Comments Regarding the Proposed Land Use Change Penalty for Ethanol from Corn in the *Proposed Regulation to Implement the Low Carbon Fuel Standard*

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The purpose of this communication is to provide to the Air Resources Board our comments on the proposed penalty to be placed on ethanol from corn starch's carbon intensity rating in the land use change (iLUC) portion of the Low Carbon Fuel Standard regulation. First, let us state that we fully espouse the comments offered by the group of 100 scientists in a letter to Governor Swartzenegger dated February 25, 2009, and to the comments offered by the Renewable Fuels Association regarding the proposed regulation. In addition to the comments provided already, our further additional comments on the proposed regulation are presented below.

Major Points

- *The market for ethanol is maturing and considerable adjustment has already occurred. Therefore, very little, if any, additional change in land use beyond the current agricultural land in the United States and elsewhere due to future corn starch-based ethanol use would be expected.*
- *If future corn-based ethanol use is penalized through the indirect Land Use Change policy proposed in California, which results in a penalty in its measure of carbon intensity, the penalty will do nothing to offset the land use changes that have already taken place, but rather it will only serve to cause further unnecessary distortions in the market for fuels.*
- *The GTAP CGE model is inadequate to analyze the problem at hand.*
- *A critical price elasticity in the model has changed as a result of increased corn-based ethanol production, making the GTAP model results more suspect.*

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The Market for Ethanol is Maturing

The Energy Independence and Security Act of 2007 (signed Dec 19, 2007) set the renewable Fuels Standard of 36 billion gallons for 2022. This standard involves renewable biofuels of 15 billion gallons and advanced biofuels (fuel other than ethanol derived from corn starch, which includes cellulosic and biomass-based diesel). The latest WASDE-USDA (March 2009) estimates that 3.7 billion bushels of the 12 billion bushels of total corn use (31 percent) will be utilized for ethanol production in 2009-10. At a conversion rate of 2.8 gallons/bushel this equates to current production of approximately 10.4 billion bushels. This accounts for 70% of the renewable fuels standard meaning that only an additional 30% would need to be developed to meet the standard by 2022. Notwithstanding the goal of 15 billion gallons of renewable biofuels (corn-based ethanol) to be produced by 2022, it is likely that equilibrium production will fall short of that. In other words, the demand for corn-based ethanol will be met at a production level less than the standard. This would be even more dramatic if current support mechanisms that encourage U.S. production of ethanol are reduced (i.e., blenders tax credit). As one can see in Figure 1, the projected use of renewable biofuels will level off at about 5.2 billion bushels of corn by 2016, which falls short of the 5.4 billion bushels implied by the renewable fuel standard (the green line at the top of Figure 1). Excess capacity exists currently in the ethanol production sector, which is further evidence of a maturing market.

An additional factor that will prevent further land use changes attributable to the production of corn for ethanol is the impressive increases in corn yields being realized now and expected in the future. Monsanto Company has projected a doubling of corn and soybean yields from their 2000 levels by 2030 and Edgerton (2009) and Eathington (2007) make it clear that, with new biotechnology traits and molecular marker-assisted breeding, there is a high likelihood that Monsanto’s goals will be reached, further solidifying the lack of need for additional land. Nearer-term projections are that average corn yield will increase to 180 bushels per acre by 2015 (Schlicher, 2008).

In addition to the yield increases, strides are being made to increase the ethanol yield from each bushel of corn. Today that yield is 2.8 gallons per bushel, as is mentioned above. Ethanol yield is expected to increase to 3.3 gallons per bushel in 2015, mainly because of the further development of corn hybrids expressly for ethanol production (Schlicher, 2008).

The iLUC Penalty for Cornstarch-based Ethanol Will Not Affect Past Land Use Changes

The land use changes that may have occurred in the past because of an increased demand for biofuels will not be affected at all by a policy that is proposed to begin in 2011. *All of the costs of land use changes in the past are sunk costs and should not enter into the calculus of assigning penalties for land use change.* Doing so would be akin to locking the barn door after the horse got out.

Critical Comments Regarding the GTAP Modeling Framework

The "Global Trade Analysis Project" (GTAP) modeling framework is a prominent example of the class of "computable general equilibrium" or CGE models. These models are a commonly used tool for policy analysis. The GTAP modeling framework has been extensively applied in the analysis of trade policies, including evaluations conducted by, among others, the World Trade Organization, the U.S. International Trade Commission, and the World Bank. In spite (or perhaps because) of its prominence, the GTAP modeling framework is often subject to considerable criticisms.

As a CGE model, the GTAP attempts to capture the entire economic system in any analysis and because of this, it often lacks the necessary detail and precision to address specific problems of interest. These models also often represent an agglomeration of parameters cobbled together from a variety of different sector-specific analyses. After several years of experience working with these models, a number of criticisms have emerged. First and foremost is the fact that an ex-post evaluation of the predictive power of these models reveals very weak empirical performance. Kehoe (2002) considered the performance of CGE models in projections of the economic effects of NAFTA. He concluded that "they did not do a good job" and points out that the correlation of the predictions of such models with what actually happened was very low in many cases.

Such models have also been criticized for their weak econometric foundations (see, for example, McKitrick (1998) and Jorgenson (1984)). The GTAP developers outline and discuss these very criticisms (Hertel et al., 2003). They note that the models are based upon price and substitution elasticities gathered from a variety of (mostly sector-specific, partial-equilibrium) time-series studies. These individual estimates do not represent precise statements of truth but rather are estimates subject to varying degrees of estimation error (e.g., standard errors of the estimates). As Hertel et al. (2003) note, CGE modelers typically take the point estimates as truth and ignore the uncertainty associated with estimation error. The end result are estimates and projections (such as those of land use contained in this study) that have relatively unknown precision. As Hertel et al. (2003) note, "*the confidence one has in various CGE conclusions depends critically on the size of the confidence interval around parameter estimates. Standard "robustness checks" such as systematically raising or lowering the substitution parameters does not properly address this problem because it ignores information about which parameters we know with some precision and which we do not*." Hertel et al. (2003) also point to other criticisms of the GTAP modeling framework, which includes the use of inappropriate prices in estimation and the application of parameters taken from varying and potentially inappropriate levels of aggregation. Hammouda and Osakwe (2008) also discuss these limitations and note that "*these models are highly sensitive to the assumptions made—which often do not capture key features of the structure of the economies being analyzed.*"

These concerns have been expressed in trade negotiations. For example, in its comments on the "Continued Dumping and Subsidy Offset Act of 2000" (the "Byrd Amendment"), the U.S. (Delegation of the U.S. to the WTO, 2004) stated that "*all of the parties agree that any model based on data from the … Global Trade Analysis Project ("GTAP") would result in a relatively imprecise estimate of the effect [of the Act]…"* and that "*the substitution elasticities are generally not time-sensitive … and there is no way to predict changes ... for any given product."* Finally, it is also pointed out that *"the GTAP model only provides "an approximate order of magnitude" for the domestic trade effect."*

Economics of Joint Products Now Applies to U.S. Corn

The rapid expansion of corn-based ethanol in the U.S. in the past few years, driven by an aggressive biofuels policy, has transformed the demand for the raw product corn. Like its competitor in acreage, soybeans, a large component of U.S. corn demand should now be considered to be the raw input into the joint product of ethanol and dried distillers' grains (DDG's). This property means that the price elasticity of demand for the basic input (corn) is a weighted average of the price elasticities of the joint products (ethanol and DDG's) (Houck 1964). This transformation, combined with several years of a lower U.S. dollar which has increased the demand for US exports of corn (corn export demand increased 52.3% from 2002 to 2007 totaling 2.425 billion bushels (19% of total use)), has meant that the total demand elasticity for U.S. corn has become a more complex relationship involving total demand elasticities rather than domestic elasticities (Piggott and Wohlgenant, 2002). Taking account of these relationships is critical when evaluating how current biofuels policies impact demand and the elasticity of corn demand is in play.

Minor Points

a. On page IV-11 of the Staff Report dated March 5, 2009 at the top of the page, the report states that a survey of farming practices in several corn farming regions was conducted to assess average energy use on farms. It would be more appropriate to assess average energy use for corn farming in the corn production region of the U.S. Two technologies are also important to evaluating energy use; no-till farming and corn biotechnology. Both of these technologies have spread rapidly over the past 10 years in the Corn Belt and they both use less energy in corn production than "average". The mechanism by which lower energy use is achieved through these technologies is that they require fewer passes over the field during the growing season and less chemical pesticide use. It does not appear that these effects of these technologies on energy use figure into this analysis.

b. Although the average corn yield was changed to reflect the 2006-2008 average in the Air Resources Board's analysis using the ETAP model, no account has been taken of the future yield increases that the advanced corn and soybean biotechnologies will provide. For example, the new triple stack corn hybrids and the newer hybrids containing multiple modes of action for various types of insect pests will be available commercially in 2009. In addition, higher yielding biotech soybean varieties, such as Roundup Ready® 2 Yield, are now being introduced. These innovations, coupled with molecular marker-assisted breeding techniques, should increase average corn and soybean yields in the U.S. by a substantial amount as these new technologies are adopted.

c. Both the set-aside program in Europe and the Conservation Reserve Program in the U.S. have been major sources of agricultural land coming into the production of biofuels. The European set-aside program kept 9.4 million acres of land idle in 2007 through farmer subsidies for not producing, but in the fall of 2007 the set-aside program was suspended for at least one year to free up idle land for agricultural production in the face of high commodity prices (Waterfield, 2007). In 2008, the set-aside program was abolished permanently, although European farmers will still receive the subsidies even though they can now use the land for commercial production (Wikipedia, 2009). The U.S. Conservation Reserve Program had a net loss of 2.1 million enrolled acres between 2007 and 2008 and an additional loss of 1 million enrolled acres between 2008 and 2009 (USDA, 2009). The 3.1 million acres have been put back into agricultural production. Further, the acreage cap on the Conservation Reserve Program was reduced in the 2008 Farm Bill from 39.2 to 32 million acres by 2010, thus freeing up additional agricultural land. These programs have acted as a buffer stock of agricultural land and have helped to mitigate indirect land use changes for the production of corn ethanol in the past few years. Given the slowing demand for ethanol and the excess capacity in the ethanol industry, coupled with idled agricultural land, any further non-agricultural land use change attributable to corn-based ethanol should be minimal.

Respectfully Submitted,

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References

Eathington S, Crosbie TM, Edwards MD, Reiter RS, Bull JK (2007) Molecular markers in a commercial breeding program. Crop Sci. 47(S3):S154-S163.

Edgerton, M. “Increasing Crop Productivity to Meet Global Needs for Feed, Food, and Fuel.” *Plant Physiology* 149(2009):1-7,

Hammouda, H. B., and Patrick N. Osakwe. “Global Trade Models and Economic Policy Analyses: Relevance, Risks, and Repercussions for Africa,” *Development Policy Review* 2(2008):151-170.

Hertel, Thomas, David Hummels, Maros Ivanic, and Roman Keeney. “How Confident Can We Be in CGE-Based Assessments of Free Trade Agreements?” GTAP Working Paper No. 26, 2003.

Houck, J.P. “Price Elasticities and Joint Products” *Journal of Farm Economics* 46(1964): 652-630.

Jorgenson, D. Econometric Methods for Applied General Equilibrium Analysis. Scarf, Herbert E. and Shoven, John B. (eds.) *Applied General Equilibrium Analysis.* New York, Cambridge University Press, 1984.

Kehoe, T.J. “An Evaluation of the Performance of Applied General Equilibrium Models of the Effects of NAFTA on CGE analysis of NAFTA”, paper presented at the Fifth Annual Conference on Global Economic Analysis, Taipei, Taiwan, 2002, Available from http://www.gtap.agecon.purdue.edu/resources/download/1100.pdf.

McKitrick, R. Ross. “The Econometric Critique of Computable General Equilibrium Modeling: The Role of Parameter Estimation.” *Economic Modeling* 15(1998): 543-573.

Piggott, N.E. and M.K Wohlgenant. “Price Elasticities, Joint Products, and International Trade.” *Australian Journal of Agricultural and Resource Economics* 46(2002): 487-500.

Schlicher, M.A. “Biofuels in the US: Today and in the Future,” *AgBioForum 11(2008)(1): 1-7.*

State of California, Air Resources Board. *Proposed Regulation to Implement the Low Carbon Fuel Standard*. Staff Report: Initial Statement of Reasons, March 5, 2009.

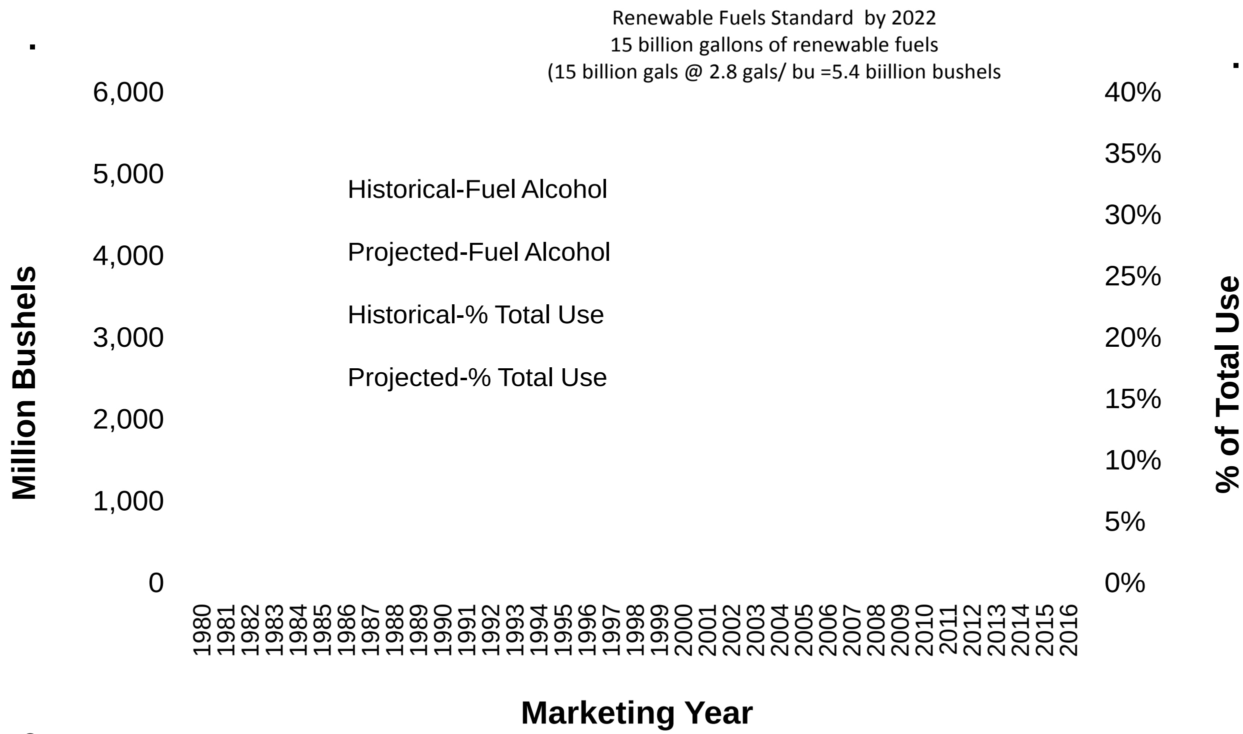
U.S. Delegation to the WTO. “U.S. Comments on Requesting Parties’ Replies to Arbitrators’ Questions,” United States Continued Dumping and Subsidy Offset Act of 2000, Recourses to Arbitration Under Article 22.6 of the DSU, June 14, 2004.

USDA. *FY 2008 CRP Enrollment Activity, and Change from Last Year (1,000 acres) As of March 2008*, Available from http://www.fsa.usda.gov/Internet/FSA_File/ytychange.pdf

USDA. *Conservation Reserve Program Status – January31, 2009.* Available from http://www.fsa.usda.gov/Internet/FSA_File/January2009onepager.pdf

Waterfield, B “Set-aside subsidy halted to cut grain prices”, Telegraph Media Group, Sept. 2007. Available from http://www/telegraph.co.uk/news/uknews/1564327/Set-aside-subsidy

Wikipedia. *Set-aside.* Available from http://en.wikipedia.org/wiki/Set-aside



Source:
ERS-USDA Feedgrain Database (http://www.ers.usda.gov/data/feedgrains/FeedGrainsQueriable.aspx)
ERS-USDA USDA Agricultural Projections to 2018 (http://www.ers.usda.gov/publications/oce071/oce20071.pdf)

Figure 1. Ethanol Production and Use – 1980-2016