Renewable Fuels Association

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July 15, 2008

Mr. John Courtis
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1001 "I" Street
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Dear Mr. Courtis,

The Renewable Fuels Association (RFA) respectfully submits the attached comments in response to the California Air Resources Board's land use change workshop held on June 30, 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. As you will see in the attached comments, we have questions and comments about the land use models, key assumptions, and fundamental approach CARB is using for its current lifecycle analysis of ethanol and other biofuels.

First, we continue to believe the current scientific, social, and economic understanding of land use change is woefully insufficient. Presentations at the workshop and the ongoing discourse surrounding land use change clearly suggest we are not currently able to estimate land use changes 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 believe the Purdue University Global Trade Analysis Project (GTAP) model 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. The GTAP modeling results presented and discussed at the June 30 workshop clearly demonstrate that the model has substantial limitations and flaws. For example, the GTAP model's land inventory does not include Conservation Reserve Program (CRP) lands or idle cropland.

Logically, CRP and idle cropland would be the first lands to be brought back into production if future increased crop demands cannot be met solely through increased yield per acre. Why does the GTAP model not include these lands?

Further, we encourage a thorough peer-reviewed validation of GTAP that uses back-casting to compare modeling results against real-world empirical data. It is of great concern to us that such validation has not been performed as part of this process. Many of the assumptions underlying the collective understanding and modeling of global land use change—such as the idea that U.S. corn exports will be drastically reduced, or the idea that U.S. soybean production will be dramatically reduced—have certainly not proven true.

We also question whether current modeling efforts account for the statutory restrictions on certain land use changes included in the 2007 Energy Independence and Security Act. The Act's "renewable biomass" provision clearly precludes biofuels derived from feedstocks coming from previously forested or non-agricultural lands. How do GTAP and other models account for this and other regulatory restrictions on land use change?

As stated in our June 27, 2008, comments to CARB, we continue to believe it is important that land use (and other indirect effect) metrics are applied equally to all fuel pathways and that the *positive* effects of possible indirect effects are also considered.

We sincerely appreciate CARB's consideration of these comments and look forward to further interaction with the agency on land use change issues. We welcome a further dialog on this subject and look forward to responses to any of the questions offered in the attached comments. 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
California Air Resources Board
June 30, 2008, Workshop Presentations and Materials
Submitted July 14, 2008

I. Introduction

The California Air Resources Board (ARB) on June 30 held a Low Carbon Fuels Standard (LCFS) workshop on the land use effects of corn-based ethanol. There were two presentations made on the GTAP model—one by ARB and one by Purdue University, the developers of the model. After the workshop, a spreadsheet was provided on the LCFS website that utilized GTAP modeling results to estimate the carbon release associated with different types of land conversion.

Four scenarios were analyzed by ARB:

Scenario A. Increase in ethanol from 1.75 bgy to 15 bgy, normal forest/pasture conversion values

Scenario B. Increase in ethanol from 13 bgy to 15 bgy, normal forest/pasture conversion values

Scenario C. Increase in ethanol from 1.75 bgy to 15 bgy, lowest forest conversion values in U.S. and elsewhere

Scenario D. Increase in ethanol from 1.75 bgy to 15 bgy, pasture conversion values for all land in U.S., normal forest/pasture conversion values outside of U.S. (so-called "CRP case")

Results indicated a range of land use impacts from 39 grams of CO2-equivalent/Megajoule (Scenario D) to 117 g CO2 eq/MJ (Scenario A). ARB indicated that there was much more work to do in a number of areas, and welcomed comments and questions on the models, inputs, methods, and results. Comments and questions were requested by July 15.

We have reviewed the two presentations and the spreadsheet provided. We also have interacted with representatives from both Purdue University and the University of California--Berkeley (UCB). We have a number of comments and questions on the analyses presented at the June 30 workshop. Our major comments are summarized below. Following the major comments, we have included detailed comments and questions on GTAP, and detailed comments/questions on the spreadsheet which utilizes the GTAP outputs.

We should note that we are continuing to evaluate both GTAP and the spreadsheet, and may have additional comments as we learn more.

II. General Concerns with Indirect Land Use Change Analysis

Prior to presenting our major comments and concerns on the materials presented, we want to reiterate an overarching concern we have with the current status of the science of quantifying "indirect" land use changes.

Life-cycle analysis (LCA) is a standards-driven procedure for determining the environmental impacts of products and processes. Credible LCA is data dependent. However, there are no data in ARB's current analysis conducted by Purdue and UC Berkeley on the land use changes that actually occur as more corn is processed to ethanol. These analyses are, in fact, highly speculative and uncertain scenarios for what *might* happen as a result of increased corn demand.

Even if there were data connecting increased corn demand for ethanol with global land use changes, ethanol produced in the U.S. would not be "responsible" (in a strict LCA sense) for anything but its own environmental profile. "New" corn produced in Brazil by clearing savannah to satisfy animal feed demand is responsible for its own environmental profile as an animal feed, not as an ethanol feedstock. It is arbitrary and unreasonable to make individuals who are producing biofuels responsible for the tenuous, uncertain land use decisions of other individuals many thousands of miles away who are producing animal feed.

This is clearly different from the situation in which tropical wetlands and forests are actually converted to oil palm production to provide oil for biodiesel production. Direct land use change as a result of biofuel production is a legitimate subject for LCA and carries a reasonable level of certainty. In contrast, indirect land use change supposedly caused by biofuel production is tenuous, uncertain and highly speculative.

III. Specific Major Comments and Concerns

Our major comments are listed below and summarized in the paragraphs following the list.

1. The analyses do not appear to consider the restrictions on land use for biofuels imposed by the 2007 Energy Independence and Security Act (EISA).

2. The GTAP model requires much further development before it can be reasonably used in this analysis.

3. The sensitivity case presented on GTAP outputs did not test the sensitivity of the results to the major input assumptions. Consequently, the range of results presented by ARB is not at all indicative of the range of possible results.

4. Some of the outputs of GTAP are misleading. For example, estimates of forest converted to crops may not be current forests, but forests that have not even

been planted yet. This can lead to serious errors in estimating land conversion emissions

5. The emission rates for land conversion come from only one source, and it appears those values have not been critically reviewed by ARB for use in this analysis.

6. There does not seem to be any verification of GTAP predictions. We assumed the results would be verified using other models, back-tests of GTAP, or empirical data. However, it appears this verification has not occurred.

7. The ARB analysis to date focuses solely on putative agricultural expansion as a driving force for land use change worldwide. However, there is significant academic literature on land use change, and the actual factors driving land use change are by no means as simple as the scenario being studied by ARB using GTAP.

Based on these and other comments and concerns as presented in the remainder of this document, we conclude that the range of estimates provided by ARB for the land use impacts of corn ethanol – from 39 to 117 g CO2 eq/MJ – cannot be trusted as an initial range of results that will be refined later. Our recommendation is that ARB (1) attempt to validate the GTAP projections with other independent models (FASOMGHG perhaps) and with real data (2) exercise GTAP over a wider range of input assumptions, (3) critically evaluate what the outputs of GTAP mean relative to the base case, (4) and critically evaluate the data and procedures being used to estimate emissions from land converted.

IV. Expansion on Major Comments

1. The analysis does not consider the restrictions on land use for biofuels imposed by the Energy Independence and Security Act (EISA).

Sec. 201(I)(i) of the Energy Independence and Security Act defines "renewable biomass" as: "Planted crops and crop residue harvested from agricultural land cleared or cultivated at any time prior to the enactment of this sentence that is either actively managed or fallow, and non-forested."

Based on this language, it is our presumption that feedstocks coming directly from previously forested or other non-agricultural lands will not qualify for the federal Renewable Fuels Standard program. This provision discourages farmers from clearing forested and non-agricultural lands and it seems highly unlikely that there will be a market for biofuel feedstocks that don't meet the "renewable biomass" criteria.

The GTAP modeling results show a substantial amount of U.S. forested land being converted to crop production. Do the GTAP modeling results account for the EISA "renewable biomass" provision and its likely influence on the farmer's land use decision-making process? If not, how does ARB propose to integrate this consideration into its modeling?

2. The GTAP model requires much further development before it can be reasonably used in this analysis

A significant limitation of the GTAP model is that it does not currently include (in its inventory of land) the Conservation Reserve Program (CRP) land in the U.S., nor does it include idle cropland that is not part of CRP. This means that when the model tries to find land for crops, it can only take it from forest and pasture. Scenario D, which ARB and others indicate is a "CRP scenario" because all the land is assumed to be pasture land (no forest), is not really a CRP scenario at all. The reason it is not a CRP scenario is because the *amount* of land converted in this scenario is estimated from the relative rents and productivities of pasture, forest, and crops. It is highly likely that if Purdue were to input CRP land or idle land into the model appropriately, the amount of land converted would be significantly reduced from Scenario D, thereby reducing the carbon impact. Idle lands fall in this same category. There is good available documentation on the amount of CRP land available in the U.S. We are searching for documentation on the amount and status of idle or unused land.

3. The sensitivity case presented on GTAP outputs did not test the sensitivity of the results to the major input assumptions. Consequently, the range of results presented by ARB is not at all indicative of the range of possible results.

The sensitivity cases presented for the GTAP model focused only on the reasons for the expansion of biofuels in the U.S. – oil prices or public policy measures. The conclusions drawn from these were that the reason for the expansion had some effect, but that it was small. Another conclusion presented was that the "model response was fairly robust – 0.70 hectares per 1000 gallons of ethanol." However, the analysis ignored four other input factors that would have had a much more significant effect on land use outputs per 1000 gallons of ethanol, as follows:

a. CRP and idle lands, as discussed above
b. The impact of different assumptions regarding projected improvements in crop yields
c. The impact of different assumptions regarding the treatment of distillers grains (DGs) displacement
d. The impact of the model's rent and productivity assumptions for different types of land

No sensitivity analyses were performed with these critical inputs. Consequently, the conclusion that the model is "robust" is false. Much more time should be spent in performing detailed sensitivity analyses of GTAP model outputs to these inputs. We can provide additional information on these inputs, but first we need to better understand what the assumptions in the model are. For example, we know that GTAP estimates a U.S. coarse grain yield of 151 bushels/acre in the base case, and only about 154 bushels/acre in the expanded ethanol case. We think this increase in yield is far too low for the time period from 2001 to 2015, but we want to understand the various assumptions used to make these estimates before we provide more details.[1]

4. Some of the outputs of GTAP are misleading. For example, estimates of forest converted to crops may not be current forests, but forests that have not even been planted yet. This can lead to serious errors in estimating land conversion emissions. In fact, since there are no actual carbon emissions from land conversion in such instances, but only carbon capture that is forgone, the way this must be treated from a life cycle basis is completely different. No one-time emission will be incurred, but rather a distributed reduction in carbon capture over many years.

The GTAP model estimates that in Scenario A, an additional 3.6 million acres of forest will be converted to crops more than would be converted in the base case. However, forest cover has been increasing in the U.S. in spite of federal and state biofuels use requirements. Thus, this estimate of forest converted is not existing forest converted, but "future forests" that have not yet been planted. In estimating the emissions from these converted future forests, UCB has been assuming they are existing forests, resulting in one-time conversion emissions as well as future uptake emissions. If the estimate is for future forest, then only the future uptake should be counted under the current procedures utilized by UCB. [2] This output is misleading; ARB should clarify how much of this forest is existing forest, and how much is future forest that has not yet been planted.

5. The emission rates for land conversion come from only one source, and do not have appear to have been critically reviewed by ARB for use in this analysis.

The emission rates for lands converted come from only one source (Houghton) and were also used in the Searchinger, et al analysis. These come from the types of lands converted in various countries in the 1990s. It is not clear that this data is appropriate for use for biofuels expansion in the 2001-2015 time period. Also, some of the methods used to apply these data are very questionable. For example, UCB assumes that for forests, all mass above the ground is converted to CO2. However, nearly all forests are first harvested for lumber, and the lumber is used to build

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[1] We know that GTAP assumes that the lands coming into corn production may be more marginal lands that may have lower yields than current lands, and this is mitigating some of the improvements. But how the productivities of the various lands are being estimated in GTAP is not clear.

[2] We are not agreeing that future uptake should be counted. The counting of future uptake is dependent on the type of forest assumed and the number of years over which it is counted. The number of years is mostly an arbitrary assumption.

houses, furniture, etc. Not all this lumber would be converted to CO2 in 30 years. The researchers appear to have dismissed this as *de minimus* effect without performing any calculations. Another concern is that all the carbon is attributed in the analysis to biofuels such as ethanol, even though the land is harvested for lumber first, and may serve as pasture second, and finally may be utilized to grow crops. With such multiple uses over time, it does not seem appropriate to allocate the entire one-time carbon loss (or carbon uptake for 30 years) solely to biofuels.

6. There does not seem to be any verification of GTAP predictions using other models, back-tests of GTAP, or empirical data.

There is a clear need for verification and validation of the GTAP model results, either using historical data, other models, or both. For example, as noted in point 4, the model predicts that significant forests are converted in expanding from 1.75 bgy to 15 bgy. This should be validated with independent data. Also, the FASOMGHG model results presented by Murray at the EDF workshop on July 2 appear to significantly contradict the GTAP modeling results. Further work should be done to understand why the two models predict vastly different results for the United States.

7. The ARB analysis to date focuses solely on putative agricultural expansion as a driving force for land use change worldwide. However, there is significant academic literature available on land use change. The actual factors driving land use change are by no means as simple as the scenario being studied by ARB using GTAP.

The literature cited at the end of this document indicates that there are a multitude of reasons for land use changes, and it is seldom just one factor as indicated with GTAP. Taken as a whole, since there are a multitude of reasons, it is speculation to attribute significant indirect land use changes solely to increased corn production for biofuels production. At a minimum, these other reasons should be taken into account in the method of allocating the carbon released during a land use change.

These are the seven primary concerns we have at this time. We appreciate the opportunity to comment on this analysis. We will provide additional comments when we learn the answers to our questions.

V. Questions on Dr. Tom Hertel's Presentation at June 30 Workshop

All references in this section are to the presentation entitled "Implications of U.S. Biofuels Production for Global Land Use" presented June 30, 2008

Page 5: Do these values come from the Energy Information Administration? What is the source of these numbers?

Page 6: The ethanol percent of coarse grain sales rises from 5.6% in 2001 to 35% in 2015, while the animal feed fraction drops from 48.2 to 27.4%. We assume these are gross sales (or similar), and do not take into account co-products like distillers grains from dry mill corn ethanol production that make up some of the loss in animal feed.

Page 7: We note that coarse grain production rises by 9.8%, and livestock production decreases by 1.5%. Are there GHG credits associated with a reduction in livestock production? We realize that Purdue is not estimating GHGs for ARB, but wonder whether UCB will be including livestock reduction credits.

Page 9: Do we understand Dr. Hertel's analysis to mean that there is a 17.6% increase in ethanol from sugarcane in Brazil with $115 oil, and a 5% increase in ethanol from sugarcane in Brazil with $60 oil? Why does the price of oil have such a disproportionate effect on Brazilian ethanol production and whether ethanol is imported into the United States?

Page 11: In the U.S., when cropland is increased, how does the model choose between forest and pasture to make up this land? In other words, why doesn't the model just choose all forest, or all pasture?

Page 13: For the "world" why is the percent increase in cropland lower for the $107 oil than for the $60 oil? Is this because at $107 oil, there is less demand for energy at this price?

Page 15: The top of the slide indicates a 2 bgy increment-- shouldn't this be a 13.25 bgy increment, as indicated in slide 14?

Page 18: We are not clear how the values at the bottom of this slide are estimated (4.7%, -2.6%). Please elaborate.

Slides 23 and 26: What is included in "coarse grains"? For example, in slide 26, the yield is 151 bu./acre. Is this for corn, or is it some average of all "coarse grains"? Since the yields of coarse grains are so different from one another, why average them?

Slide 27: This slide indicates a 2.3% increase in yield of coarse grains. Again, is this all coarse grains, or just corn? We want to understand how you take the time dimension into account in this estimate. We understand that you shock the model in going from 1.75 to 15 bgy. This implies no time change. And yet, in the real world, it is not "shocked" like this with a big demand all at once, but this demand increase occurs between 2001 and 2015, or over 14 years. Over the last 20 years, corn yields have increased at a far faster pace than 2.3% over 14 years. We do understand that you are also taking into account the use of perhaps less productive lands, as well as yield increases on current lands. But on the current more productive lands, what is the assumed yield increase between 2001 and 2015? How are technology developments that apply to yields accounted for when the model is "shocked"? Finally, when the model is shocked for ethanol, is it also shocked for baseline conditions in 2015 that may be completely different from today (increased food demand, higher oil prices)?

Slide 32: Please explain how the numbers are estimated for "effective land", "productivity adjust", and "physical land" in this slide. Also, where do the "rents" come from (data sources, references)? How much variation is there in these rents? How sensitive are the model results to these rents. What correlation is there between potential crop yields from forest and grazing land and their current rents?

Slide 35: We assume that the conclusion that 23 million acres are needed to boost average crop land the equivalent of 5.4 million acres flows from the data on slide 32. This says that if crops are from converted pasture and forest, that we will need over 4 times as much land (23/5.4). Another way of stating this is that if one assumes 151 bushels/acre from current cropland, then the average converted pasture/commercial forest will only yield 38 bu/acre, based on the current rent analysis presented in slide 32. Is there any evidence of corn yields being this low in the U.S. currently? Why would anyone convert pasture or forest to cropland if they expected their yield to be only 25% of the average yield in the nation? We think this is an area where the omission of idle land and CRP land becomes very significant.

Slide 38: This slide indicates that the (land) impacts depend in part on the source of expansion: mandates or oil prices. The slide also indicates that once the focus is on corn-only ethanol, that the land cover results are "fairly robust across the scenarios", e.g., 0.7 ha/1000 gallons." We have two comments on this:

- First, the source of the expansion seems to have very little effect on the results (our conclusion on this is from slides 11, 13, and 15).

- Second, the conclusions ignore four other very important determinants of the land impacts: (1) omission of idle land and CRP land in the U.S., (2) effect of estimated projected yield improvements, and (3) GTAPs rent and productivity analysis and its impacts on land use, and (4) the treatment of distillers grains. These factors are much more important than the source of the expansion, and are not tested for "robustness" at all.

VI. Additional GTAP Modeling Questions

Questions in this section are in reference to the presentation entitled "Implications of U.S. Biofuels Production for Global Land Use" presented June 30, 2008, as well to the GTAP model in general.

1. The model does not currently contain CRP land or land that is idle. What effect does this have on the analysis of the type of land converted in the U.S.? What is

the current inventory of CRP land in the U.S.? What is the current inventory of idle land? Does ARB intend to add these types of land to the GTAP model or analysis? Why or why not?

2. Scenario A indicates that in the U.S., 3.6 million hectares of "forest" would be converted to agriculture between 2001 and 2015, when ethanol volumes increase from 1.75 bgy to 15 bgy. By this year (2008), nearly 9 bgy of ethanol will be used, implying conversion of about 2 million hectares of "forest". Is there independent verification that 2 million Ha of forest has been converted between 2001 and 2008? If so, where has this occurred?

3. Forested areas are actually increasing in the U.S. and have been for a number of years. Is the forest that is estimated by GTAP to be converted existing forest, or is it areas that are planned to be forest under the baseline at some time in the future?

4. What is GTAP's definition of "forest" from an ecosystem standpoint? Are these primary forests or commercial forests? What is the definition of "pasture"? Does GTAP differentiate between grassland and pasture? Why or why not?

5. In estimating area converted to agriculture from forest and pasture, GTAP adjusts for productivity based on average rents. Where do the rent data come from for the U.S., and what time period is it from? We have the same question for the rest of the nations in GTAP.

6. Also related to the productivity adjustment, what evidence is there that economic rents are the correct method to adjust the acres converted? Does this take into account intensive farming techniques that could be applied to converted forest (advanced seed, irrigation, fertilizer, etc.)? Why or why not? We have the same question with respect to adjustments made to pasture lands. This question extends to areas outside the U.S. as well.

7. We understand that the effect of distillers grains (DGs) from ethanol plants on land use was only added to the model in the last month or so. What are GTAP's assumptions on the types and mass of feed that 1 lb of DGs replaces? What other assumptions were made to incorporate the DG effect on land use into GTAP? What is the underlying evidence or sources for these assumptions?

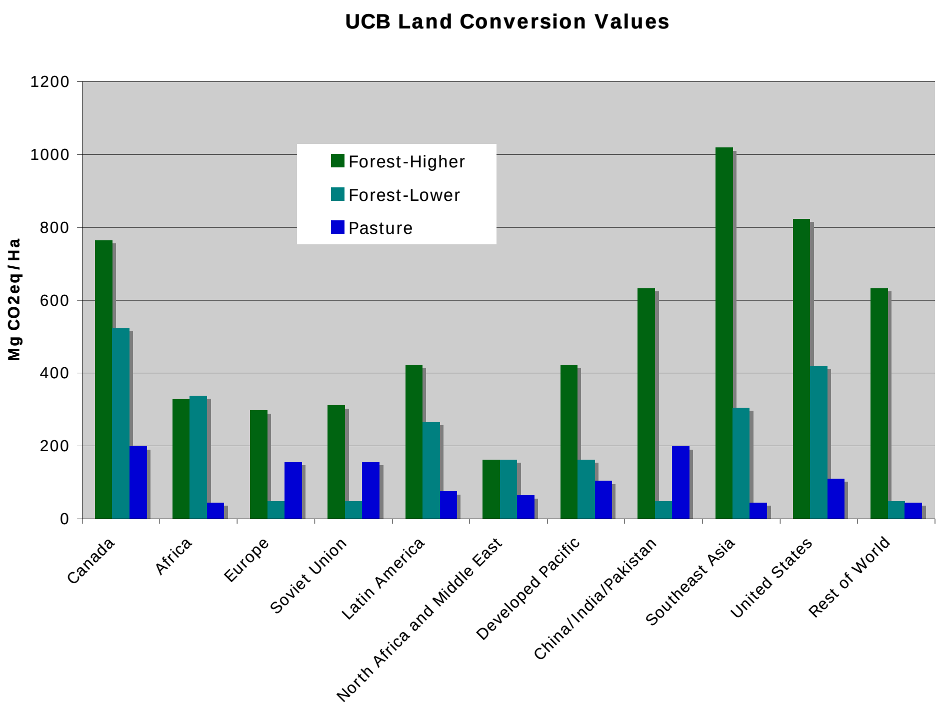
8. For Scenarios A-D, where (geographically) are the predominant areas that the forest is located in the U.S. that GTAP assumes is converted to agriculture? Where in the U.S. are the predominant areas of pasture that GTAP assumes is converted to agriculture?

9. For each of the scenarios, how does GTAP balance or choose between forest and pasture to be converted?

VII. UC-Berkeley Spreadsheet Questions

Questions in this section are in reference to the U.C. Berkeley spreadsheet posted on the CARB Low Carbon Fuels Standard web site following the June 30 workshop.

1. In the plot below, we compare the high forest, low forest, and pasture values used by UCB. What is the reason for the high degree of variability between the high and low forest values (some of the high values are 13 times as high as the low values)? What is the reason why some of the pasture values are higher than some of the low forest values (Europe, Soviet Union, China/India/Pakistan)?



2. We understand that “grassland” values are being used to estimate emissions from land that GTAP designates as “pasture”. What is the reason for this? We assume that areas designated by GTAP as pasture would be used to graze animals, and would have relatively short grasses, while areas designated as “grasslands” would have much taller grasses. Also, there is evidence that some pastureland was previously planted to crops, leading us to believe that the carbon stored in these lands would be less than in native grassland. Doesn’t this assumption result in overestimating the emissions from converted “pastures”?

3. Why is there so much variation in carbon values of “pasture” between different countries? We note in the plot above that the “pasture” values range from 44 to 199.

4. When estimating carbon conversion values, UCB is first estimating the one time conversion of ¼ of the underground carbon and all of the above ground carbon. Then, UCB estimates lost uptake of carbon for the forest (or pasture) for 30 years, and adds the two numbers together to obtain the total carbon loss. Why did the analysis use 30 years? Why not 50 or 100? Why not 5 years? The choice of number of years for uptake losses is arbitrary.

5. Why does UCB include all of the forest above ground as carbon loss? When forests are harvested, much of the aboveground mass is used in building (homes or furniture or other wood products), so it would not be lost for a long time. Why wasn't this factor taken into account?

6. When forest is cleared, it is harvested for lumber first, generally used for pasture second, and is sometimes converted to crops. Why is all of the carbon associated with clearing a forest being attributed only to biofuels? Shouldn't some of the carbon also be associated with lumbering and cattle operations?

7. What types of forests are assumed to be converted—are they commercial, primary, or a combination of both? If commercial forest is being converted, isn't this just forest that would have been converted more slowly anyway? Don't the conversion rates depend on the Net Ecosystem Exchange (NEE) of the type of forest?

References

1. Proximate Causes and Underlying Driving Forces of Tropical Deforestation, Geist and Lambin, February 2002 Issue of Bioscience

2. The emergence of land change science for global environmental change and sustainability, Turner, Lambin, and Reenburg, PNAS, vol 104, no 52, December 26, 2007

3. Dynamics of Land-use and Land-Cover Change in Tropical Regions, Lambin, Geist, and Lepers, Annual review of Environmental Resources, 2003

4. Bioenergy Expansion and Indirect Land Use Change: An Application of the FASOMGHG Model, Murray, presentation at EDF Forum, July 2, 2008