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Washington, D.C. 20001

June 27, 2008

Mr. John Courtis
Manager, Alternative Fuels Section
California Air Resources Board
1001 "I" Street
Sacramento, CA 95812

Dear Mr. Courtis,

The Renewable Fuels Association (RFA) respectfully submits the attached comments in response to the California Air Resources Board Lifecycle Analysis Working Group's "Detailed California-Modified GREET Pathway for Denatured Corn Ethanol." As the national trade association for the U.S. ethanol industry, RFA appreciates the opportunity to comment on CARB's current approach to lifecycle analysis for corn-based ethanol. As you will see in the attached comments, we have questions and comments about several of the key assumptions CARB is using for its current lifecycle analysis approach to corn ethanol.

It appears that CARB's value for corn farming input energy is based on a figure from the U.S. Department of Agriculture's 1996 Agricultural Resource Management Survey (ARMS). A more recent ARMS survey with corn farming energy use data was conducted in 2001, and even its usefulness is limited because of the rapid adoption of new technologies and tillage practices in the past seven years. We believe CARB should update its farm input energy use values based on current practices and technologies.

CARB's assumption for nitrous oxide emissions resulting from nitrogen fertilizer application is inconsistent with other research and appears arbitrary. Intergovernmental Panel on Climate Change findings suggest that 1% of nitrogen fertilizer is released as nitrous oxide, while CARB is using a factor of 2%. RFA supports the use of the 1% IPCC factor in the CARB model.

Further, we believe there is good reason for CARB to reevaluate its assumptions on carbon dioxide emissions related to lime application. The actual CO2 emission rates from lime vary

widely and depend on a number of factors. It is also notable that farmers who use limestone do not apply it annually and many do not ever apply lime.

In terms of energy input assumptions for ethanol production facilities, we encourage CARB to consider the results of a new industry survey on ethanol plant efficiency. The survey data were analyzed and published by Argonne National Laboratory in March 2008. The report clearly shows that energy use for ethanol processing has declined in recent years and that the values used by CARB, which were obtained from GREET, are likely too high.

RFA understands that there are a variety of methodologies and differences in opinion on the issue of co-product energy credits. However, we believe that because distillers grain typically contains higher protein and energy content than the feed products it is replacing, a pound-for-pound displacement assumption is incorrect. We encourage CARB to 1.) Engage animal scientists on this issue; and 2.) Review recent scientific literature on current distillers grains feeding practices.

Finally, RFA continues to be highly interested in the CARB's current thinking on the subject of indirect land use change and its impact on the overall lifecycle. We understand that CARB may be reconsidering the land use change factor presented in its April 21, 2008, report. RFA encourages the agency to ensure the best science is brought to bear on this issue. We also believe it is important that land use metrics are applied equally to all fuel pathways and that the *positive* effects of possible land use changes are also considered.

We sincerely appreciate CARB's consideration of these comments and look forward to further interaction with the agency as the fuel pathway methodologies are refined. We will continue to review information provided by CARB and respond with comments as appropriate.

Sincerely,

Bob Dinneen
President & CEO
Renewable Fuels Association

Comments of the Renewable Fuels Association on
"Detailed California-Modified GREET Pathway for Denatured Corn Ethanol"

Overview

This report was issued by the CARB Stationary Source Division on April 21, 2008 and is labeled Version 1.0. It is stated that the report remains under internal review and hence the results are subject to change.

This report is a well-to-wheels (WTW) analysis of greenhouse gas emissions associated with ethanol production from corn and its use in vehicles. It follows typical protocols for this type of analysis, namely separating the analysis into well-to-tank (WTT) and tank-to-wheels (TTW) sections. The WTT portion includes energy and greenhouse gas emissions (GHGs) from farming, agricultural chemicals, corn transport, ethanol production, ethanol transport and co-product credits. There is a small land use GHG category as well. The TTW portion encompasses the vehicle use phase. CO2 from the combustion of ethanol is not counted since it is renewable. Only the CO2 from the 2.5% gasoline denaturant is included. Nitrous oxide and methane from vehicle use of ethanol are not included since "ethanol is not typically used as a fuel by itself in California."

As noted in the title of the report, the model used is a version of GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation) called the CA-modified GREET model. Modifications to the model have been made to reflect California specific conditions, rather that the U.S. national average values used in GREET. For this exercise, however, most energy use occurs outside California and hence U.S. national average values are used.

ARB has indicated that this is the first release of the report, and that they are performing additional work on many of the numbers used in the report, and that there will be a later release of the report with updated numbers. Our review evaluates both the methods and the numbers in the current report.

Comments

In the following comments, we first state the ARB assumption as indicated in the Corn Ethanol report. Then we state our comments on that assumption or estimate. [1]

1. Corn farming input energy is assumed to be 22,500 Btu per bushel, which is stated to be 90% of the 1996 value. The 1996 value was based on the Agriculture and Resources management Survey (ARMS), which is conducted every several years by USDA.

[1] In this document, footnotes are indicated with a superscript, and references are indicated with square brackets: [x]

Comment: What calendar year is ARB estimating the corn farming energy input for? Is it for calendar year 2006, which is the ARB-proposed base year from which the 10% LCFS reduction requirement is being estimated? We think the most recent corn farming survey in the ARMS is for 2001. If so, then the corn farming energy input value is out-of-date, and should be updated to a 2006 level.

Work conducted by Dale and Kim indicate a corn farming energy input of about 16,217 Btu per bushel, or 28% less than the GREET value.[2] *[1] We believe this value is more current than the GREET value, and should be used in the California GREET model.*

2. There is a land use change factor of 195 grams of CO2 per bushel. There is no indirect land use effect in the model.

Comments: We understand that this is an area that the ARB may change in the near future, and is conducting much more research on this issue. However, we offer the following comments at this time, and will offer more comments on land use issues if and when ARB releases its new analysis:

First, we think the science and data for developing the size of the indirect land use change and the effect of that change due to biofuels is currently too uncertain and inadequate to support the kind of estimates that ARB is attempting to make. We agree with the letter that was sent from Blake Simmons, PhD, et al to Mary Nichols on June 24th, stating that, "significant research is still required to develop reliable data training sets and validated LCA tools that can accurately guide policies such as the LCFS." [2]

Second, in its effort to estimate the effects of the indirect land use change, ARB appears to not be considering the positive effects of possible land use change. For example, research by Oak Ridge National Laboratory and others indicates the biofuels can: (1) reduce recurring use of fire to clear land, thereby reducing GHG emissions, (2) reduce the pressure to clear more land, and (3) improve soil carbon. [3] These factors are not included in the GTAP modeling framework that ARB is using to project land use changes. In addition, research by Kauppi, et al, indicates that if annual per capita GDP is greater than $4,600, forest biomass stocks were increasing. [4] If communities around the world participate in growing additional crops, then it is possible that their improved standard of living would allow for increased yields, reducing the pressure to convert additional land, and thereby increasing forestation, rather than reducing it.

Third, ARB appears to have chosen to include indirect land use effects for biofuels grown from various crops or other feedstocks such as switchgrass, poplar, etc. However, ARB currently appears to be ignoring direct and indirect effects (land use and other effects) for other fuel pathways such as petroleum and electricity. The reasons for this are not clear. One example of direct land use effect for electricity is the use of coal to generate

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[2] The values for 8 counties in 7 different states range from 8,146 Btu/bu to 31,483 Btu/bu. See the data in Appendix 1, which is consistent with the information presented in Table 4 of the Reference 1.

electricity, where the coal comes from open mining operations in Wyoming and Montana. The ARB report "Detailed California Modified GREET Pathway for California Average Electricity" indicates that 15.4% of the electricity use in California comes from coal-fired facilities located out of the state (this 15.4% accounts for 48.4% of the GHGs from electricity). These coal-fired facilities are located in Nevada and Utah, and very likely use coal that comes from open mines in Wyoming and Montana, where the surface land has been stripped away to reveal the coal for mining. The ARB Electricity report does not discuss these land-use impacts.

Also, according to research conducted by Oak Ridge National Laboratory and others, the building of roads in tropical areas to install petroleum extraction facilities can lead to significant deforestation along the roads as the population expands along the roads and further. [3] Finally, ORNL references work that estimates that the Alberta tar sands operations have resulted in the clearing of 140,000 km^2 of land in Canada. [3] To be consistent, these land use effects should be included for other fuel pathways if they are going to be included for biofuels. These issues are not discussed in the ARB report "Detailed California-Modified GREET Pathway for California Reformulated Gasoline Blendstock for Oxygenate Blending (CARBOB) from Average Crude Refined in California." In order to be consistent with the primary purpose of AB 32 to reduce the potential global warming impact of greenhouse gases, the Low Carbon Fuel Standard regulatory activities should adequately consider all fuel related sources of greenhouse gases.

Finally, we have at least one major concern with the GTAP model that ARB appears to be using to evaluate land use changes. This concern is the fact that the model does not include co-product effects. [5] The primary co-product from dry milling ethanol plants are distillers grains, which are used in various forms as feed for ruminants, and replaces some of the grain used to feed cattle. Inasmuch as the corn used to make ethanol produces feed for cattle, this reduces the land needed to grow corn for cattle. This is discussed further in our comments on co-products.

3. It is assumed that 2% of the fertilizer nitrogen is released to the atmosphere as N2O.

Comments: Michigan State University's work with the DAYCENT model using location-specific modeling information indicates that the range of nitrous oxide emissions is very large and depends on local soil type, temperature, rainfall and especially management practices. [1,6] It can be essentially eliminated, for example, using cover crops. The 2% value is on the high side of averages that MSU has calculated. The IPCC recommends a rate of 1%. We recommend that ARB use the IPCC rate of 1% instead of an arbitrary 2% rate.

4. It is also assumed that all carbon contained in lime is emitted to the atmosphere as CO2.

The CO2 emission rates from lime depend on the lime application rates. We think the lime application rate is far too high, but in general, the data on lime application rates are not very good. The lime application rate in GREET is 1,202 g/bushel. Work by Kim and Dale have estimated the rate as 32.39 kg/HA, which translates to about 87.4 g/bushel.[3] *[1]. A common error is to assume that the application rates given in sparse data are yearly values. Actually farmers never apply limestone on a yearly basis. If they apply limestone at all, it is every few years, not yearly. We think ARB's estimates are far too large.*

The lime application rates have a significant effect on WTT energy. With a 1,202 g/bushel lime rate, WTT energy for chemical input for a dry mill from GREET is estimated at 159,380 Btu/mmBtu (Table 2.01 of ARB report). If the lime rates were reduced to 87.4 g/bu as indicated in the Kim and Dale work, the WTT energy would be 119,492, or 25% lower.

5. The primary energy input for a dry mill plant for anhydrous ethanol is 34,889 Btu/gallon, or 457,046 Btu/mmBtu (Table 4.02). The primary energy input for a wet mill plant for anhydrous ethanol is 45,950 Btu/gallon, or 601,945 Btu/mmBtu (Table 4.03).

These energy use values for ethanol plants are obtained from GREET, and may be values based on older plants and surveys. The ARB report does not indicate what this estimate is based on, other than the GREET model.

RFA recently conducted a survey of 22 dry mill and wet mill plants. The survey data were analyzed by Argonne National Laboratory. [7] Average total primary energy use for dry mill plants was 31,070 Btu/gallon, or 410,124 Btu/mmBtu. This is 11% less than the GREET value. Average total primary energy use for dry mill plants was estimated at 47,409 Btu/gallon, or 625,798 Btu/gallon. This is 4% higher than the GREET value. We believe the RFA survey data for dry mills is appropriate, and should be used in the California GREET model. We have reason to believe that the wet mill plants responding to the survey may have been on the high side in terms of energy consumption. Further work is being done on wet mill energy consumption, which will be shared with ARB as soon as it is available.

6. Co-product energy credits for the dry mill are approximately half those of the wet mill, 96,137 vs. 200,986 Btu/mmBtu. It is noted in Appendix A (page 64) that "the weightings for displacing feed corn and soybean meal are different here compared to the original GREET which uses a much higher default co-product credit for dry mills." The energy credit for wet mills reduces the total WTT energy by 20%.

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[3] See Table 1 of the reference, where the lime application rate is 32.39 kg/HA, which translates to 87.42 g/bushel at an average yield of 150 bushels per acre and 2.47 acres per HA.

We have at least two concerns with the co-product credits used by ARB. One concern is ARB's assumption that distillers grains (DGs) replace conventional animal feed on a pound for pound basis (i.e., one pound of DGs replaces 1 lb of combined corn and soymeal). There is evidence that the replacement rate is higher than this; i.e. that 1 lb of DGs replaces more than 1 lb of conventional feed. If this is true, then the energy credit associated with DGs (estimated with the substitution method) is higher than ARB estimates. [8,9]

The second concern is that the GREET model does not include a land use credit for DGs. DGs replace both corn and soy meal utilized in animal finishing yards (feedlots). This replacement should not only have an energy credit, but should also significantly reduce the land area impact of ethanol. As indicated in point 2, this is a shortcoming of the GTAP model, and other land-use impact estimates as well. Therefore, in estimating direct or indirect land use changes due to ethanol, ARB should first estimate the land use credit due to DGs, using information on current and anticipated practices of use.

References

1. "Life Cycle Assessment of Fuel Ethanol Derived from Corn Grain via Dry Milling," Kim, S. and Dale, B., Department of Chemical Engineering and Materials Science, Michigan State University, Bioresource Technology 99 (2008), 5250-5260.

2. Letter from Blake Simmons, et al, to Mary Nichols, June 24, 2008.

3. "Global Land Use Issues", Presentation by Keith Kline, et al, Oak Ridge National Laboratory, at the 5th Annual Forum of the California Biomass Collaborative, May 29, 2008.

4. Kauppi, P.E., et al, "Returning Forests Analyzed with the Forest Identity", Proc. Nat. Acad. Sci., USA 103, 17574 (2006).

5. "Biofuels for all? Understanding the Global Impacts of Mulitnational Mandates", Hertel, Tyner, and Birur, Revised May 1, 2008, Department of Agricultural Economics, Purdue University, GTAP Working Paper No. 51, 2008.

6. Kim and Dale, "Life Cycle Assessment Study of Bipolymers (Polyhydroxyalkanoates) Derived from No-Till Corn", International Journal of Life Cycle Analysis, 10 (3) 200-210 (2005).

7. "Analysis of the Efficiency of the U.S. Ethanol Industry 2007", Argonne, March 27, 2008.

8. "Use of Distillers By-Products in the Beef Cattle Feeding Industry", Klopfenstien, Erickson and Bremer, J Animal Sci, 2008:86:1223-1231.

9. "Effect of Dietary Inclusion of Wet Distillers Grains on Feedlot Performance of Finishing Cattle and Energy Value Relative to Corn", Vander Pol, Erickson, et al, Animal Science Department, University of Nebraska/Lincoln, 2006.

Appendix 1

Corn Farming Energy Inputs

Source: Reference 1 and Authors

County	Farming, Btu/mmBtu	Farming, Btu/bu*
Hardin (IA)	51695	10608
Fulton (IL)	39696	8146
Tuscola (MI)	98282	20167
Morrison (MN)	95690	19636
Freeborn (MN)	68379	14031
Macon (Mo)	74963	15382
Hamilton (NE)	153426	31483
Codington (SD)	50117	10284
Average	79031	16217
Assumes 76,000 Btu per gallon of ethanol and 2.7 gallons ethanol per bushel of corn		