Comments on the CA-GREET 2.0 Model
November 6, 2014
Air Improvement Resource, Inc.

ARB staff released a draft report comparing GREET1.8b, GREET12013, and CA-GREET 2.0 on October 10. In addition, staff released the GREET 2.0 model for comment. AIR has reviewed some aspects of this model, and offers comments in the following areas:

- GREET2014
- Denaturant Modifications for Ethanol
- DGS Reduced Enteric Emissions Credit
- Improper Cell References

Some of these comments have already been emailed and verbally communicated with Staff.

GREET2014

The CA-GREET 2.0 model is based on the GREET1-2013 model from Argonne. GREET2014 was released by Argonne on October 3, 2014. ARB should examine GREET2014 to determine improvements that should be made to CA-GREET 2.0.

Denaturant Modifications for Ethanol

The amount of denaturant assumed in CA-GREET1.8b was 2.0%. However, in CA-GREET-2.0 the amount of non-ethanol material in ethanol was increased to 5.4%. The 5.4% is assumed to be 2.4% denaturant, at most 1 percent water, at most 0.5 percent methanol, and at most 1.4 percent "other." The 2.9% combination of water, methanol, and "other", is assumed to have the same carbon intensity of CARBOB, so the net effect of this assumption is the same as assuming 5.4% CARBOB in ethanol. The CI of CARBOB is higher than most ethanol pathways, so increasing the denaturant from 2% to 5.4% in effect raises the CI of ethanol (and doubles the denaturant effect).

It is very clear that water does not have the CI of CARBOB. It is also highly unlikely that methanol and "other", whatever the other is, would have the same CI as CARBOB. AIR believes increasing the denaturant to 5.4% is a mistake that unfairly penalizes ethanol. AIR recommends that the denaturant percentage be set to 2.4% in CA-GREET 2.0.

DGS Reduced Enteric Emissions Credit

GREET2013 contains a distiller grains (DGs) credit for the coproduct due to reduced enteric fermentation from livestock from feeding with DGs. Staff is proposing no

DGs reduced enteric emissions credit "due to the feeding of animals not being considered in the LCFS pathway LCA system boundary." Staff goes on to say that "...including the feeding of animals in the LCA would require significant analysis and would not only include the enteric emissions or change thereof from business as usual, e.g., other emissions would need to be considered and feed markets would need to be analyzed and updated."

Staff's arguments for not including the enteric emissions credit due to feeding of DGs are weak. First, Staff expands the system boundaries in arbitrary ways already. The Staff has included indirect land use system emissions (iLUC), which cannot be measured, and can only be estimated with a combination of economic modeling and estimates of the carbon released during specific land use changes (i.e., the emission factors of each land use change). Staff has spent a great deal of time and effort on this indirect effect. So, other indirect effects such as reduced enteric fermentation should also be included in Staff's analysis. Second, Argonne has already estimated this effect, and has included it in GREET1-2013.

Staff has no specific criticisms of the effect as estimated in GREET1-2013. Staff say, however, that the primary driver of reduced enteric emissions are shortened lifespan of livestock. Staff is concerned that if feeding DGs increases livestock throughput, then enteric emissions could increase. They also cite studies that show feeding defatted DGs compared to grain feeding causes an increase in N2O emissions from finishing beef cattle, which could reduce the enteric credit.

We recommend that Staff include the DG enteric credit in CA-GREET2.0. It is already included in GREET2013. If Staff have concerns with the effect, then they should develop a better estimate of the effect after finalizing CA-GREET2.0 with the current effect, in much the same way as Staff adopted an iLUC effect in 2009 and have spent some effort in the last 1.5 years attempting to improve it.

We note that there is another very significant effect of enteric fermentation. The economic models show that increasing biofuels requires additional cropland, and much additional cropland comes from pasture and cropland/pasture. This raises livestock prices, thereby reducing total livestock herds and total enteric fermentation emissions. The EPA included this effect in the RFS four years ago. We have repeatedly commented to ARB that the Staff should include this effect as well in its analysis, and Staff has pushed this off to the future. Clearly, there are very significant effects of biofuels on enteric fermentation emissions in two areas – the DGs effect and the price effect – and ARB has ignored these effects in this analysis. These are very serious shortcomings in the current ARB analysis.

<u>Improper Cell References</u>

The release version of CA-GREET-2.0 has a number of improper cell references for chemicals used in corn and sugarcane ethanol plants. The improper references are as follows:

Corn Ethanol

1. T1 Calculator Cell E33 (Sulfuric Acid) is linked to ETOH Cell L361 (Sulfuric Acid), which is not used in any calculations
2. T1 Calculator Cell e34 (Ammonia) is linked to ETOH cell L362 (Ammonia), which is not used in any calculations

Sugarcane Ethanol

1. T1 Calculator Cell E175 (sulfuric acid) is linked to ETOH cell DU357 (Alpha Amylase), which is incorrect. That cell should be linked to ETOH cell DU361.
2. T1 Calculator Cell E176 (Ammonia) is linked to ETOH cell DU358 (Gluco Amalyse), which is incorrect. The cell should be linked to ETOH cell DU362.

Therefore, for corn ethanol, the emissions of sulfuric acid and ammonia are always zero. However, for cane ethanol, the emissions calculated for sulfuric acid and ammonia are erroneously those for alpha amylase and gluco amylase, respectively.