Renewable Fuels Association

November 21, 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’s workshop held October 16, 2008.

As the national trade association for the U.S. ethanol industry, RFA appreciates the opportunity to comment on the information presented at the workshop and CARB’s current approach to lifecycle analysis and land use change effects. As you will see in the attached comments, we have prepared detailed comments about the land use models, key assumptions, and fundamental approach CARB is using for its current lifecycle analysis of ethanol.

In general, we continue to believe the current understanding of the causes and effects of indirect land use change is woefully insufficient. The ongoing discourse and research surrounding land use change issues clearly suggest we are not currently able to estimate indirect land use changes (particularly international land conversions) with any degree of certainty. The soundness and effectiveness of a policy framework based on concepts that are not fully understood would most certainly be called into question by stakeholders and consumers alike.

Additionally, we continue to believe the Global Trade Analysis Project (GTAP) model employed by CARB for this analysis requires significant refinement and validation before it can be reasonably used in the development of a policy framework such as the Low Carbon Fuels Standard. Our attached comments are quite detailed in this regard, as we continue to gain a better understanding of the model.

Among the major concerns we have with the GTAP modeling used to produce the results presented October 16 are: underestimation of the productivity of converted land in the U.S.; underestimation of average grain yields due to the absence of a factor accounting for technology improvements; underestimation of the significant land use “credit” provided by distillers grains (the feed co-product of grain ethanol); and omission of Conservation Reserve Program land and idle cropland from the land inventory.

One other particular concern with the GTAP model is that it does not include a time element. To simulate ethanol expansion, the model is "shocked" for a 13.25 billion gallon ethanol increase (simulating the increase in ethanol between 2001 and 2015). The model must "handle" this extreme adjustment instantaneously. In the real world, market conditions change, new technologies are introduced and dynamic adjustments are made every year. In other words, the "shock" is much slower and sufficiently more complex in the real world, with potentially much different effects than simulated by the model.

Further, we have concerns about the data (from Woods Hole Research Center) being used by CARB to estimate carbon emissions from converted lands. The Woods Hole data are derived from research examining Latin American native grassland with relatively high carbon storage rates, but these data are being applied to non-native grassland and pasture with much lower carbon storage rates in the United States. We believe more accurate data on emissions rates from U.S. grassland and pasture is available through Colorado State University and the U.S. Environmental Protection Agency.

As stated in our July 15, 2008, comments to CARB, we continue to believe it is important that indirect land use (and other indirect effect) metrics are applied equally to all fuel pathways and that the *positive* effects of possible indirect effects (e.g. reductions in enteric methane emissions from livestock due to increased feeding of distillers grains) are also considered.

We sincerely appreciate CARB's consideration of these comments and look forward to further interaction with the agency as it continues development of the Low Carbon Fuels Standard regulation. We welcome a further dialog on this subject and look forward to responses to any of the comments offered in the attached document. We will continue analyze the GTAP model, review the information provided by CARB, and respond with comments as appropriate.

Sincerely,

Bob Dinneen
President & CEO
Renewable Fuels Association

Comments from the Renewable Fuels Association
to California Air Resources Board
Regarding October 16 Workshop Materials and GTAP Model

November 21, 2008

On October 16, 2008, the California Air Resources Board (CARB) released a draft regulation for the California Low Carbon Fuels Standard (LCFS) and a document entitled "Supporting Documentation for the Draft Regulation for the California Low Carbon Fuels Standard." Our comments are primarily focused on information presented in the supporting documentation report.

Our main comments focus on CARB's current estimates of greenhouse emissions resulting from land use changes (LUC) due to corn ethanol expansion. CARB's analysis of LUCs for corn ethanol is contained in Appendix A of the supporting documentation report. Basically, CARB ran the Global Trade Analysis Project (GTAP) model through a number of different sensitivity cases using various elasticities to estimate a range of land use change impacts. GTAP was used for estimating land use changes and the locations of those changes, and the Woods Hole data was used to estimate emission rates for converting different types of land (e.g., forest vs. grassland). The land use change estimates ranged from 20 to 88 g CO_2 eq./MJ, with a median estimate of about 35 g CO_2 eq./MJ. We note that this represents a factor of more than 4X between the low and high estimate.

We still have a number of concerns with how the GTAP modeling is being conducted, and also with certain applications of the Woods Hole emissions data. These concerns are summarized below, and subsequently expanded upon.

1. CARB likely underestimates the productivity of land being converted to crops in the United States (i.e. "marginal" land).

2. Due in part to item 1, and considering the fact that there is no factor to account for observed and future technology improvements in yield independent of price, the projected crop yields are too low in the most recent GTAP analysis. Because the model is "shocked" with 13.25 billion gallons of new ethanol production instantaneously, and yield values do not take into account the improvement in yields between 2000 and 2015, the model is converting too much land to crops as a result.

3. The GTAP model may not be accounting for natural declines in wheat and cotton in the U.S. expected between 2001 and 2015. Empirical data indicates lost production of wheat and cotton in the United States over the past several years has not entirely been made up for in other locations.

4. The above three factors cause exports of corn and soybeans to decline significantly in the modeling. Empirical data shows exports have not declined in the period from 2001 to 2007.

5. The distillers grain (DG) land use "credit" being used in the GTAP modeling is likely too low and needs to be modified, taking into account the recent analysis of DG feed displacement performed by Argonne National Laboratory.

6. The land conversions in GTAP do not adequately take into account the economic cost of converting forest and native grasses to cropland.

7. There does not appear to be Conservation Reserve Program land or idle cropland in the GTAP database used for the analysis described in the October 16 documentation.

8. Woods Hole data for native grassland with high carbon storage rates are being used to estimate emissions from non-native grassland and pasture in the U.S. with lower carbon storage rates.

9. Emissions for forest area assume all mass above ground is converted to CO_2 immediately, when some is likely to be used in building products that would not be converted for a long time.

These concerns are expanded upon below.

Comment 1: *CARB likely underestimates the productivity of land being converted to crops in the United States (i.e. "marginal" land).*

CARB refers to this factor as the "elasticity of crop yields with respect to area expansion." CARB indicates that "although this is a critical input parameter, little empirical evidence exists to guide the modelers in selecting the appropriate value. Based on the judgment of those with experience in this area, the modelers selected a value of 0.66. For purposes of the sensitivity analysis this parameter was varied from 0.25 to 0.75. This input variable produced by far the greatest variation in the output GHG variable: 77%."

When CARB varied this parameter from 0.25 to 0.75, the GTAP model produced the two extremes in LUC emissions, 88 and 20 g CO_2 eq./MJ (the price-yield elasticity was held at 0.4 for this sensitivity analysis).

RFA believes there is empirical data to guide the selection of this important parameter, especially for the U.S. Through our analysis of land use patterns, it has become evident that land devoted to wheat and cotton in the U.S. is declining somewhat, and corn is replacing these crops in some of these areas. In addition, corn-on-corn cropping systems are increasingly replacing traditional corn-soybean rotations. Literature suggests the corn-corn pattern does involve a modest decline in corn yields from a corn-soybean system, but the expected decline for this rotation is not in the range of 25-75%. Finally, farmers may convert some idle land or cropland pasture to corn. Many farmers will crop land for a given period, and then convert it to pasture or fallow the land to regain nutrients and carbon. When the land is re-cropped after fallowing, yields tend to rise.

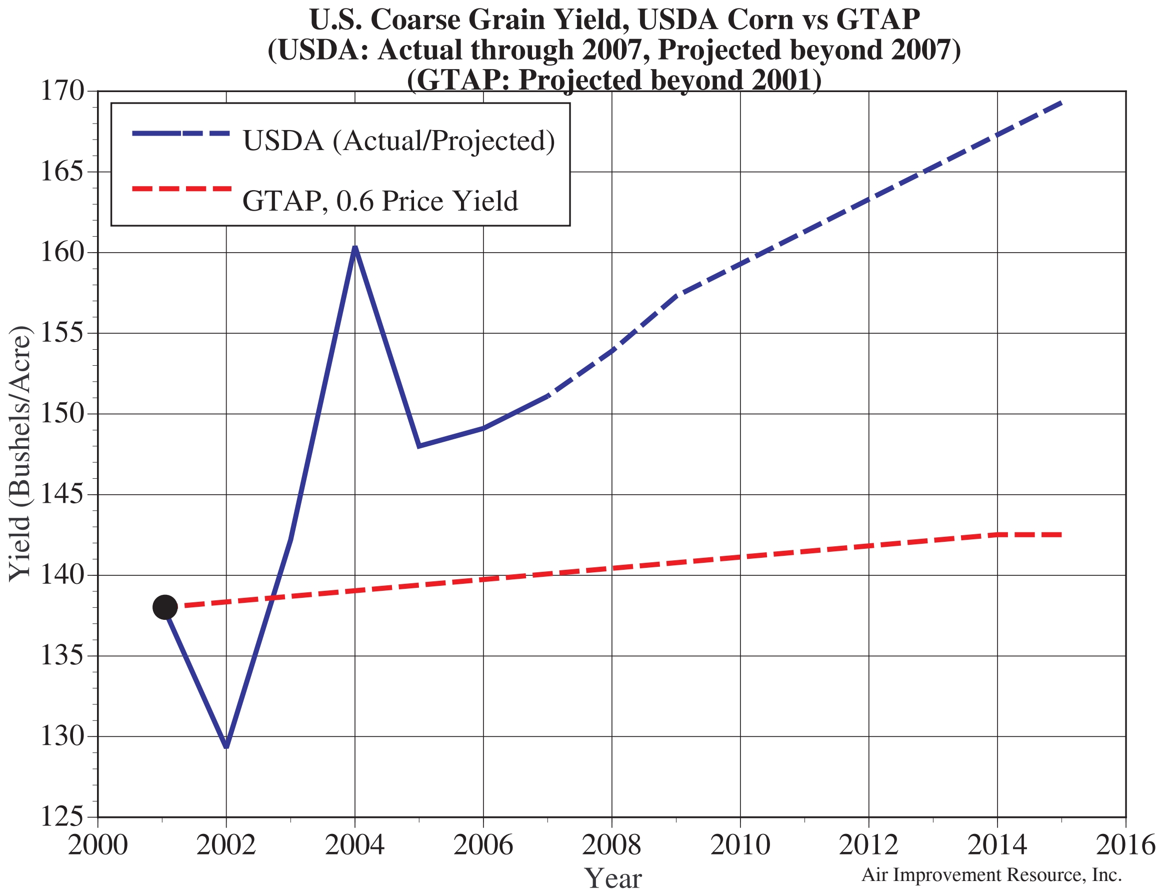
To evaluate the potential yield of corn replacing cotton and wheat, we examined USDA corn yield data for states with the highest cotton and wheat output. The corn yields in these states were a volume-weighted average of 20% below the corn yields in the top 10 corn producing states. The details of this analysis will be described in a forthcoming land use change report by Air Improvement Resource (AIR). As a result, we believe that there is data available in the U.S. that indicates the elasticity of crop yields with respect to area expansion should be 0.8 or higher.

We have not found data for areas outside of the U.S., but that is a different matter. One of the major flaws with the current GTAP model is that it applies the same expansion elasticity to all regions, all agricultural ecological zones (AEZs) within a region, and all crops. This is a parameter that should be input by region, AEZ, and crop (e.g., coarse grains should have a different elasticity value than oilseeds).

Comment 2: *Due in part to the issues described in Comment 1, and considering the fact that there is no factor to account for observed and future technology improvements in yield independent of price, the projected crop yields are too low in the most recent GTAP analysis.*

The GTAP model used for the October 16 report is based on a 2000/2001 database. To simulate ethanol expansion, the model is "shocked" for a 13.25 billion gallon ethanol increase (simulating the increase in ethanol between 2001 and 2015, for example). The model must "handle" this extreme adjustment instantaneously, while in the real world, conditions change every year and dynamic adjustments are made every year. In other words, the "shock" is much slower in the real world, with potentially much different effects than simulated by the model.

Nevertheless, the model outputs the change in yield for different crops in response to the shock. This yield is a function of two factors: the elasticity of crop yields discussed in comment 1, and the price-yield elasticity. CARB ran a sensitivity analysis of the price-yield elasticity, with values ranging from 0.6 to 0.1, while the elasticity of crop yields was fixed at 0.5. In this analysis, LUC impacts varied from 29 to 57 g CO_2 eq./MJ, not as sensitive as the elasticity of crop yields, but still quite sensitive. The higher value (0.6) would indicate a higher response of crop yields to crop prices. For its pending report, AIR examined the yield increases before and after the shock, and compared these yields to historical and projected yields obtained from USDA for the time period from 2000-2001 to 2015-2016, which the model is trying to represent. The results are shown in the figure below.



Note: 2001-2007 USDA yield plots are actual recorded values. 2008-2015 yield plots are USDA projections from "Agricultural Long Term Projections to 2017"

Analysis of GTAP output shows that for this scenario, yield values increase by 3.27% in the production region defined as "U.S." The base yield is 138 bu./acre, so a 3.27% increase is 4.5 bu./acre, and, thus, the expected 2015-16 yield in the U.S. is 142.5 bu./acre. This is far too low, as USDA historical yields for the 2004-2007 time period are much higher (in the 150+ bushel/acre range). USDA's projections to 2015-16 show a yield of approximately 170 bu./acre, or 20% higher than the GTAP 2015-16 yield value generated by the 13.25 billion gallon ethanol shock. This underestimation of yield in GTAP results in much more land being converted than is likely to be the case.

Part of the reason the GTAP yields stay low in the U.S. under this scenario is because the elasticity of crop yields with area expansion is set to 0.5. To evaluate only the price-yield effect, we reset the elasticity of crop yields to area expansion to a value of 1.0, left the price-yield elasticity at 0.6, and ran the 13.25 billion gallon shock through GTAP to examine the coarse grain yield increase in the U.S. The results show a coarse grain yield increase of just 3.9%, from 138 bu./acre to 143.4 bu./acre. This is still far below the USDA projection, and a source for significant concern.

One conclusion from this is that the price-elasticity function does not explain all of the yield increases that are anticipated. The model is shocked, coarse grain prices increase somewhat, and the elasticity function predicts a slightly higher yield (but not enough). We believe there is a technology factor in yield that is not necessarily explained with price. This would mean that either the price-yield elasticity value needs to be increased to explain this technology driver, or perhaps a separate factor should be added that would be a technology driver. Either way, the current yield increases in the U.S. being modeled by GTAP on the 13.25 billion gallon ethanol shock are far too low, as demonstrated by actual average yields from the past four years and the projected yield for 2008 of 153.8 bu./acre.

We did try to increase the yield in GTAP by setting the yield expansion elasticity to 1.0 and increasing the price yield elasticity well above 0.4 or 0.6. However, the model applies this price-yield elasticity to every crop in every region. The GTAP model should allow the user to apply different improvements to different crops and different regions. We are attempting to program this characteristic into GTAP so that we can vary price yield elasticity by crop (e.g., oilseeds vs. coarse grains) in the U.S.

Comment 3: *The GTAP model may not account for reductions in wheat and cotton in the United States.*

This issue is based on analysis of trends, just like the previous issue. Information from USDA and other sources indicates that land devoted to cotton and wheat in the U.S. has been declining over the long term, due to a reduction in the demand for wheat (along with productivity improvements), reduction in the demand for cotton, and a shift from cotton growing in the U.S. to some being grown in China and India. Since the GTAP model starts with a 2000/2001 database, and the model is shocked for 13.25 billion gallons, the model may not be appropriately accounting for this change. The model appears to assume that the demand for cotton and wheat are essentially constant, and is therefore forced to make up the loss in these crops elsewhere.

Comment 4: *The three factors described in Comments 1-3 cause exports to decline significantly in the modeling.*

Since the factors discussed in comments 1 and 2 result in yields that are too low for the U.S., and the situation described in comment 3 may not be not properly accounted for, U.S. exports drop significantly on the shock, and the regions outside of the U.S. must make up for the drop in exports. These regions do so by converting land to coarse grains and other crops. However, since yields are lower outside the U.S., more land is converted to meet these shortfalls than would be converted inside the U.S. For this reason, it is very important that GTAP model the U.S. situation as accurately as possible with respect to land elasticity and price-yield elasticity.

Comment 5: *The distillers grain (DG) land use credit is too low and needs to be modified, taking into account the recent analysis of this issue performed by Argonne National Laboratory.*

The GTAP report "Biofuels and their Byproducts: Global Economic and Environmental Implications" (June 2008) indicates that DGs are being modeled as a substitute for coarse grains (see flow diagram on page 12 of the GTAP report) in the livestock sectors of the model. GTAP is using an elasticity of substitution of .30 between coarse grains and DGs. This value was selected by examining the price changes of coarse grains and DGs over the time period of 2001-2006 when ethanol production was rising sharply. Results of simulations with and without coproducts indicate that incorporating these effects reduces the increase in the demand for corn land from 9.8% to 6.3%, a reduction of 36%.

A recent report by Argonne National Laboratory on the use of ethanol co-products in all livestock sectors indicates that 1 lb. of DGs replace around 1.28 lbs. of base animal feed, Of the feed replaced, 0.96 lbs. is corn and 0.29 lbs. is soy meal.[1] There are two important implications for GTAP in the Argonne report. One is that the GTAP model should be modified so that DGs replace not only coarse grains, but also replace some amount of oilseed meal (in the livestock section of the model). Since soybean yields are lower per acre than corn yields, this will have significant land use implications. In other words, referring to page 12 of the GTAP report referenced above, the oilseed part of the feed model should be modified in a similar way as coarse grains were for byproducts. Then, the model will have to allocate a portion of the DGs to coarse grains and oilseeds, according to the allocations developed by Argonne.

The second implication of the Argonne work is that DGs replace base feed on a greater than 1-to-1 basis. It appears this fact is not being included in the GTAP model simply by evaluating historical data of the elasticity of substitution between coarse grains and DGs. Therefore, some factor will need to be incorporated into GTAP for this relationship as well.

We estimated the impacts of the Argonne work on land use changes using inputs from the California GREET report for corn ethanol.[2] The report indicates that the DG yield per gallon of anhydrous ethanol is 6.4 lbs. Assuming 151 bu./acre (USDA value for 2007), and 2.6 gal/bu. (GREET input), this results in 2,513 lbs. DGs per acre. The Argonne co-products report indicates that this amount of DG will replace 3,217 lbs. of feed, consisting of 2,445 lbs. of corn meal and 772 lbs. of soy meal. Again using USDA's corn and soy yields for 2007 of 8,456 lbs./acre for corn (151 bu./acre * 56 lbs./bu.) and 2,502 lbs. per acre for soy (42 bu./acre and 44 lbs. of soy meal/bu.),

[1] "Update of Distillers Grains Displacement Ratios for Corn Ethanol Life-Cycle Analysis," Arora, Wu, and Wang. Argonne National Laboratory. September 2008.

[2] "Detailed California-Modified GREET Pathway for Denatured Corn Ethanol," Stationary Sources Division, ARB, April 21, 2008.

the corn acres replaced are 0.29 acres, and the soy acres replaced are 0.42 acres, for a total of 0.71 acres replaced by the DGs produced from making ethanol from one acre of corn.[3] Thus, 71% of the acres devoted to ethanol are replaced by the resultant DGs. This is significantly higher than the current GTAP assumption of about 36%. Most of this difference is due to the fact that GTAP is not currently assuming that DGs replace any soy meal.

Comment 6: *The land conversions in GTAP may not adequately take into account the cost of converting forest and grasses to cropland.*

The land conversions between cropland, pasture and forest are governed at least in part by the elasticity of land transformation across cropland, pasture, and forestry. This value "was set to the relatively low value of 0.2, based on historical evidence for land cover change in the U.S. over the 1982-1997 period," according to the supporting documentation. We are not sure that this value properly evaluates the costs of converting land from forest to crops and from grass to crops. Research conducted by Colorado State University for the U.S. EPA in estimating conversion of land to cropland in the U.S. indicates that most of the land converted in the last decade to crops in the U.S. has been non-native grassland such as pasture or fields that have been idled, and not forest or native grassland. [4] CARB's "Scenario A" in Appendix A indicates that GTAP expects that 40% of the land converted in the U.S. to be forest, and 60% to be pasture. Other scenarios in this appendix indicate a range of 31% to 50% forest converted. We will be providing further information on forest conversion in the forthcoming AIR land use report.

Comment 7: *There does not appear to be CRP land or Idle Land in the GTAP database.*

In our comments on the previous workshop (June 30, 2008), we indicated that CRP land and idle land should be included in the GTAP model land use database. To our knowledge, this has not yet been done, but we understand CARB, U.C.-Berkeley, and Purdue University may still be working on this.

This issue is important because it affects the mix of land converted to crops. Idle land and CRP land are both areas of land that previously grew crops. If this land is not available in the model, then the model will instead convert forest, pasture, and other crops to corn. The inappropriate conversion of forest will raise emissions. The inappropriate conversion of pasture will cause a false reduction in livestock output.

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[3] Note that in this estimate, we have estimated that 100% of the corn is converted to corn meal, but 73% of the soybean bushel of 60 lbs. is converted to soy meal because 26% of the mass has been extracted in the form of soy oil and other materials. (Source: Chicago Board of Trade "Soybean Crush Reference Guide"). Also, the ethanol yield of 2.6 gal./bu. may be too low – two recent studies of ethanol processing efficiencies indicate that the yield may be between 2.7 and 2.8 gal./bu. This would increase the DG land credit from 71% to 77%. (Sources: "Analysis of the Efficiency of the U.S. Ethanol Industry in 2007", May Wu, Argonne, March 27, 2008; and "U.S. Ethanol Industry Efficiency Improvements, 2004 through 2007", Christianson and Associates, August 5, 2008)

[4] Personal Communication with Dr. Steve Ogle, Colorado State University, November 14, 2008.

The inappropriate conversion of other crops will mean that production needs to be made up elsewhere, when this is not likely the case.

A good source of data on idle cropland is the 2003 National Resources Inventory (NRI). [5] This data source is also used by the Colorado State University CENTURY model mentioned earlier. The table below shows trends in cultivated and non-cultivated cropland. CRP land, pasture land, range land, and forest land are separate from these categories in the NRI.

Cultivated and non-Cultivated Cropland by Year (millions of acres)			
Year	Cultivated	Non-cultivated	Total
1982	375.8	44.1	419.9
1992	334.3	47.0	381.3
1997	326.4	50.0	376.4
2001	314.0	55.5	369.5
2003	309.9	58.0	367.9

These data show that the agriculture industry had 58 million acres of non-cultivated cropland in 2003. It is unclear whether this land is part of the GTAP land inventory for the U.S., but based on the modeling results it seems unlikely. Much of the non-cultivated cropland would be utilized for expansion of crops before forest or native grass is converted.

Comment 8: *Woods Hole Research Center data for native grassland with high carbon storage rates are being used to estimate emissions from non-native grassland and pasture in the U.S. with lower carbon storage rates.*

The emissions rate for grassland converted to cropland being used in GTAP is a value of 110 Mg CO_2 eq./Ha. This comes from the Woods Hole data, and was developed in Latin America for natural or native grassland in that region. [6]

ARB is currently applying this rate of 110 Mg CO_2 eq./Ha to conversion of all grassland in the U.S. and elsewhere, whether it is native grassland, pasture, or idle farmland. However, it is inappropriate to apply this emission rate to U.S. pasture or idle farmland. Native grassland, since it has been undisturbed for perhaps hundreds of years, would store much more carbon than pasture and idle farmland.[7] And, it is

[5] 2003 Annual NRI – Land Use, USDA.
[6] "Changes in the Landscape of Latin America Between 1850 and 1985 II. Net Release of CO2 to the Atmosphere", R.A. Houghton, et al, Forest Ecology and Management, 38 (1991). This study indicates that 10 Mg of C/ha is above ground for grassland, and 80 mg of C/Ha is below ground, and that by conversion of the land, 25% of the root carbon is released (10+25%*80 = 30 Mg/ha). This is then converted to CO2 by multiplying by the ratio of molecular weights of CO2 to C (3.67).
[7] Personal Communication with Dr. Steve Ogle, CSU, November 14, 2008.

very unlikely that widespread conversions of native grassland are taking place in the U.S. Thus, a different emissions rate must be used for grassland conversion in the U.S., and for pasture conversions outside the U.S.

The Colorado State University (CSU) CENTURY model was used to estimate the emissions from converting land to cropland for the most recent EPA Greenhouse Gas and Sinks Report. [8] According to CSU, most of this land converted was grassland. Using information in various Annexes to this report which show total emissions and total land converted, the average emission rate is about 16 Mg CO_2 eq/Ha. This is far less than the 110 Mg CO_2 eq./Ha being used by CARB. Our review of the EPA report indicates that this is a much more detailed and better method of estimating carbon releases from land conversions in the U.S. than using estimates for native grassland in tropical areas. It should also be used for pasture conversions outside of the U.S., since these are also not "native grasslands."

Comment 9: *Emissions for forest area assume all mass above ground is converted to CO2.*

The emission rates being used for forest converted in the model assume that all forest is converted to CO_2. In reality, much of the forest mass is harvested before conversion. Some of this mass is used to produce furniture or to build houses and other products, where it would not be converted to CO_2 for many years. ARB should subtract some mass from forest conversion for these products. AIR is evaluating data on these fractions and will supply what we have a later date.

Conclusion

This concludes our comments at this time. We are continuing to evaluate GTAP and emissions rate data for land conversion from different sources. We will have more specific comments on GTAP in the near future. We also continue to review other sections of the draft LCFS regulation ad supporting documentation and may have comments on other aspects of the pending regulation in the near future.

[8] "Inventory of U.S. Greenhouse Gases and Sinks: 1990-2006", USEPA, April 15, 2008.