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July 3, 2008

Mary D. Nichols, Chairman
California Air Resources Board
Headquarters Building
1001 "I" Street
P.O. Box 2815
Sacramento, CA 95812

Dear Chairman Nichols,

We note with interest the letter dated June 24 from 27 colleagues urging you to implement the Low Carbon Fuel Standard without reference to what they call "indirect impacts of renewable biofuels production."

Its authors are especially concerned with what has come to be called the *indirect Land Use Change* (iLUC) effects, whereby use of feedstocks grown on land that would otherwise be used to grow food induces wild or uncultivated land to be converted to food cultivation possibly after a series of steps involving different crops. This process is mediated by both the international commodity prices for foods as well as biofuels, and the land-use policies enacted by governments around the world. The salience of this issue comes from the very large carbon releases from soil and biomass that can occur when the land is cultivated and the standing vegetation is burned or decays.

The authors of the 24 June letter recommend, in simplest terms, that the LCFS be implemented for several years as though the global warming effect of iLUC were zero, on grounds that "great uncertainties" exist about its magnitude and about indirect global warming (GW) effects of fossil fuel use. We disagree with this 'free pass' approach on several scientific, economic, and public policy grounds.

We have been actively engaged in studying the life-cycle impacts of biofuels for several years[i, ii], including the development of the technical and policy analysis of the LCFS for the state of California[iii], and have been focused on the iLUC issue for several months, as has the USEPA and other teams around the world, and we strongly advise against the path recommended in the July 24 letter. While the

science of iLUC impacts is evolving, zero is most certainly not the most likely or scientifically most soundly supported value, and we see no evidence that it will be in the foreseeable future.

It has long been suggested that CO_2 emissions released from the conversion of land could dominate the entire lifecycle GHG emissions of biofuels[iv,v,vi] The evidence that iLUC GW effects are large rests on economic models, including those used to generate the peer-reviewed paper published in January, and widely accepted estimates of the carbon stored in standing biomass in different ecological zones around the world. The Searchinger *et al*[vii] paper is based on projections from the FAPRI model developed at Iowa State University, along with historical allocation of land use conversion to different agro-ecological zones. The FAPRI model, the GTAP model and similar models are well established tools that routinely contribute to informed policy decisions throughout the world. These and other economic simulation models have helped policymakers understand the likely land use changes of agricultural price, trade and environmental programs in the United States and many other places. The Congressional Budget Office, USDA, the WTO, OECD, the EU, the World Bank, the Chinese Academy of Sciences and many other organizations use such models to analyze implications of agricultural policy and changes in regulatory incentives similar to those under discussion by CARB. Using these models as an input to life cycle analysis is well within the scope of these models.

That said, of course economists continue to make progress with the development and application of forward-looking simulation models. For example, economists continue to gather and use better data for parameter estimates. And, considerable progress is underway to refine the specific applications to LCA and related greenhouse gas and climate change assessments. This research is important and likely to be extremely useful over the next few months and years.

There is no scientifically respectable alternative way to predict how human systems will respond to policy than to use what we know about the behavior of economic systems, including (in this case) the international markets for energy, food, and agricultural inputs including land.

So far no models, in particular no peer-reviewed models, have been advanced that come up with values for iLUC that are significantly lower than those in the Searchinger *et al* paper. Note that the current large values obtained for iLUC are not revisions of conventionally accepted low values: the current studies are the first time this issue has been explored in detail. We are expanding the library of scientific estimates of iLUC[viii]; in particular, we have been using the state-of-the-art GTAP model housed at Purdue University to produce forecasts with added geographic and crop-focused detail and clarity of what kinds of land are converted and where. We anticipate that we will have extensive results for a variety of biofuels scenarios by the end of the summer. At present we can report that we have found very similar GHG emission results to Searchinger's for

ethanol from corn using this more sophisticated approach. We feel that this approach is consistent with the use of 'best science' to assess the full life-cycle impacts of fuel choices, be they biologically based or derived from fossil-fuel resources.

This approach is in contrast to the arguments put forth in the letter "against" the iLUC values currently being studied. In particular, we note that the fragmentary history of corn exports and prices is almost entirely irrelevant to the marginal effect of *more* bioethanol from food crop land, and in any case misleading as it ignores, among other aspects, the near-complete emptying of the corn inventory during the period discussed.

We are not only making better economic models of LUC but also explicitly modeling the effect of the real uncertainties in the parameter values of these models. With a stochastic version of the computational model used in the Searchinger et al analysis we assign probability distributions to nine uncertain variables and our results show that consideration of uncertainty in model parameters does not qualitatively alter the conclusion that the global warming intensity (GWI) of corn ethanol—even under the most GHG-efficient production practices—exceeds that of gasoline. We show that the low end of a 95% confidence interval around the mean LUC-related CO_2 term is approximately 70 g CO_2 per MJ, which doubles the life cycle GWI rating of typical US corn ethanol. This analysis allows us to better understand the core question this discussion addresses, which is: *how likely is it that the iLUC effect is so small that food-competitive biofuels are less GW-intensive than petroleum fuels?*

Our judgment incorporates recognition that land use effects of fossil fuels need to be compared to those of biofuels. Briefly, petroleum (with the important exception of strip-mined oil sands and oil shale) affects tiny amounts of land compared to biofuels per unit of energy obtained. Oil is extracted from open water, from deserts, and in any case from very small land footprints. We are making specific estimates of these land use effects and will have estimates this fall.

We urge you to recognize that just because we are uncertain about the value of a quantity, even over a fairly wide range, does not mean that we know nothing about it. The authors of the June 24 letter do not appreciate that the option to "not recognize iLUC" is not in fact available to ARB! Fuel in the LCFS will have a value for iLUC attributed to it; the question for ARB is, does existing science (and we strongly agree that as we learn more, policy should adapt if estimates change) best justify a value of zero? This is what it would mean to omit an LUC term, and our judgment is that the answer to this question is emphatically "no".

It remains to consider whether ARB should impute a value on the low side of current estimates as somehow "conservative". This would imply that it would be better for the planet to cause a given amount of GW by burning and decay of

standing vegetation than by using fossil fuels for transportation, a judgment that seems to us completely without foundation. This is not a case of erring on a "safe" side; being wrong here either way is equally bad for the climate. Furthermore, mistakes and oversights are particularly difficult to rectify in the fuels market once producers have invested money and land, developed processes and markets. The history of corn ethanol shows how hard it is to have both mandates and incentives changed.

Looking beyond climate change, an underestimate of iLUC is probably worse than an overestimate since it would create incentives for overproduction of crop-based biofuel. Ongoing research by our group into broad sustainability considerations[ix] and water use[x] (reports to be finalized by mid-July), as well as a growing body of research into the food price, biodiversity, and social effects of biofuel production should lead ARB to be wary of over-incentivizing agricultural biofuels. For example, our study shows that the volume of water consumed in production of agricultural ethanol in California ranges from about 640 to over 1850 gal/gal ethanol depending upon the feedstock and the region. During this period of severe water shortage in our state, creating incentives for this new consumption should not be taken lightly.

There are places in the world where lands degraded through past unsustainable agricultural practices may be improved through energy crop production with very low net GW effect but these practices have not yet been modeled and further research is definitely required, especially as regards alternative uses of the land. These opportunities are important (as are biofuels from wastes, algae, and other sources that do not compete with food for land) but the current discussion is about ethanol from corn plants grown in the US. Note, in this context, that unless the LUC effect is recognized and our best estimates used, it will be impossible to distinguish GW-reducing biofuels from GW-aggravating ones.

There are also regulations and controls that might be implemented in places where the wave of LUC effects comes to a halt that would reduce the LUC term, but the modeling done to date describes what will happen and not what would happen if the world were different. Implementing performance-based standards that can be effectively applied is crucial to ensuring sustainable supplies from anywhere the state may procure biofuels. The state should be careful not to arbitrarily or unintentionally eliminate options for improving land and environmental quality, but nor should we fail to appropriately include adequate accounting mechanisms and estimates of iLUC effects.

Our past and ongoing work lend strong support to the path CARB is pursuing: developing the life-cycle assessment methods to assess not only the greenhouse gas impacts, but also the wider sustainability of our energy choices. CARB has the opportunity and has demonstrated the leadership to use the best scientifically based assessments — and we emphasize that we consider both technical potential and economic impacts central to the process — of the iLUC term in any

fuel's Average Fuel Carbon Intensity (AFCI), and be prepared to alter that estimate as the science advances. Right now, that best estimate for additional corn ethanol is between 100 and 200 gCO_2eq/MJ.

The challenge that comes with opening up new technical, economic, social, and environmental areas of not only inquiry but also action is of balancing further study with implementation. We know today more than enough to move ahead with a scientifically and socially responsible LCFS. Further work is needed, but this can not be used as an excuse to permit irresponsible ventures to gain a foothold when the science exists today to make more informed choices.

Sincerely (in alphabetical order),

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