March 28, 2014

Ms. Katrina Sideco, Air Resources Engineer
California Air Resources Board
Transportation Fuels Branch

Dear Ms. Sideco:

On behalf of the more than 40,000 members of the National Corn Growers Association (NCGA), we appreciate the opportunity to comment on the new concepts being considered for the California Low Carbon Fuel Standard Program particularly the indirect land use change (ILUC).

Corn farmers work hard to be good stewards of the land and environment while producing crops that will be used for animal feed, fuel, food and hundreds of other applications. Farmers know first-hand that they must embrace and seek practices that will sustain the soil and climate to produce the crops of the future. Fortunately, U.S. Agriculture has made incredible technological advances. In 1960, the average U.S. farmer fed 26 people; today, due to these advances, the number has increased to 155 people. In fact, in the last 30 years, corn production has improved on all measures of resource efficiency, by decreasing per bushel: land use by 30 percent, soil erosion by 67 percent, irrigation by 53 percent, energy use by 43 percent and greenhouse gas (GHG) emissions by 36 percent.[1]

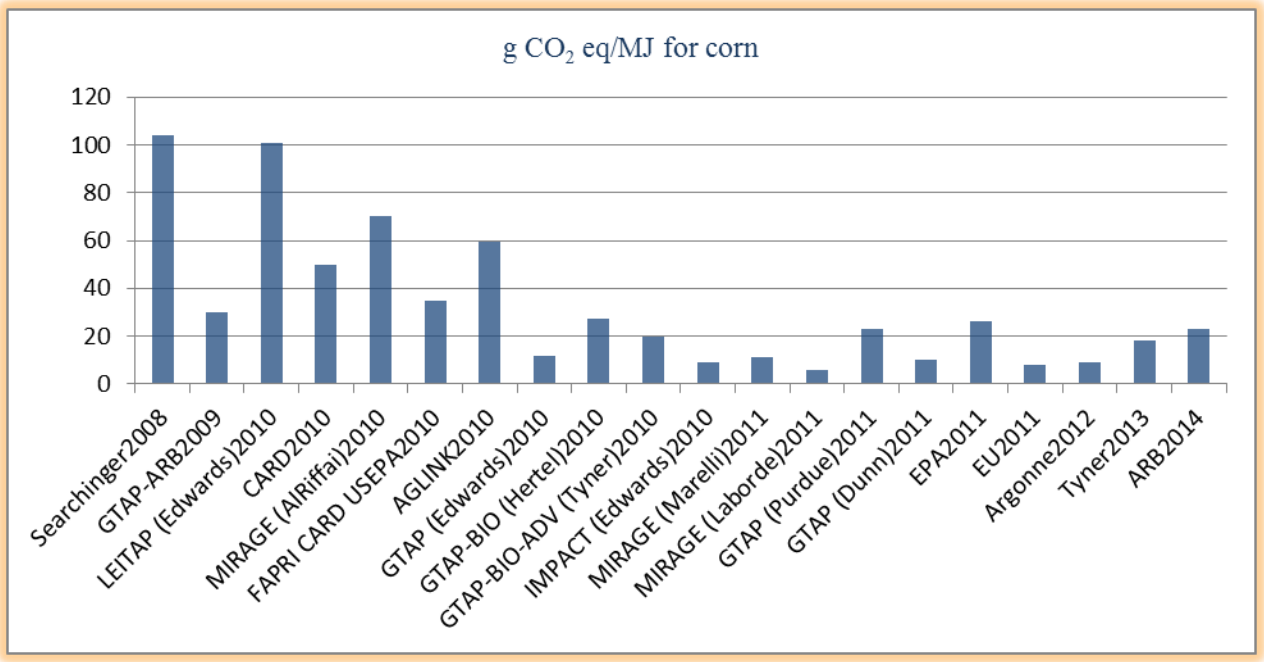
Between 1900 and 2012, the world's population grew from 1.6 billion to more than 7 billion. The Food and Agriculture Organization of the United Nations estimates that the world's population will increase to 9 billion by 2050. With the increased demand for conventional agriculture, it is more important than ever to produce crops today while looking towards the future health of the planet. All of these improvements have continued while the ethanol industry has made its own improvements in efficiency production.[2]

NCGA supports CARB's willingness to use current scientific literature for refining ILUC values, however, we are concerned about including ILUC in a regulatory environment given its large inherent uncertainties. ILUC has proven to be much smaller than originally envisioned. Further, any increase in South American soybean acreage has been driven by the increasing demand for soybeans from China, a factor completely independent of U.S. biofuel policy. Additionally, advancements in imagery processing make it possible to directly and un-intrusively track the direct supply chain of agricultural feedstock. Any feedstock tracked this way could be exempt

[1] "Environmental and Socioeconomic Indicators for Measuring Outcomes of On-Farm Agricultural Production in the United States" Field to Market: The Keystone Alliance for Sustainable Agriculture, July 2012.
[2] Mueller, S., et al. (2013). 2012 Corn ethanol: emerging plant energy and environmental technologies, available: http://www.erc.uic.edu/PDF/mueller/2012_corn_ethanol_draft4_10_2013.pdf .

from ILUC or at least receive a large credit towards the current ILUC "penalty."[3] That said, convergent science-based studies have accumulated that support ILUC values significantly lower than originally calculated, see for instance Figure 1.[4,5]

**Figure 1.** Reference summary of ILUC studies.



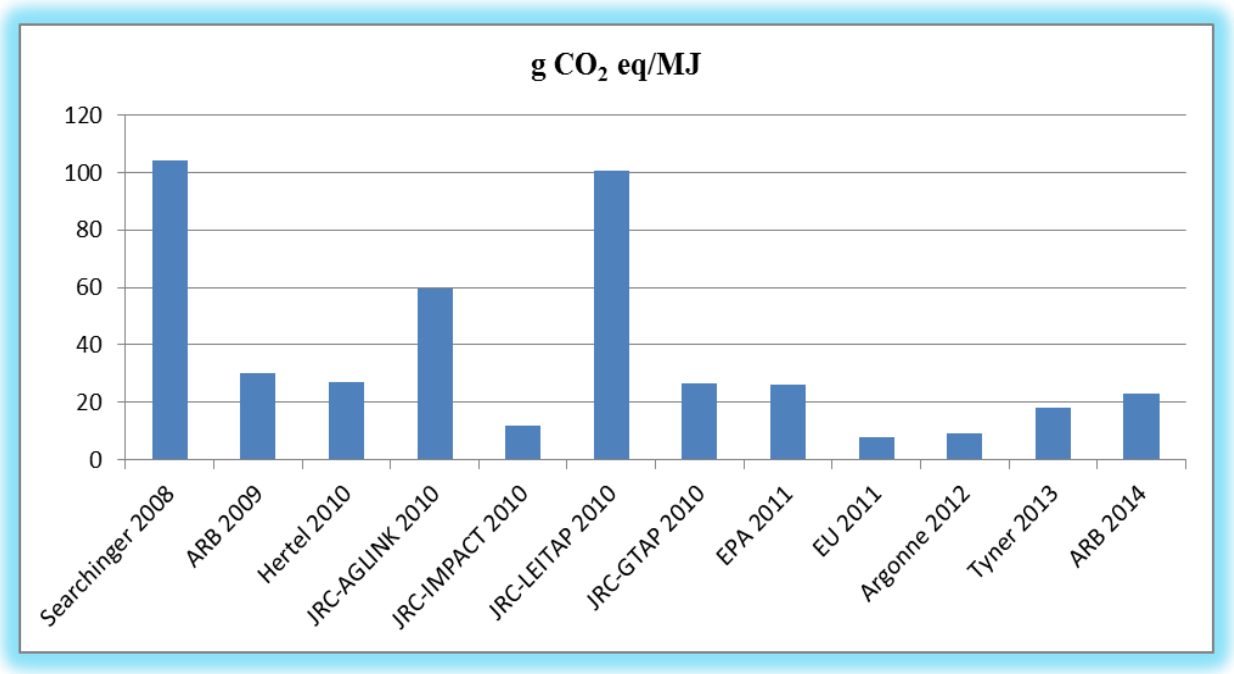

The CARB analysis contained on slide 56 of the March 11, 2014 meeting entitled "iLUC: Comparison of Results for Corn Ethanol" contains several references not based upon the most up-to-date information and/or the most current data or models. It is reproduced here (organized based on year published) as Figure 2. The Tyner, 2013 reference was changed in Figure 2 to reflect the published value of 18 g $CO_2$ e/MJ which includes the CARB emission factor (not that of 22.6 g $CO_2$ e/MJ which included the TEM emission factor as cited on slide 56). While NCGA feels that the use of any ILUC value is questionable, some of the most recent work including the lastest Argonne publications would suggest an ILUC value of less than 10 g $CO_2$ e/MJ for corn ethanol.

[3] See CARB Comments by S. Mueller (UIC) submitted 3/11/14 and Elliott, J., B. Sharma, et al. (2014). "A Spatial Modeling Framework to Evaluate Domestic Biofuel-Induced Potential Land Use Changes and Emissions." Environmental Science & Technology.

[4] Ahlgren, S. and Lorenzo, D. L. (2014). "Indirect land use changes of biofuel production - a review of modelling efforts and policy developments in the European Union." Biotechnology for Biofuels **7**(35).

[5] Keeney, R. and Hertel, T. (2008). "Yield Response to Prices: Implications for Policy Modeling." Working Paper #08-13.

**Figure 2.** Summary of ILUC studies used by CARB.




This letter will summarize some of the main items that NCGA recommends for adoption by CARB as the ILUC value is updated within GTAP and/or GREET namely: yield price elasticity, fertilizer emissions, factors impacting dried distillers grains, and nesting structure.

**1. Yield Price Elasticity**

Yield price elasticity (YPE) is the percentage change in intensive yield over the percentage changes in relative price of a crop over input prices. The yield price elasticity does not measure changes over one crop year (i.e., short term) and in fact, if done so would be inappropriate for GTAP since the time horizon for this model measures responses over the medium to long term timeframe (i.e., 8 or more years).[6] In slide 27, CARB cites both long and short term elasticity values in its literature review. However, Purdue University has clearly stated that short-term price yield elasticities are not appropriate inputs into the GTAP model.

By selecting an YPE of 0.05 to 0.3 as shown on slide 26, CARB has in effect chosen 0.175 as the median value, contrary to the expert workgroup recommendations and contrary to new studies produced since that time. Based upon a thorough literature review, the GTAP model utilized by Purdue University adopted a default yield price elasticity of 0.25.[7] This means that a 10% increase in the price of corn would result in a 2.5% increase in yield. Additionally, in 2011 the expert workgroup utilized further studies[8] and recommended to CARB, that a yield price elasticity value be set at a midpoint 0.25, with a range of 0.175 for countries with no double

[6] See CARB Comments by W. Tyner (Purdue University) submitted 3/11/14.
[7] Keeney, R. and Hertel, T. (2008). "Yield Response to Prices: Implications for Policy Modeling." Working Paper #08-13.
[8] Khanna, H. (2010). "An Econometric Analysis of US Crop Yield and Cropland Acreage: Implications for the Impact of Climate Change."

cropping; 0.25 for the U.S.; and 0.30 for Brazil and Argentina.[9] Since that time, two studies further reinforce the recommendations of the expert workgroup that the long term price yield elasticity should be at least 0.25.[10,11] Additionally, numerous literature studies have agreed that intra-season price yield elasticity values are small.[9,12,13,14] Slide 26 of the March 11, 2014 presentation refers to exogenous and endogenous factors contributing to YPE. The literature does not support this nor did the expert workgroup recommend such factors. NCGA recommends that CARB rely on the expert workgroup recommendations and their use of the published literature.

Further, NCGA finds no real-world, empirical evidence for a negative or zero price yield elasticity as included by CARB on slide 27. To do so would mean that farmers do not make enhancements in production practices related to yield and this is not the case. U.S. Farmers have responded to market signals by modifying production technologies, including but not limited to planting improved genetics, utilizing technology such as GPS systems and adopting precision planting.

In the U.S., corn processed into ethanol represents less than six percent of harvested cropland. With increasing yields in agricultural production, farmers have avoided clearing additional acres of land that would have been required to produce the same amount of corn. It should also be noted that U.S. agricultural land used for production agriculture has decreased over the past 70 years as shown in Figure 3. It is noteworthy that a recent international study found that urbanization, industrialization, expansion of infrastructure, nature and forest development and land abandonment has taken twice as much agricultural land as biofuels production globally.[15]

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[9] Babcock, B., Gurgel, A., et al. (2011). "Final Recommendations From the Elasticity Values Subgroup." Report to CARB.

[10] Goodwin, B. and Marra, M., et al. (2012). "Is Yield Endogenous to Price? An Empirical Evaluation of Inter- and Intra-Seasonal Corn Yield Response."

[11] Rosas, J. F. (2012). "Essays on the environmental effects of agricultural production." Iowa State University Graduate Thesis.

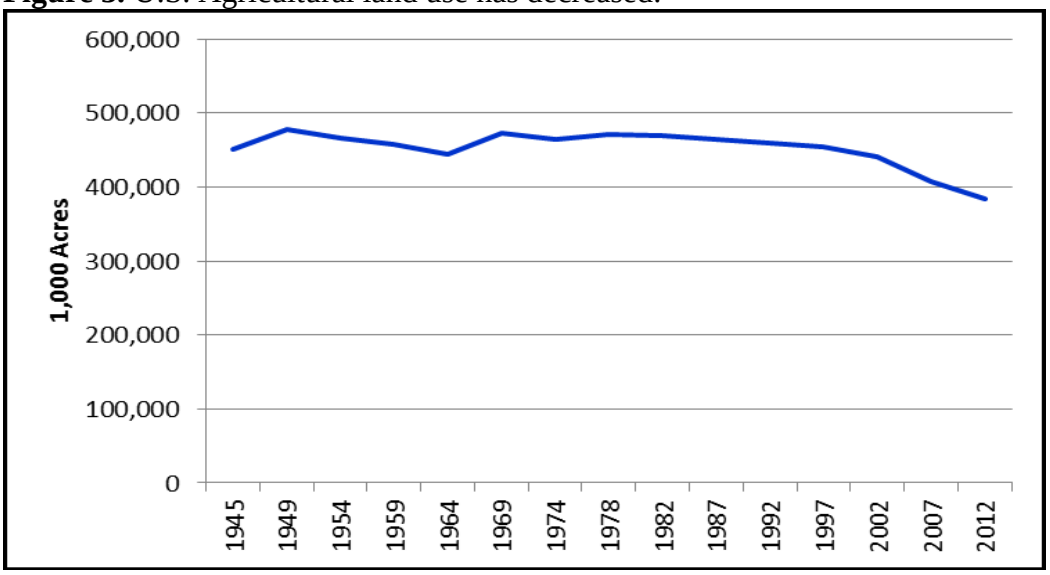
[12] Berry, S. T. and W. Schlenker (2011). "Technical Report for the ICCT: Empirical Evidence on Crop Yield Elasticities."

[13] Berry, S. T. (2011). "Biofuels Policy and the Empirical Inputs to GTAP Models." Report to CARB.

[14] Goodwin, B. K., M. Marra, et al. (2012). "Is Yield Endogenous to Price? An Empirical Evaluation of Inter- and Intra-Seasonal Corn Yield Response."

[15] Langeveld, J., et al., *Biomass Research Report* 1301 (2013). "Analysing the effect of biofuel expansion on land use in major producing countries:evidence of multiple cropping.

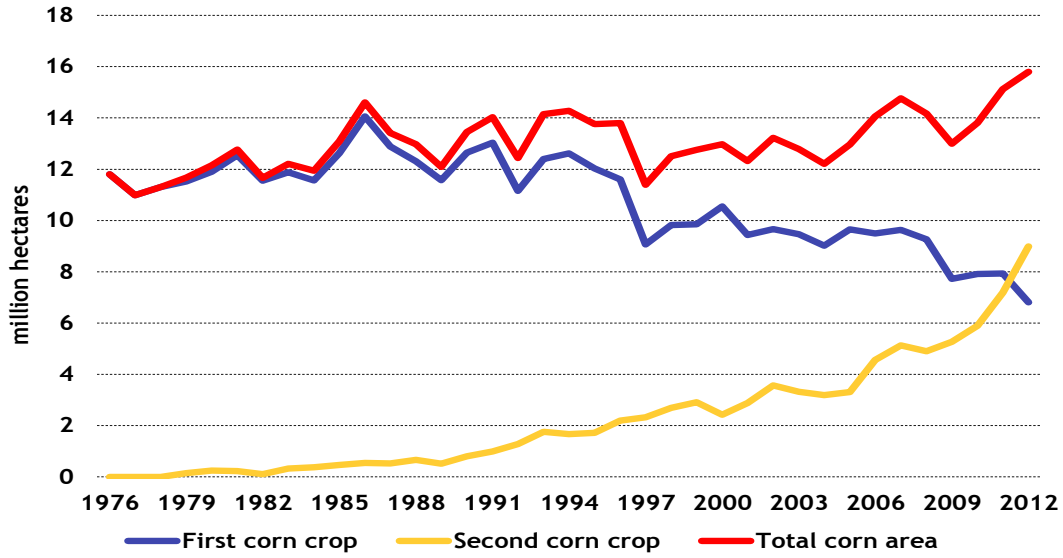
**Figure 3.** U.S. Agricultural land use has decreased.




Source: USDA

The investments and efficiency improvements as indicated by yield price elasticity calculations occur on a global scale, often without increasing arable land. Thus, farmers have been able to produce more crops while not increasing land usage. There are many examples globally of corn farmers responding to market signals without land change. An excellent example of this is in Brazil, where the number of corn acres that are double cropped has increased significantly as seen in Figure 4. Second-season production of corn in Brazil is known as safrinha. As shown in Figure 4, safrinha acres today exceed first cropped corn.

**Figure 4.** Cropland for first, second, and total corn crop acreage in Brazil.

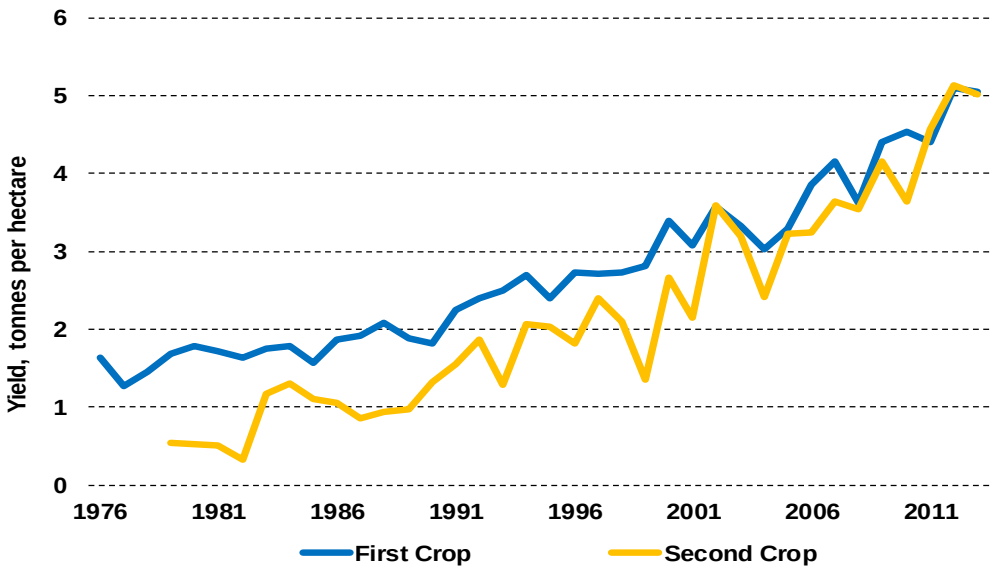



Source: LMC International, CONAB

And this increase has not been at the expense of yields. As recently as a decade ago, second crop yields were below those of the first corn crop yields in Brazil. While first corn crop land use has

decreased, double cropped land has increased and this has been concomitant with yield increases. Thus, production has greatly increased while land usage of first cropped corn has decreased.

**Figure 5.** Yields of first and second corn crops in Brazil.



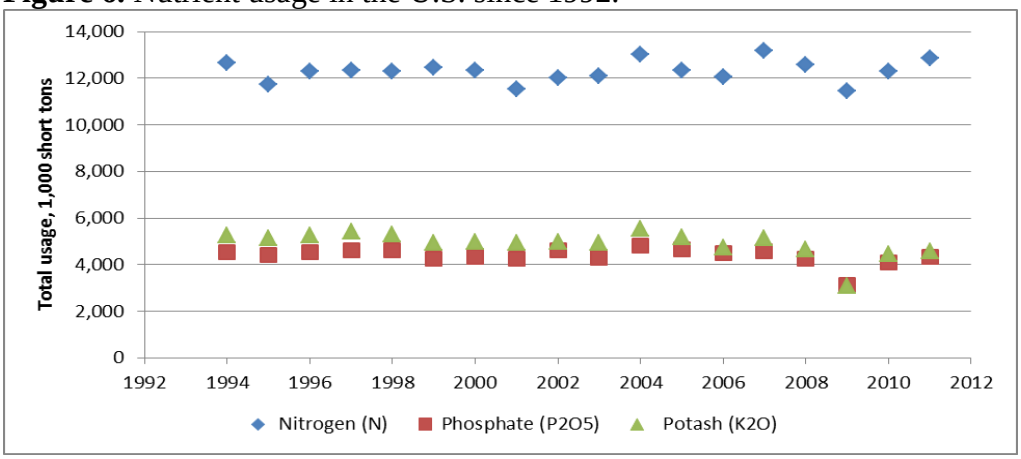

Source: LMC International, CONAB

In summary, NCGA concurs with the recommendations of the expert workgroup. If CARB insists that a different range of numbers be considered, then the expert workgroup should be reconvened to examine any new studies to determine the appropriate range.

## 2. Effects of Fertilizer, Livestock and Paddy Rice Emissions

Slide 47 indicates that CARB intends to evaluate the effects of fertilizer, livestock and paddy rice emissions on GTAP. There is no evidence that nutrient usage has increased as a result of biofuel demand as shown in Figure 6, thus we are unclear as to the purpose of this evaluation.

**Figure 6.** Nutrient usage in the U.S. since 1992.




Source: USDA

**3. Dried Distillers Grains (DDG) impact on GTAP and GREET**

The current GTAP model is built upon the assumption that DDGs substitute 1:1 for corn. However, there are significant soymeal substitution impacts that should be considered for DDGs as well since this ethanol co-product also substitutes for soymeal. This has substantial land use implications and should be added to the work list of GTAP and CA-GREET.[16]

**4. Nesting Structure**

NCGA believes that the recommendation of the expert workgroup that the CET nesting structure be modified to allow for two levels of substitution with two different elasticities of transformation between forestry and cropland than between cropland and pasture or cropland pasture.[17] This modification has been made to the Purdue model, with the results published in peer-reviewed literature.[18]

NCGA appreciates the commitment by CARB to share the efforts on the LCFS and particularly ILUC. As stated, we have concerns that ILUC, while science-based, contains too many variables such that it is difficult to design any system that can account for all of the uncertainties. We highly encourage CARB to consider the modifications outlined within this document as well as those from the expert workgroup.

Sincerely,

Martin Barbre, President
National Corn Growers Association

[16] Using approximate averages the amount of protein/acre for corn vs. soybean can be estimated. For instance, for corn: 160 bu corn/acre yields approximately 50 bu/acre of DDGs (56 pounds/bu of corn produces 17.6 pounds of DDGs after ethanol conversion) of which 30% is protein; for soybean: 40 bu soybeans/acre (60 pounds/bu) of which 80% of the grain is used for soymeal which is 48% protein. Thus one acre of corn produces approximately (160 x 17.6 x 0.3 =) 845 pounds of corn protein whereas once acre of soybeans produce approximately (40 x 60 x 0.8 x 0.48 = ) 922 pounds of protein.

[17] Babcock, B., Gurgel, A., et al. (2011). "Final Recommendations From the Elasticity Values Subgroup." Report to CARB.

[18] Taheripour, F. and W. E. Tyner (2013). "Biofuels and Land Use Change: Applying Recent Evidence to Model Estimates." Applied Sciences **3**(1): 14-38.