Committee on
Transportation and Housing
California State Senate

Hearing on
Low Carbon Fuels Standard

Testimony of

Geoff Cooper
Vice President of Research and Analysis

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Good afternoon Mr. Chairman and Members of the Committee. My name is Geoff Cooper, and I am vice president of research and analysis for the Renewable Fuels Association.

The Renewable Fuels Association (RFA) is the national trade association representing the U.S. ethanol industry. The organization promotes policies, regulations and research and development initiatives that increase the production and use of fuel ethanol from all feedstocks. RFA membership includes a broad cross-section of ethanol producers and suppliers, ranging from early-stage cellulosic and advanced ethanol producers to larger scale grain ethanol companies, as well as other businesses, individuals and organizations dedicated to the expansion of the U.S. fuel ethanol industry.

In 2008, approximately 180 biorefineries in 26 states produced 9.25 billion gallons of ethanol, displacing the need for 320 million barrels of oil. Today, another 20 facilities are under construction, while three existing facilities are expanding. When these projects are complete, the industry will have the capacity to produce more than 14 billion gallons of renewable ethanol, enough to displace the gasoline derived from 480 million barrels of oil. This is equivalent to more than half of the oil our nation imports annually from the Persian Gulf.

As it has since its beginnings in the late 1970s, the U.S. ethanol industry continues to evolve. There is no question that corn has been the cornerstone of the industry, but as we speak, dozens of our member companies and scores of other innovative businesses across the country are working to commercialize the next generation of biofuels, including ethanol from cellulosic and other biomass feedstocks. From coast to coast and border to border, RFA member companies are building upon the solid foundation laid by the first generation of biofuels. Pacific Ethanol, a California-based company, and Zeachem are developing technologies to process fast-growing poplar trees to ethanol in Boardman, Oregon; AE Biofuels will use switchgrass at its facility in Montana; Verenium, which has offices in San Diego, will use sugarcane bagasse and specially-bred energy cane to produce biofuels in Louisiana and Florida; California Ethanol + Power, LLC, will use bagasse to power its sugar cane-to-ethanol plant in Brawley, California; Range Fuels will use wood residues as feedstock for its commercial-scale plant under construction in Georgia; Irvine-based Blue Fire Ethanol plans to use wood waste and cellulosic urban waste at two prospective sites in California; and Iogen and Abengoa will process agricultural residues like wheat straw at facilities under development in Idaho and Nebraska. These are just some examples of RFA member companies that are actively engaged in the rapid development and commercialization of the next iteration of feedstocks and biofuels.

It is important to understand that cellulosic ethanol and other advanced biofuels are no longer "just around the corner" or "just over the horizon"—they are here today. Several pilot and demonstration-scale facilities are producing ethanol from cellulosic sources and waste products today. And nearly 30 cellulosic ethanol facilities—both pilot and commercial scale—are under construction or in various stages of development. RFA members have an intimate understanding of what is necessary to make advanced biofuel a commercial success, and looks forward to answering any questions about advanced biofuels in the context of the Low Carbon Fuel Standard.

While second-generation biofuel producers continue to make significant strides toward broad commercialization, innovation also continues in the existing grain-based industry. Producers of first-generation ethanol continue to make dramatic improvements in the energy efficiency and overall sustainability of the production process. A recent report by the U.S. Department of Energy's Argonne National Laboratory demonstrated how much more efficient today's ethanol plants are than even a few years ago. Since 2001, average electricity use is down 20%, average total energy use is down 15%, and water use is down 26%.[1] Such improvements have led to a significant reduction in the greenhouse gas (GHG)

[1] M. Wu, Argonne National Laboratory. "Analysis of the Efficiency of the U.S. Ethanol Industry 2007." http://www.ethanolrfa.org/objects/documents//2007_analysis_of_the_efficiency_of_the_us_ethanol_industry.pdf

intensity of producing ethanol from grain. In fact, a recent paper published in Yale University's *Journal of Industrial Ecology* found that, "Direct effect GHG emissions were estimated to be equivalent to a 48% to 59% reduction compared to gasoline, a twofold to threefold greater reduction than reported in previous studies."[2]

These improvements will continue as new technologies are introduced and the industry continues to advance. A recent paper published in the journal *Energy Policy* states, "For the future, it is estimated that solely due to technological learning, production costs of ethanol may decline 28–44%."[3] The article further states, "Future improvements in energy efficiency may lead to lower costs, but also to lower GHG emissions."

I am here today to share our industry's collective thoughts on the proposed California Low Carbon Fuels Standard (LCFS). First, our industry applauds the leadership of the state of California for aggressively pursuing policies that seek to serve the dual purpose of reducing GHG emissions *and* reducing dependence on petroleum. Notably, nearly half of the oil processed in California comes from outside of the U.S. In addition to decreasing GHG emissions and oil imports, we believe a properly structured LCFS will stimulate economic activity in both cities and rural communities by creating tens of thousands green jobs in the renewable energy sector.

While we support these overarching goals of the LCFS, we have significant concerns with the proposed regulation that was released March 5, 2009.

Because the LCFS is structured as a performance-based regulation, fair determination of a fuel's carbon intensity is critically important. In order to avoid inadvertently picking technology winners and losers, it is essential that *all* regulated fuels are evaluated using the same analytical boundaries. Unfortunately, the Air Resources Board's (ARB) analysis uses asymmetrical boundaries to assess the carbon intensity of various fuels; specifically, biofuels are penalized for a highly uncertain and unproven market-mediated effect known as indirect land use change, while petroleum and other fuel types are assumed not to cause any indirect or market-mediated impacts.

As the term implies, a direct land use change is a conversion of land that is directly attributable to the production of a biofuel feedstock. Existing lifecycle

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[2] A. Liska et al. "Improvements in Life Cycle Energy Efficiency & Greenhouse Gas Emissions of Corn-Ethanol." *Journal of Industrial Ecology* Available online 22 January 2009. http://www.ethanolrfa.org/objects/documents/2110/2009_jie_improvements_in_corn_ethanol-liska_et_al.pdf

[3] W. Hettinga et al. "Understanding the reductions in US corn ethanol production costs: An experience curve approach." *Energy Policy*. Available online 30 September 2008.

analysis models, such as the U.S. Department of Energy's GREET model, do indeed account for emissions from direct land use change. Accounting of direct land use changes is straightforward and data-driven. To be clear, there is no debate over whether emissions from direct land use change should be included in biofuels lifecycle analysis. Indirect land use changes, on the other hand, are those that purportedly occur in the global marketplace as a result of shifting economic, social, or political behaviors. Specifically, the notion of indirect land use change suggests that if a farmer in the United States reacts to signals from the marketplace and plants corn on land that might have otherwise grown soybeans, the lost soybean production must be made up somewhere else in the world. While this concept may make sense in theory, accurately assigning and quantifying indirect land use changes in the real world is a virtual impossibility. There are no empirical data or proven methodologies that can positively link land conversions halfway around the world to a farmer's decision here in the United States.

There is a larger philosophical question about the appropriateness of including these highly speculative indirect effects in public policy at all. Owing to the lack of consensus on justification and methodology, no state or Federal regulation has ever assessed penalties against a specific product because of that product's predicted indirect effects. Indeed, according to a recent paper published in the journal *Environmental Science & Technology*, "…holding domestic industries responsible for greenhouse gas emissions by their competitors worldwide through market forces…is fraught with a host of ethical and pragmatic difficulties."[4] But rather than engaging in this high-level debate today, this testimony focuses largely on the technical shortcomings of ARB's analysis, as well as the practical implications of implementing an LCFS that penalizes one class of fuels for indirect effects, while others are effectively given a free pass.

We share the concern of 111 scientists and academics from California, other states, and even other countries who recently submitted a letter to Governor Arnold Schwarzenegger, stating, "Leaving aside the issue of whether these [indirect] effects can be predicted with precision or accuracy, or whether such a penalty is appropriate for the LCFS, it is clear that indirect effects should not be enforced against only one fuel pathway." The letter's signatories, including members of National Academies of Sciences and Engineering, further stated that the proposal "…creates an asymmetry or bias in a regulation designed to create a level playing field. It violates the fundamental presumption that all fuels in a performance-based standard should be judged the same way…"[5]

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[4] B. Dale et al. "Biofuels, Land Use Change, and Greenhouse Gas Emissions: Some Unexplored Variables." *Environmental Science & Technology*. Available online 28 January 2009. http://www.ethanolrfa.org/objects/documents/2116/kim_dale_09.pdf

[5] Letter to Gov. Arnold Schwarzenegger. http://www.arb.ca.gov/lists/lcfs-lifecycle-ws/74-phd_lcfs_final_feb_2009.pdf

In the draft regulation, ARB clearly states it did not identify any significant indirect effects associated with other fuels. This is hard to believe. It is a basic notion that if we take electricity and natural gas out of power markets and make it available for use in vehicles, we may be increasing our demand for the least cost alternative for additional power production: coal. It is also a basic proposition that oil dependence has wide ranging effects on a number of critical economic markets. We cannot understand these effects until we analyze them, and there is no evidence in the staff report that these effects were analyzed. It is our opinion that the agency failed to do a legitimate analysis of the market-mediated effects associated with oil production and use, or the secondary effects of proliferation of electric, hydrogen, and natural gas-powered vehicles. Preliminary analysis presented by Life Cycle Associates to ARB in January indicated several potential sources of indirect and direct GHG emissions associated with oil production that have been overlooked in ARB's analysis and most other traditional lifecycle analyses. Examples of these emissions include methane from flaring, methane from tailing ponds, and emissions associated with some refinery byproducts. The report said that other fuels could—and should—be run through economic models and other analytics to test for indirect effects. This has not been done.

As a result of the selective enforcement of indirect effects, ARB's analysis suggests that most ethanol from corn is *equivalent* to gasoline in terms of carbon intensity and therefore offers no GHG reduction benefits. This finding stands in stark contrast to the established understanding of the ethanol lifecycle, as well as recent analyses suggesting modern corn ethanol reduces GHGs 40-60% relative to gasoline.[6]

Even if consensus existed on the critical public policy question of including indirect effects in this type of policy (which it clearly does not), California regulators would need a sound, validated, and defensible scientific methodology for quantifying these secondary effects. Unfortunately, such a methodology does not yet exist. The RFA has several concerns with the modeling framework used by ARB to determine indirect land use change effects. ARB is using Purdue University's Global Trade Analysis Project (GTAP) model to conduct its indirect land use change analysis. While GTAP has been somewhat useful in providing insight into the expected short-term impacts of certain global trade policy decisions, it was not initially designed to analyze the long-term, multi-year land use impacts of expanded biofuels production.

GTAP is a static model that does not include a time element. To simulate ethanol expansion, the model is "shocked" for a 13.25 billion gallon ethanol increase

[6] For example, see Liska et al. See footnote 2.

(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.

The GTAP model has technical flaws and structural shortcomings that, in our opinion, currently prevent it from generating results that are usable for the development of the LCFS. RFA purchased the GTAP model early in 2008 and has been experimenting with the model for much of the last year. In that time, we have identified a number of technical flaws and incorrect assumptions. We have shared our comments and recommended adjustments with ARB staff, U.C. Berkeley, and Purdue University over the past several months.

Though we have identified several areas of concern, two specific areas have significant bearing on the land use change results for corn ethanol. Those two factors are: 1.) the model's treatment of future crop yields; and 2.) the land impacts of distillers grains, which are the livestock feed co-product of grain ethanol. As discussed earlier, GTAP is a static model based on 2001 data. In essence, this means the model is "stuck" in 2001 and must be "shocked" to achieve some other condition. Because of this, the model is unable to account for the significant improvements in grain yields that have occurred since 2001 and are projected to continue through 2015 and beyond. Since the model cannot account for these yield improvements, ARB staff and Purdue economists have proposed a yield adjustment external to the model. We are concerned that the method upon which the external adjustment is based is logically flawed and does not go far enough in considering observed yield increases and projected improvements. In making the exogenous yield adjustment, ARB is going only from 2001 to a 2006-2008 average yield. This is inconsistent with the years of the ethanol shock. This also suggests ARB's best estimate of average corn grain yields in 2015 is that they will be unchanged from 2006-08. This conclusion is contrasted by projections from the U.S. Department of Agriculture and a number of other public and private entities. What are the specific reasons for the belief that yields will not continue to increase after 2006-08? What are the impacts on the land use changes if yields go significantly higher, as indicated by the recent USDA projections? We do not know the answers to these questions because ARB has not performed any sensitivity analysis of the land use impacts of this yield assumption.

The second major factor that is mistreated by GTAP is the land use impact of distillers grains. Distillers grains (DG) are a co-product of producing ethanol from grain. About one-third of every bushel of grain (by weight) processed into ethanol is returned to the livestock feed market in the form of DG. Because the nonfermentable components of the corn kernel are concentrated by a factor of three in the ethanol fermentation process, DG have about three times the protein and fat content of corn. DG significantly reduces the land-use impact of ethanol made from corn by displacing some of the corn and other feed ingredients in livestock diets. The GTAP model's assumptions about DG result in a land use credit that is about half of what it should be, based on research from Argonne National Laboratory and several universities.

Correcting only the GTAP assumptions on yield and distillers grains would result in reducing ARB's current land use penalty for corn-based ethanol from 30 grams of CO2-equivalent/megajoule (g CO2-eq./MJ) to approximately 10 g CO2-eq./MJ. We have identified numerous other specific technical flaws with the model and have shared detailed analysis with ARB and its contractors.

It is also important to note this particular model has a history of being wrong. In an earlier GTAP analysis of the impact of biofuels on U.S. land use patterns, researchers at Purdue concluded the harvested area for coarse grains like corn would increase 8.3% from 2001 to 2006. That same analysis predicted U.S. harvested area for oilseeds like soybeans would decline 5.8% during the same period. Further, the results showed a 1.5% decrease in forest area. In actuality, coarse grains harvested area declined 2%, oilseed area increased 0.5%, and forested area increased 0.6% from 2001 to 2006. The model predicted that nearly 10 million acres of U.S. forest would be lost from 2001 to 2006. In reality, forest area increased 0.6% during that period. These discrepancies between modeling outcomes and real world observations demonstrate the imprecision of the GTAP model and highlight the dangers of using an academic tool as the foundation of a policy that has real commercial implications.

In addition to these problems with the GTAP model, there are also glaring inconsistencies in how ARB applies land use change analysis to different feedstocks. For example, ARB's preliminary analysis of land use change effects of cellulosic feedstocks does not rely on GTAP (or any other economic model for that matter). Rather, the staff has so far relied on a few pages of unpublished and cursory analysis from Purdue University for its cellulosic feedstock land use evaluation. It is particularly notable that ARB assumes roughly 37 million acres of idles cropland and cropland pasture would be available to produce cellulosic feedstocks, but those same acres are not available to produce corn, soybeans or other conventional commodities because these land types are not included in the GTAP land database. As a result, additional land needs for corn, soybeans, and other commercial crops are assumed by ARB to be met through conversion of forest and native grasslands, at a much higher carbon cost than idle cropland and cropland pasture.

Proponents of including indirect carbon effects for biofuels argue that GTAP is the best model to deduce an effect that is certainly not zero. This may not be true. A recent study conducted for RFA by Air Improvement Resources, Inc. (AIR), found that expansion of corn ethanol production to 15 billion gallons per year in 2015 is *unlikely to result in the conversion of non-agricultural lands in the U.S. or abroad*.[7] In other words, the analysis finds that the land use change effect of expanding corn ethanol to the same levels run by GTAP modelers is likely zero. As discussed, this outcome is important because it directly challenges the position held by many indirect land use change (ILUC) advocates that goes something like this: "while quantifying ILUC may be uncertain, we know the effect is not zero." You will no doubt hear that characterization from other panelists today. But, as the AIR paper found, the effect may indeed be zero. This is because increasing crop yields and growing supplies of nutrient-dense feed co-products are likely to nullify the need to expand global cropland to meet the corn ethanol requirements of the RFS. The author of the AIR study intended to use GTAP to conduct an independent assessment of the land impacts of corn ethanol expansion, but decided the model was not fit for such an analysis after reviewing and experimenting with the model. The author concluded, "…we think that a number of corrections need to be made to GTAP before it can be utilized to fairly project land use changes due to any biofuel increases." It is also noteworthy that after reviewing the model and its inputs, the U.S. Environmental Protection Agency opted not to use the GTAP model for the land use change analysis it conducted for the federal Renewable Fuels Standard rulemaking.

Due to the highly uncertain nature of indirect land use change modeling and the lack of consensus on methodology, the European Parliament recently decided to postpone inclusion of indirect land use change as a factor in determining the carbon intensity of biofuels in the European Union Renewable Energy Directive.[8] Rather, the Parliament directed the initiation of a two-year study aimed at gaining a better understanding of the land impacts of biofuels and methods for minimizing land effects.

In addition to the unlevel playing field created by selective enforcement of indirect effects, the regulation also exhibits a bias against ethanol from corn by including it in the baseline fuel against which all fuels under the LCFS are compared. This effectively forces corn ethanol to compete against itself; that is to say, reductions in the carbon intensity of corn ethanol serve only to reduce the

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[7] T. Darlington. "The Land Use Effects of US Corn-based Ethanol." 24 February 2009.
http://www.ethanolrfa.org/objects/documents/2191/land_use_effects_of_us_corn-based_ethanol.pdf

[8] See http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P6-TA-2008 0613+0+DOC+XML+V0//EN&language=EN#BKMD-27

carbon intensity of baseline gasoline. This appears to violate the spirit of a "technology neutral" fuels standard, as characterized by Governor Arnold Schwarzenegger in a December 2007 statement. In describing the LCFS, the Governor said, "[t]his first-of-its kind standard firmly establishes sustainable demand for lower-carbon fuels *but without favoring one fuel over another*."[9] If the standard were truly technology neutral, ethanol and all other fuels would be allowed to compete fairly against the high-carbon fuels they replace. Each fuel would compete on its own merits.

Supporters of enforcing indirect land use effects against biofuel often say that this policy decision is necessary to help spur advanced biofuel production. We have a different point of view. We are concerned that the inclusion of indirect effects penalties for biofuels and the other inequalities in the LCFS will erode investor confidence and market certainty for both first *and* second-generation biofuels. This point cannot be stressed enough. Contrary to the belief held by some, producers of next generation biofuels such as cellulosic ethanol are *not* supportive of including selective indirect effects in the LCFS. In fact, a November 2008 letter to ARB Chairman Mary Nichols from 30 second-generation biofuels companies, researchers, and organizations clearly stated, "…we do not agree that throwing uncertain numbers at selected fuels under the LCFS will create a positive outcome for either the environment or the LCFS policy itself."[10] To be clear, we are not aware of any public record support for the claim that indirect effects enforcement will help advanced biofuels.

Given that one of the stated goals of the LCFS is to stimulate the production and use of new low-carbon alternative fuels in California, we would like to expand on this point. In short, artificially limiting the use of first generation biofuels may inadvertently "blow up the bridge" to future renewable fuels. Without a doubt, the commercial success of the second generation of biofuels will be contingent upon the continued success of first generation biofuels. Over the past 30 years, the first-generation ethanol industry has established robust transportation and storage infrastructure; cultivated an investment base and created financial networks; advocated policies that create market certainty; and, more generally, raised the nation's collective experience level related to introducing renewable fuels into a market dominated by fossil fuels. Conventional biofuel companies are also some of the biggest investors in cellulosic ethanol.

As for recommendations, we again encourage the ARB to make the adjustments to its modeling framework that have been recommended by RFA and

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[9] Office of the California Governor. Press release. Http://gov.ca.gov/press-release/8229/

[10] Letter to Chairman Mary Nichols. http://www.arb.ca.gov/lists/lcfs-lifecycle-ws/46-arb_luc_final.pdf

several other stakeholders. With these justified improvements to the methodology, the GTAP model might reasonably be used for the LCFS development process. We also believe the adjusted model and ARB's results must be further peer-reviewed by a multi-disciplinary group of disinterested economists, climate change scientists, soil scientists, plant biologists, and other experts. However, if ARB cannot make these adjustments and conduct this type of rigorous review soon, stakeholders may be left with no options other than to ask for the delay of inclusion of indirect effects in the LCFS regulation until more appropriate analytical tools are developed. Additionally, if ARB is truly committed to fairly enforcing market-mediated effects on a level playing field, the Board should immediately initiate a comprehensive research effort that examines the indirect effects of all fuels.

In closing, we again applaud the foresight of the state's leadership in pursuing public policies that reduce greenhouse gas emissions, enhance energy security, and stimulate the economy. However, we continue to believe the current understanding of indirect effects—and of how to regulate those indirect effects—is woefully insufficient. The ongoing debate surrounding indirect land use change is evidence that we are not currently able to estimate market-mediated effects with the necessary degree of certainty. The soundness and effectiveness of a policy framework based on highly uncertain modeling and concepts that are not fully understood will most certainly be called into question by stakeholder industries and consumers alike.