduced the fuel’s lifecycle CI impacts. Thus, it is encouraging to see the LCFS regulation finally catching up to the actual state of the industry.

However, based on the information provided during the August 22 workshop, we believe several additional revisions to CA-GREET2.0 should be considered. While it is difficult to provide useful technical comments on the CA-GREET2.0 model until the new model itself is made available to the public, we are offering these initial comments aimed at further improving the accuracy of CARB’s methodology for assigning direct CI values.

As described in the attachment, RFA believes CARB should: **1)** integrate GREET1_2013 default assumptions on ethanol co-product feed displacement, **2)** revise the CA-GREET2.0 model’s treatment of emissions from lime application based on new data from the U.S. Department of Agriculture, and **3)** adopt the GREET1_2013 methodology for estimating land use change (LUC) emissions in lieu of CARB’s current standalone GTAP methodology. These recommendations are described in more detail in the attached document.

We appreciate CARB's consideration of these comments and welcome further dialog on this subject. RFA will review the CA-GREET2.0 model in detail upon its release and respond with additional comments as appropriate.

Sincerely,

Geoff Cooper
Senior Vice President

Cc:

Katrina Sideco
Hafizur Chowdhury
Chan Pham
Todd Dooley

COMMENTS OF THE RENEWABLE FUELS ASSOCIATION (RFA)
IN RESPONSE TO
CARB WORKSHOP DISCUSSING CA-GREET 2.0 MODEL (AUGUST 22, 2014)

The California Air Resources Board (CARB) staff held a stakeholder workshop August 22, 2014, to discuss a proposal to migrate to the CA-GREET2.0 model for the purposes of assigning direct carbon intensity (CI) values under the Low Carbon Fuel Standard (LCFS). RFA offers the recommendations below in response to information presented by CARB staff during the workshop.

1. **CARB should integrate the Argonne GREET1_2013 default assumptions on ethanol co-product feed (i.e., distillers grains) displacement rates.**

During the workshop, CARB staff indicated that it intends to maintain the current CA-GREET assumptions regarding ethanol co-product feed displacement rates. When developing the original CA-GREET model in 2008, CARB deviated from the accepted Argonne GREET default assumptions on distillers grains (DDGS) displacement rates based on the opinion that "…significant barriers to the widespread adoption of DDGS as livestock feed exist."[1] In the 2009 staff report, CARB staff curiously suggested that increased volumes of distillers grains in the future would not—and could not be utilized—by the livestock and poultry industries. Time has proven that CARB staff's assessment of the distillers grains market in the staff report was terribly incorrect and uninformed. Distillers grains production has virtually doubled since 2008 and it is *inarguable* that the larger volumes of DDGS produced since publication of the staff report have effectively and economically substituted for traditional feed ingredients.

Further, it is beyond dispute that distillers grains replace both corn *and soybean meal* in livestock and poultry rations and have done so for many years. The original CA-GREET model assumed no soybean meal is replaced by DDGS. CARB should *not* maintain this assumption, which has been proven incorrect by the real-world experience with DDGS over the past six years.

In the staff report, CARB pledged that "…staff will re-visit this issue and make updates to the co-product credit, as appropriate."[2] Given that CARB is undertaking significant changes to its CI estimation methodology during the LCFS re-adoption process, this is the perfect time to correct and revise the Agency's treatment of distillers grains. As distillers grains displacement ratios have considerable impacts on the overall direct CI score associated with grain-based ethanol, it is imperative that CARB integrates the Argonne GREET1_2013 default assumptions, which are based on a transparent and sound body of nutritional research *and* real-world experience. The table below summarizes the weighted average displacement ratio from Argonne's GREET1_2013 compared to CARB's CA-GREET. In addition, the GREET1_2013 default

[1] CARB. March 5, 2009. Staff Report. Volume II. Proposed Regulation to Implement the Low Carbon Fuel Standard. Appendices. C-54.
[2] *Id.*

assumptions (pasted directly from cells A233:I275 of the EtOH sheet of the model) are provided as an attachment.

Feed Ingredients Replaced by 1.00 lb. of Distillers Grain CA-GREET vs. GREET1_2013		
	CA-GREET	**GREET1_2013**
Corn (lbs.)	1.00	0.781
Soybean Meal (lbs.)	**0.00**	**0.307**
Urea (lbs.)	**0.00**	**0.023**
TOTAL (lbs.)	**1.00**	**1.111**

In addition, CARB should revisit its treatment of DDGS for the indirect emissions analysis associated with corn ethanol. This should include reconsideration of 1) GTAP distillers grains substitution rates, 2) effects of feeding DDGS on emissions from enteric fermentation (as recommended by the CARB Expert Work Group), and 3) displacement of synthetic urea/non-protein nitrogen compounds in beef cattle diets.

2. **CARB should revise the CA-GREET2.0 model's treatment of emissions from agricultural lime application based on new data from the U.S. Department of Agriculture (USDA).**

The GREET1_2013 model uses an emissions factor of 0.44 g CO_2/g $CaCO_3$ applied to the soil for corn ethanol (cell F379 on the EtOH sheet). With the default lime application rate in the model, this results in about 2.25 g CO_2eq/MJ of ethanol after allocation. The 0.44 g CO_2/g $CaCO_3$ is the IPCC Tier 1 default emission factor for limestone.

In July 2014, the USDA released a report on the methods to quantify the GHG emissions of agricultural and forestry activities.[3] The report lays out methods for estimating changes in GHG emissions and carbon storage at a local scale. Many of the methods laid out in the report are those that are used by the USDA and the EPA to develop the U.S. National GHG Inventory report that is prepared each year for the UNFCCC program. According to the USDA report:

> *Addition of lime to soils is typically thought to generate CO_2 emissions to the atmosphere (de Klein et al., 2006). However, prevailing conditions in U.S. agricultural lands lead to CO_2 uptake because the majority of lime is dissolved in the presence of carbonic acid (H_2CO_3).* ***Therefore, the addition of lime leads to a carbon sink in the majority of U.S. cropland and grazing land systems****. Whether liming contributes to a sink or source depends on the pathways of dissolution and rates of bicarbonate leaching. The emissions factor provided in this guidance has been estimated from a review of*

[3] USDA. 2014. Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory. http://www.usda.gov/oce/climate_change/Quantifying_GHG/USDATB1939_07072014.pdf

existing models and mass balance analyses conducted for the application of lime in the United States and is a Tier 2 method as defined by the IPCC.

Since crushed limestone ($CaCO_3$) contains 12 percent C, an application of 1,000 kg $CaCO_3$ places 120 kg C on the soil surface. It is assumed that two-thirds of this (80 kg) is acidified to HCO3- and leached to the ocean where it will be sequestered for decades to centuries (Oh and Raymond, 2006). Because this transfer represents a movement from one long-term pool (geologic formations) to another (ocean), this carbon transfer does not represent a net uptake of CO_2 from the atmosphere. However, with this transfer, there is 80 kg C of atmospheric CO_2 uptake into soils. The uptake of CO_2 from the atmosphere, after subtracting the one-third of carbon in the lime that is acidified directly to CO_2 (40 kg C), yields a total net CO_2 uptake of 40 kg C per 1,000 kg $CaCO_3$ applied. This results in a carbon coefficient or emission factor of 40/1000 = -0.04 kg C per kg $CaCO_3$. This equates to a carbon sink (40 kg C sequestered/120 kg C × 100). Dolomite contains only slightly more carbon than does $CaCO_3$ (13 percent vs. 12 percent) so the factors are essentially the same.[4]

The reaction of calcium carbonate, water and carbon dioxide to produce carbonic acid is:

$$CaCO_3 + H_2O + CO_2 \rightarrow Ca^{2+} + 2HCO_3^-$$

This shows the carbon uptake resulting from the limestone reaction.

CARB should be using the best available science and data for its CI modeling. In this case, that means the adoption of the Tier 2 methodology developed by the USDA for estimating the impact of liming US agricultural soils on carbon emissions for use in the CA-GREET2.0 model.
Thus, in the GREET model, Cell F379 should be changed to:

=G332*-0.04*44/12

Or =-G332*0.147

This makes a difference of approximately 3 g CO_2/MJ ethanol after allocation. We note that this emission factor is dependent on the specific soil conditions and the change should only apply to U.S.-produced crops at this time. If other regions that lime soils have data or Tier 2 methods for

[4] *Id*. (Emphasis Added) See also: Oh, N.-H., and P. A. Raymond (2006), Contribution of agricultural liming to riverine bicarbonate export and CO_2 sequestration in the Ohio River basin, Global Biogeochem. Cycles, 20, GB3012, doi:10.1029/2005GB002565.
http://onlinelibrary.wiley.com/doi/10.1029/2005GB002565/pdf

determining the emission factors for their regions they should be considered, but in the absence of such data the IPCC Tier 1 approach should be used outside of the United States.

3. **CARB should adopt the GREET1_2013 methodology for estimating land use change (LUC) emissions in lieu of CARB's current standalone GTAP methodology.**

CARB's current method for assigning CI scores to crop-based biofuels involves deriving a direct CI estimate from CA-GREET and adding a LUC penalty factor derived from the GTAP model. There are obvious disadvantages to haphazardly appending LUC factors from one model using one set of boundary conditions to direct CI estimates from another model using a different set of boundary conditions. Recognizing the ad hoc nature of existing LUC methodologies, researchers from the University of Illinois and Argonne National Laboratory developed an integrated LUC estimation tool (called CCLUB) *within the GREET model framework*.[5] This integrated approach ensures that assumptions used in estimation of direct CI values are properly carried over into estimation of indirect emissions.

The land change estimates underlying the CCLUB module still come from GTAP, which is the same model used by CARB. However, the GTAP values are combined in an integrated fashion—within the GREET framework—with SOC change data for the U.S. from the CENTURY model, above-ground carbon stock data from the Carbon Online Estimator, and international carbon stock data from Winrock.

Based on the improved integration, more precise underlying data, and consistent boundary conditions offered by the CCLUB module, RFA believes CARB should adopt the GREET1_2013 CCLUB methodology for estimating LUC emissions in lieu of CARB's current standalone GTAP methodology.

[5] See J. B. Dunn, S. Mueller, H. Kwon, M. Wander, M. Wang. May 30, 2012 (Revised April 1, 2014). Carbon Calculator for Land Use Change from Biofuels Production (CCLUB) Manual.

1.3c) Calculations of Co-Product Credits for Corn Ethanol

Displacement-based method:

Co-product yield

Dry milling		Wet milling	
DGS to animal feed (Bone-dry lb/gal EtOH)	5.63	CGM to animal feed (Bone-dry lb/gal EtOH)	1.22
		CGF to animal feed (Bone-dry lb/gal EtOH)	5.28
		Corn oil to animal feed (Bone-dry lb/gal EtOH)	0.98

Shares of Dry DGS and Wet DGS in Animal Farm

		Share of DDGS and WDGS by Animal Type	
	Animal Type Farm Share	DDGS	WDGS
Beef	40.6%	23.4%	17.1%
Dairy	40.6%	23.4%	17.1%
Swine	12.8%	12.8%	
Poultry	6.0%	6.0%	
U.S. Total Weighted Average		65.7%	34.3%

Displacement of Conventional Animal Feed by Dry and Wet DGS

	DDGS Displacement Ratio (lb/lb co-product)			WDGS Displacement Ratio (lb/lb co-product)		
	Corn	SBM	Urea	Corn	SBM	Urea
Beef	1.203	0.000	0.068	1.276	0.000	0.037
Dairy	0.445	0.545	0.000	0.445	0.545	0.000
Swine	0.577	0.419	0.000			
Poultry	0.552	0.483	0.000			
U.S. Total Weighted Average	0.751	0.320	0.024	0.861	0.273	0.019

Composite DGS Displacement Ratios for U.S. Consumption and Export Market

		DGS Displacement Ratio(lb/lb co-product)		
	Market Share	Corn	SBM	Urea
U.S. Consumption	80.4%	0.788	0.304	0.022
Export Market Consumption	19.6%	0.751	0.320	0.024
Aggregated Displacement Ratio: U.S. and Export Markets		0.781	0.307	0.023

DGS Displacement ratios: lbs. per lb. co-product

	Dry milling	Wet milling			
	DGS	CGF	CGM	1.529	
Corn	0.781	1.000	1.529	Relative value of CGM to CGF	
SBM	0.307				
Urea	0.023	0.015	0.023		-2,260
Co-products used for new cattle production:		0.0%			Less CH4 from cattle and cow fed with DGS (g CO2e/mmBtu EtOH)

Total displaced lbs. per gallon of ethanol:

	Dry milling	Wet milling	Dry milling	Wet milling	
	Data		Calculation cells		m-based ethanol
Corn:	-4.402	-7.149	-4.402	-7.149	-4.401
SBM:	-1.731	0.000	-1.731	0.000	-1.731
Urea	-0.128	-0.109	-0.128	-0.109	-0.128
Soy oil		-0.980	0.000	-0.980	