State of California
California Environmental Protection Agency
AIR RESOURCES BOARD

CALIFORNIA'S LOW CARBON FUEL STANDARD

SUPPLEMENT TO THE FINAL STATEMENT OF REASONS

Comments on and Responses to the Severability Clause and the Conversion of Midwest Soybeans to Biodiesel and Renewable Diesel

March 2010

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State of California
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Supplement to the Final Statement of Reasons for Rulemaking, Including Summary of Public Comments and Agency Responses

PUBLIC HEARING TO CONSIDER ADOPTION OF A PROPOSED REGULATION TO IMPLEMENT THE LOW CARBON FUEL STANDARD

Public Hearing Date: April 23, 2009
Agenda Item No.: 09-4-4

This Supplement (Supplement) to the Final Statement of Reasons (FSOR) for the Regulation to Implement the Low Carbon Fuel Standard (LCFS) summarizes and responds to comments received in accordance with the Third Notice of Public Availability of Modified Text and Availability of Additional Documents and Information (Third 15-Day Change Notice) and the Fourth Notice of Public Availability of Modified Text and Availability of Additional Documents and Information (Fourth 15-Day Change Notice). The numbering of comments in this Supplement follows the numbering in the original FSOR. For further clarity, the comments are grouped by commenter, with the agency's response following the comment summaries to explain how the proposed action was changed to accommodate an objection or recommendation or the reasons for making no change. Unless otherwise noted below, all references to other comments are with respect to the original FSOR.

I. GENERAL

A. Action Taken in This Rulemaking

The procedural history for the Board's adoption of the LCFS regulation was presented in the original FSOR[1], which is incorporated herein by reference. As discussed in the original FSOR, the adoption of the LCFS regulation was bifurcated. From the original FSOR, the Executive Officer determined after the first two supplemental comment periods that the regulation was complete and ready for adoption with two limited exceptions. First, it was and is ARB's intent that the regulation identify carbon intensity values for two additional fuel pathways – biodiesel (fatty acid methyl esters – FAME) converted from Midwest soybeans, and renewable diesel converted from Midwest soybeans. However, by early November 2009 the development of the carbon intensity values had not yet been completed. Second, a severability clause had been inadvertently omitted from the versions of the regulation made available for public comment. The Executive Officer determined it was appropriate to bifurcate adoption of

[1] The original FSOR ("original FSOR") document was posted to ARB's website (http://www.arb.ca.gov/regact/2009/lcfs09/lcfsor.pdf) and filed with the Office of Administrative Law (OAL) on November 25, 2009.

the regulation so that the final regulation, except for these two limited incomplete elements, will enter into force as expeditiously as possible.[2]

Accordingly, on November 25, 2009, the Executive Officer issued Executive Order R-09-014, adopting the California LCFS regulation – new sections 95480, 95480.1, 95481, 95482, 95483, 95484, 95485, 95486, 95487, 95488, 95489, and 95490 of title 17, California Code of Regulations – reflecting the final modifications that had been made available for the first two supplemental comment periods. The Executive Order expresses ARB's intent that the adopted regulatory language will, by the completion of this rulemaking, be augmented by the addition of the two remaining elements described above. However, the Executive Officer has determined that the adopted regulation meets all applicable statutory requirements in the absence of those elements. On January 12, 2010, OAL approved this first part of the bifurcated LCFS regulation[3], and it became effective the same day.

To complete the adoption of the remaining elements described above, on December 15, 2009, the Executive Officer published on ARB's website the Third 15-Day Change Notice. This notice contained the modified regulatory text reflecting the two soy pathways and the severability clause noted above, along with supporting documents and materials. The comment period ended January 14, 2010, by which time nine written comment letters were received. It has been ARB's practice to provide at least 30 days for comment on new pathway documents for the LCFS regulation. Accordingly, a 30-day comment period was provided for the public to comment on the modifications, pathway documents, and other materials made available by the Third 15-Day Change Notice.

As noted, the third supplemental comment period made available for public review proposed carbon intensity values and supporting pathway documents for biodiesel and renewable diesel processed from Midwest soybeans, as well as a severability clause. Section 95481(a)(20.5) of the adopted regulation was augmented by the incorporation by reference of GTAP-SOY (December 2009), which is the GTAP model customized for Midwest soybeans, along with its component files. Also, two pathways and their associated carbon intensity values in Table 7 for biodiesel and renewable diesel made from Midwest soybeans were added to section 95486 of the adopted regulation. The corresponding supporting pathway documents were also incorporated by reference.

From the beginning of the LCFS development, it was ARB's intent to make each section and provision of the LCFS regulation severable to the extent allowed by law. However, the severability clause was inadvertently omitted from earlier versions of the regulation. The addition of this clause effectuated this intent, and was necessary to help assure

[2] The OAL approved and filed with the Secretary of State the LCFS regulation, without the modifications described in this Supplement, on January 12, 2010; the LCFS regulation as approved entered into effect on the same day.

[3] The adopted regulatory text contained a few nonsubstantial corrections to the texts made available for the first and second supplemental comment periods.

that invalidation of one provision of the LCFS regulation does not have the unintended effect of invalidating the entire regulation. Therefore, a new subsection (f) was added to section 95480.1 to incorporate a severability clause.

Comments received from stakeholders during the third supplemental comment period, as well as staff's own analysis, identified the need to make changes to the land-use change modeling for the soy biodiesel and renewable diesel pathways covered by the Third 15-Day Change Notice. Thus, as a result of the comments received and staff's analysis, staff concluded that a reevaluation of the land-use change effects portion of the supporting documents for soy biodiesel and renewable diesel was warranted. In contrast, after consideration of the comments received on the severability clause, no further changes were made to that provision.

Accordingly, on February 1, 2010, the Fourth 15-Day Change Notice, containing the modified regulatory text as well as supporting documents and information, was posted on ARB's Internet site for the rulemaking. This fourth supplemental comment period covered the reevaluation of the land-use change effects for soy biodiesel and renewable diesel. The comment period ended February 16, 2010, by which time two additional written comments were received.

The reevaluation yielded no changes in the carbon intensity value for the direct emissions and indirect land-use change effects for both soy biodiesel and renewable diesel. Therefore, ARB is not proposing modifications to the Carbon Intensity Lookup Table 7 in section 95486(b). The only modification to the regulatory text would be in section 95481(a)(20.5) to the definition of the incorporated GTAP-SOY model to reflect the updated version date (January 2010).

With respect to the Third 15-Day Change Notice and the Fourth 15-Day Change Notice, on the Internet posting date the notices and all attachments were mailed to four parties identified in section 44(a), title 1 CCR, for whom ARB staff did not have electronic mail addresses. At the same time, the notices and all attachments were electronically distributed to all other parties identified in section 44(a), title 1, CCR, in accordance with Government Code section 11340.85, and to all persons that have subscribed to ARB's "LCFS" and "fuels" listserves for notifications of postings pertaining either to rulemaking actions or motor vehicle fuels. The "LCFS" listserve has approximately 6,600 subscribers, and the "fuels" listserve has approximately 5,300 subscribers.

After considering comments received in both the third and fourth supplemental comment periods, the Executive Officer issued Executive Order R-10-003 on March 4, 2010, incorporating into the LCFS regulation (title 17, California Code of Regulations, sections 95480 through 95490) the soy biodiesel and renewable diesel pathways and supporting documents, as well as the severability clause. This reflects the final modifications that had been made available during the third and fourth supplemental comment periods.[4]

[4] The adopted regulatory text contained a few nonsubstantial corrections to the texts made available for the first and second supplemental comment periods.

This Supplement updates the original FSOR document posted by ARB on November 25, 2009, and the supplement to the FSOR posted on January 5, 2010, by providing the rationale for the modifications made during the third and fourth supplemental public comment periods. This Supplement also contains a summary of the comments received on the regulation during the third and fourth supplemental comment periods of the formal regulatory process and ARB's responses to those comments.

B. Incorporation of Materials by Reference

In addition to the materials identified in the original FSOR as being incorporated by reference, this Supplement identifies other materials for incorporation. Section 95481(a)(20.5) in the regulation approved by OAL on January 12, 2010 incorporates the Global Trade Analysis Project (GTAP) Model (February 2009). This model is a software package comprised of the following programs:

- RunGTAP (February 2009), a visual interface for use with the GTAP databases (posted at http://www.arb.ca.gov/fuels/lcfs/lcfs.htm in February 2009 and available for download at https://www.gtap.agecon.purdue.edu/products/rungtap/default.asp);
- GTAP-BIO (February 2009), the GTAP model customized for corn ethanol (posted at http://www.arb.ca.gov/fuels/lcfs/lcfs.htm in February 2009 and available with its components as a .zip file for download at http://www.arb.ca.gov/fuels/lcfs/gtapbio.zip); and
- GTP-SGR (February 2009), the GTAP model customized for sugarcane ethanol (posted at http://www.arb.ca.gov/fuels/lcfs/lcfs.htm in February 2009 and available with its components as a .zip file for download at http://www.arb.ca.gov/fuels/lcfs/gtpsgr.zip).

In accordance with the Executive Order R-10-003, this incorporation was modified by incorporation of an updated version of GTAP (dated January 2010), which includes the three components noted above as well as the following:

- GTAP-SOY (January 2010), which is a compressed file containing the GTAP model customized for Midwest soybeans (posted at http://www.arb.ca.gov/fuels/lcfs/lcfs.htm in January 2010 and available with its components as a .zip file for download at http://www.arb.ca.gov/fuels/lcfs/gtap-soy.zip).

In a related action, section 95486(b)(1) was modified to incorporate by reference an updated version of the California-modified GREET (CA-GREET) model version 1.8b (updated December 20099). Further, section 95486(b)(1)(A) was modified to incorporate by reference the following two fuel pathway supporting documents:

- Stationary Source Division, Air Resources Board (December 14, 2009, v.3.0), "Detailed California-Modified GREET Pathway for Biodiesel from Midwest Soybeans;" and
- Stationary Source Division, Air Resources Board (December 14, 2009, v.3.0), "Detailed California-Modified GREET Pathway for Renewable Diesel from Midwest Soybeans."

Each instance of incorporation identifies the incorporated document or model by title and date. All of the documents and models were made available in the context of this rulemaking in the manner specified in Government Code section 11346.5(b) or 11347.1. Sections 95481(a)(20.5) and 95486(b)(1) identify the ARB website locations where the CA-GREET and GTAP models may be downloaded. Note that fully functional, working versions of both the CA-GREET model and GTAP model package were installed on a laptop and made available for public review at ARB's principal place of business in Sacramento, California, during the supplemental comment periods. In addition, the two soy fuel pathway documents referenced in section 95486(b)(1) are readily available from ARB's internet site and upon request. Based on the above reasons, these documents are reasonably available to the affected public from commonly known sources.

These documents are referenced and incorporated into the California Code of Regulations because it would be cumbersome, unduly expensive, and otherwise impractical to publish them in the Code. Existing ARB administrative practice has been to have specifications, test procedures, and similar documents incorporated by reference rather than printed in the CCR because these specifications and procedures are highly technical and complex. These include "nuts and bolts" engineering protocols and laboratory practices and have a very limited audience. Because ARB has never printed complete test procedures and similar documents in the CCR, the directly affected public is accustomed to the incorporation format used in the regulation.

These test procedures and similar documents as a whole are extensive, and it would be both cumbersome and expensive to print these lengthy, technically complex procedures in the CCR for a limited audience. Printing portions of the test procedures and other documents that are incorporated by reference would be unnecessarily confusing to the affected public. For similar reasons, it has been a longstanding and accepted practice of the ARB to incorporate ASTM International standards and test methods into the CCR by reference. (see, e.g., section 2263, title 13, CCR.) Among other things, this enables interested parties to verify that the standards or practices have been adopted by a consensus-driven, authoritative source. Further, it is not technically possible to publish computer models such as CA-GREET and GTAP in the CCR. Thus, due to their length, limited audiences, or electronic format, it is impractical to publish the referenced fuel pathway documents, computer models, and other incorporated materials in the CCR.

C. Fiscal Impacts

No supplementary information is presented in this Supplement; the discussion of fiscal impacts presented in the original FSOR remains applicable to this Supplement.

D. Consideration of Alternatives

No supplementary information is presented in this Supplement; the discussion of alternatives considered presented in the original FSOR remains applicable to this Supplement.

II. MODIFICATIONS MADE TO THE ORIGINAL PROPOSAL AS APPROVED BY THE OFFICE OF ADMINISTRATIVE LAW (OAL)

The following discussion addresses all substantive modifications made to the regulatory text approved by OAL on January 12, 2010. It does not include modifications to correct typographical and citation errors, numbering errors, grammar errors, or the rearranging of sections and paragraphs for structural improvements, nor does it include all of the minor revisions made to improve clarity.

A. Applicability (Section 95480.1)

A new subsection (f) has been added to incorporate a severability clause. From the beginning of the LCFS development, it was the ARB's intent to make each section and provision of the LCFS regulation severable to the extent allowed by law. However, the severability clause was inadvertently omitted from earlier versions of the regulation. The addition of this clause effectuates this intent, and is necessary to help assure that invalidation of one provision of the LCFS regulation does not have the unintended effect of invalidating the entire regulation.

B. Definitions (Section 95481)

Section 95481(a)(20.5) of the adopted regulation contains the definition for "GTAP" or "GTAP Model." The definition includes the computer files for the GTAP model customized for corn ethanol (GTAP-BIO (February 2009)) and for sugarcane ethanol (GTP-SGR (February 2009)), which are incorporated by reference in the regulation. In the Third 15-Day Change Notice, this definition was modified to incorporate by reference GTAP-SOY (December 2009). This was modified in the Fourth 15-Day Change Notice by revising the incorporation by reference of GTAP-SOY to reflect the updated version date (January 2010). The revised GTAP-SOY package was posted at http://www.arb.ca.gov/fuels/lcfs/lcfs.htm on January 29, 2010 and available with its components as a .zip file for download at http://www.arb.ca.gov/fuels/lcfs/gtap-soy.zip.

C. Determination of Carbon Intensity Values (Section 95486)

In section 95486(b)(1), the reference to the California-modified GREET (CA-GREET) model was updated to reflect the most recent version (version 1.8b, February 2009, updated December 2009).

As noted above, two pathways and their associated carbon intensity values in Table 7 for biodiesel and renewable diesel made from Midwest soybeans were added. The corresponding supporting pathway documents are also incorporated by reference.

To facilitate a comparison to the carbon intensity values approved by OAL on January 12, 2010, the regulatory text in Table 7 as approved by OAL are shown in plain text, additions are shown in ***double underline bold italics***, and deletions are shown in ~~***double strikethrough bold italics***~~ .

Table 7. Carbon Intensity Lookup Table for Diesel and Fuels that Substitute for Diesel

Fuel	Pathway Description	Carbon Intensity Values (gCO_2e/MJ)		
		Direct Emissions	Land Use or Other Indirect Effect	Total
Diesel	ULSD – based on the average crude oil delivered to California refineries and average California refinery efficiencies	94.71	0	94.71
Biodiesel	Conversion of waste oils (Used Cooking Oil) to biodiesel (fatty acid methyl esters -FAME) where "cooking" is required	15.84	0	15.84
	Conversion of waste oils (Used Cooking Oil) to biodiesel (fatty acid methyl esters -FAME) where "cooking" is not required	11.76	0	11.76
	Conversion of Midwest soybeans to biodiesel (fatty acid methyl esters – FAME)	***21.25***	***62***	***83.25***
Renewable Diesel	Conversion of tallow to renewable diesel using higher energy use for rendering	39.33	0	39.33
	Conversion of tallow to renewable diesel using lower energy use for rendering	19.65	0	19.65
	Conversion of Midwest soybeans to renewable diesel	***20.16***	***62***	***82.16***
Compressed Natural Gas	California NG via pipeline; compressed in CA	67.70	0	67.70
	North American NG delivered via pipeline; compressed in CA	68.00	0	68.00
	Landfill gas (bio-methane) cleaned up to pipeline quality NG; compressed in CA	11.26	0	11.26
	Dairy Digester Biogas to CNG	13.45	0	13.45
Liquefied Natural Gas	North American NG delivered via pipeline; liquefied in CA using liquefaction with 80% efficiency	83.13	0	83.13
	North American NG delivered via pipeline; liquefied in CA using liquefaction with 90% efficiency	72.38	0	72.38
	Overseas-sourced LNG delivered as LNG to Baja; re-gasified then re-liquefied in CA using liquefaction with 80% efficiency	93.37	0	93.37

	Overseas-sourced LNG delivered as LNG to CA; re-gasified then re-liquefied in CA using liquefaction with 90% efficiency	82.62	0	82.62
	Overseas-sourced LNG delivered as LNG to CA; no re-gasification or re-liquefaction in CA	77.50	0	77.50
	Landfill Gas (bio-methane) to LNG liquefied in CA using liquefaction with 80% efficiency	26.31	0	26.31
	Landfill Gas (bio-methane) to LNG liquefied in CA using liquefaction with 90% efficiency	15.56	0	15.56
	Dairy Digester Biogas to LNG liquefied in CA using liquefaction with 80% efficiency	28.53	0	28.53
	Dairy Digester Biogas to LNG liquefied in CA using liquefaction with 90% efficiency	17.78	0	17.78
Electricity	California average electricity mix	124.10	0	124.10
	California marginal electricity mix of natural gas and renewable energy sources	104.71	0	104.71
Hydrogen	Compressed H_2 from central reforming of NG (includes liquefaction and re-gasification steps)	142.20	0	142.20
	Liquid H_2 from central reforming of NG	133.00	0	133.00
	Compressed H_2 from central reforming of NG (no liquefaction and re-gasification steps)	98.80	0	98.80
	Compressed H_2 from on-site reforming of NG	98.30	0	98.30
	Compressed H_2 from on-site reforming with renewable feedstocks	76.10	0	76.10

III. SUMMARY OF COMMENTS MADE DURING THE 45-DAY COMMENT PERIOD AND AGENCY RESPONSES

Because the adoption of the rulemaking was bifurcated and OAL approved the first part on January 12, 2010, no changes were made to the comments or agency responses for this section as discussed in the original FSOR or the first supplement (released on January 5, 2010).

IV. SUMMARY OF COMMENTS MADE DURING THE FIRST 15-DAY COMMENT PERIOD AND AGENCY RESPONSES

Because the adoption of the rulemaking was bifurcated and OAL approved the first part on January 12, 2010, no changes were made to the comments or agency responses for

this section as discussed in the original FSOR or the first supplement (released on January 5, 2010).

V. SUMMARY OF COMMENTS MADE DURING THE SECOND 15-DAY COMMENT PERIOD AND AGENCY RESPONSES

Because the adoption of the rulemaking was bifurcated and OAL approved the first part on January 12, 2010, no changes were made to the comments or agency responses for this section as discussed in the original FSOR or the first supplement (released on January 5, 2010).

VI. SUMMARY OF COMMENTS MADE DURING THE THIRD 15-DAY COMMENT PERIOD AND AGENCY RESPONSES

This Section VI contains a summary of each comment that (1) was submitted during the third supplemental comment period and (2) was specifically directed at the proposed regulation or to the procedures followed by ARB in proposing or adopting regulation, together with ARB's responses. Comments not involving objections or recommendations specifically directed towards the regulation or procedures followed are generally not summarized. These included several comments by concerned citizens that involved completely unrelated rulemakings or topics.

As shown below, the comments are grouped by commenter, with agency responses following the summary of the comments.

List of Commenters

Comment Abbreviation	Commenter
NFA4	Andrew Schuyler and R. Brooke Coleman New Fuels Alliance Written testimony: January 14, 2010
A2O4NESTE6	Cal Hodge, A Second Opinion, Inc., on behalf of Neste Oil Written testimony: January 14, 2010
WSPA6	Catherine Reheis-Boyd, Western States Petroleum Ass'n. Written Testimony: January 14, 2010
NBB3	Shelby Neal, National Biodiesel Board Written testimony: January 14, 2010
GE7	Tom Buis and David Bearden, Growth Energy Written testimony: January 14, 2010
MUELLER	Darryl Mueller, Private Citizen Written testimony: January 12, 2010

New Fuels Alliance

VI-1. **Comment:** Soy-based biodiesel is debited for a category of emissions [i.e., indirect effects] not enforced against other fuels, including the petroleum baseline. (NFA4)

Comment: In early 2008, ARB announces its intent to add an iLUC adder to biofuels under the LCFS without committing to access the market-mediated effects of other fuels. In doing so, ARB expanded the LCA system boundary for biofuels without also expanding it for other fuels, which runs afoul of an established ISO Standard 14040 and skews the relative value of biofuels to its competitors. (NFA4)

Comment: As such, and irrespective of the iLUC modeling outcomes provided by ARB staff for soy biodiesel, ARB has developed a system in which soy-based biodiesel pays for a category of emissions not enforced against other fuels, including the petroleum baseline that soy biodiesel is valued against, thereby skewing the results and leaving the regulation vulnerable to scientific criticism and legal action. NFA urges ARB to stop advancing the agenda of selectively enforced indirect effects, and asks ARB staff to answer the following questions in its amended FSOR. (NFA4)

- Did ARB conduct an analysis, formally or informally, of the indirect, market mediated effects of other fuels pathways? To be clear, such an analysis would require the use of economic models; estimating the direct land use impact of petroleum is not the corollary to assessing the indirect, market-mediated land use effects of biofuels. If an analysis was conducted, it should be a part of the record. Again, we request that any analysis conducted be made publicly available immediately.

- If economic modeling of other fuels was not conducted, how was the determination made that other fuels, including petroleum, do not have significant indirect effects? Please provide a detailed analysis for how it was determined that other fuels, including petroleum, do not have significant indirect effects. (NFA4)

Comment: Several stakeholder groups expressed concern about selective enforcement of indirect effects, including more than 110 PhDs and a range of respected environmental, academic and clean-tech investment entities. The rationale provided by ARB staff was that other fuels do not appear to have significant indirect effects at this time. However, notwithstanding claims to the contrary, ARB staff has not conducted economic modeling of any other fuel, according to the public record. This means that they are debiting biofuels for indirect effects selectively, and assigning zero for indirect effects for other fuels without scientific support. NFA has repeatedly asked ARB staff for all materials related to investigating the market mediated effects of other fuels, and has not

received a response. ARB leadership nonetheless insisted that regulators were still using the traditional "cradle to grave" lifecycle approach. This is not the case. (NFA4)

Response: In Resolution 09-31, the Board found that the staff performed complete lifecycle analyses for fuels including petroleum-based fuels, biofuels, and non-liquid fuel alternatives (such as electricity, CNG, and hydrogen) and has assigned scientifically defensible carbon intensity values to these fuels. The Board further found that indirect land use change has been appropriately included as part of the lifecycle analyses conducted by staff. Moreover, the Board found that no other significant indirect effects that result in large GHG emissions have been identified that would substantially affect the LCFS framework for reducing the carbon intensity of transportation fuels. Altogether, these findings clearly demonstrate that the Board has adequately addressed the debiting of indirect effects for all fuels subject to the LCFS at this time.

In addition to the Board's findings, this issue was discussed extensively in the responses to comments L-75 through L-78, L-132, and C-90 in the original FSOR. With that said, the Board recognizes that the science of land-use change analysis is continuing to evolve and the LCFS needs to continue to reflect the best science. To this end, in Resolution 09-31 the Board directed the Executive Officer to convene an expert workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels and return to the Board no later than January 1, 2011 with regulatory amendments or recommendations, if appropriate, on approaches to address issues identified. The issue identified by the commenter falls within the permissible scope of work for the expert workgroup and can therefore be considered for further investigation by the workgroup.

ARB's approach to the assessment of indirect effects is identical for each fuel subject to the LCFS. No discrepancy in "system boundaries" exists from fuel to fuel. As noted above, ARB did not undertake any studies into the indirect effects of any fuel in the absence of compelling evidence that such impacts are likely to exist (and are likely to be significant). Our inquiry into the land-use change impacts of biofuels was triggered by the publication of important studies indicating that such effects are significant.[5] As noted in Resolution 09-31, ARB has identified no studies to date indicating that other fuels generate significant indirect effects. To the extent studies are published in the future showing significant, market-mediated indirect effects for other fuels or other categories of indirect effects, we can consider how best to reflect the results of such modeling studies in the LCFS. And if such studies are published before 2011, we can consider those studies through the expert workgroup process discussed above.

[5] The earliest and possibly best known such study was completed by Timothy Searchinger et al. "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land-Use Change." Science 319:1238-1240 February 29, 2008. We also relied on the following studies cited in the ISOR: (1) Sonia Yeh, et al. (2009). "Land Use Greenhouse Gas Emissions for Conventional and Unconventional Oil Production." UC Davis., and (2) Lifecycle Associates, LLC. February 2009. "Assessment of Direct and Indirect GHG Emissions Associated with Petroleum Fuels." Prepared for New Fuels Alliance. LCA.6004.3P.2009

With regard to the comment on ISO Standard 14040, this voluntary industry standard is designed to highlight environmental problems and areas for improvement in the production and use of products. It is also intended to facilitate the process of evaluating the impacts that a product has on the environment over its entire life, thereby encouraging the efficient use of resources and decreasing liabilities. According to ISO, Standard 14040 is intended for use by product managers and individual companies to optimize the environmental performance of a single product (ecodesign) or that of a company. There is no legal requirement for government regulatory agencies such as ARB to adhere to ISO Standard 14040 when developing regulatory program like the LCFS. However, even if ARB were held to the ISO Standard 14040 requirements, there would still be no conflict, contrary to the commenter's suggestion, because ARB's approach to the assessment of indirect effects does not expand the LCA system boundary.

VI-2. **Comment:** ARB does not provide sufficient information to enable a substantive public review of the soybean biodiesel pathway. The supplemental package posted December 15, 2009 does not provide sufficient information for public review of the soy biodiesel pathway. The supplemental package quadruples the CI Value for soy-biodiesel, with the potential to fundamentally change the market value of soy biodiesel and related investments in the liquid fuel marketplace. (NFA4)

Comment: Of equal concern is the fact that iLUC modeling, by definition, is based largely on assumptions made by modelers and run through a CGE model about yields, energy density per acre, and type of land theoretically converted. This reality puts high value on transparency and supporting documentation. However, there is virtually no discussion about how the assumptions are made in key areas and the rationale for making them. For example, the 4-page land use change document posted on the ARB website states: "Because almost all of the land that is well-suited to crop production has already been converted to agricultural uses, yields on newly converted lands are almost always lower than corresponding yields on existing crop lands." This type of assumption offered to support the use of a low yield factor fundamentally changes the iLUC outcomes created by GTP. Yet there is no supporting documentation offered, and ARB staff does not discuss the statement in the supporting documentation.

ARB staff has been working on the soy biodiesel CI value for more than a year. While some preliminary conclusions are included in the Initial and Final Statement of Reasons, the bulk of the work supporting the current number was not released in these documents. The paucity of data and analytical work provided in the 4-page supporting documentation leaves the impression that the bulk of the work conducted over the last 12+ months was omitted from the record. It is not enough to provide a folder of generalized and highly technical modeling documentation, without explanation, which takes (at least) months of training to decipher and articulate in meaningful terms. (NFA4)

Comment: We are aware that ARB is leading an Expert Working Group to further analyze many key issues as they relate to carbon accounting and indirect effects. We look forward to this process. However, it should not be considered a proxy for providing the information discussed above as a condition of moving forward with biodiesel iLUC penalties as part of a direct regulation. (NFA4)

Response: The level of detail in the soy biodiesel materials[6] made available with the Third 15-Day Change Notice was comparable to the level of detail in previous ARB releases of documentation supporting the corn and sugar cane ethanol carbon intensities. Government Code section 11346.8 only requires a state agency to provide 15 days for the public to review and comment on a post-hearing modification to a proposed regulation. However, we provided 30 days for the third supplemental comment period in order to give interested parties additional time in which to comment on the supporting materials for the soy biodiesel fuel pathway. After considering comments received in the third supplemental comment period, we revised the soy biodiesel analysis and made the revised materials available with the Fourth 15-Day Change Notice. The data in these materials were similar to the data made available in the third supplemental comment period, except for a specified number of revisions described in the documentation accompanying this release.

It is important to reiterate that the subject matter of the third and fourth supplemental comment periods, aside from the severability clause, was the fuel pathways for conversion of Midwest soybeans to biodiesel and renewable diesel. The indirect land-use change effect analysis associated with these fuel pathways relied on the same type of GTAP analysis already described in detail in the ISOR and used to generate land use analyses for other biofuels such as corn ethanol and sugarcane ethanol. As such, a full technical description of the GTAP model, of specific model runs, and the rationale behind all model input parameters would have been unnecessary and cumbersome.

Instead, the supporting materials that were published for these two fuel soybean pathways focused on inputs, assumptions and results that were specific to the soybean pathways. The soy biodiesel results presented in the December 15, 2009 release were as consistent as possible with previous releases. Based on comments received during

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[6] The following materials in support of the soy biodiesel pathway were posted on ARB's formal rulemaking internet site (http://www.arb.ca.gov/regact/2009/lcfs09/lcfs09.htm):

- Stationary Source Division, Air Resources Board (December 14, 2009, v.3.0), "Detailed California-Modified GREET Pathway for Biodiesel from Midwest Soybeans" (PDF - 696K)
- GREET, v.1.8b (updated December 14, 2009), which is the GREET model updated in December 2009 to reflect the Midwest soybean to biodiesel and renewable diesel pathways (XLS-15.7Mb)
- GTAP-SOY (December 2009), the GTAP model customized for Midwest soybeans, along with its component files (ZIP-4,152k)

the third supplemental comment period, adjustments were made to the analysis, which was made available for comment on February 1, 2010. The February 1st release was even more consistent with previous releases than the December 15, 2009.

We strongly disagree with the commenter's suggestion that the analysis lacked transparency. The materials made available in the Third and Fourth 15-Day Change Notices discuss the differences between the data they present and previous information released during the LCFS rulemaking cycle. In addition, the GTAP model used to generate the results that were released—including all input parameters—was made available both online for download and installed on a laptop, which was made available for use by any interested party at the Cal/EPA headquarters in Sacramento during both supplemental comment periods.

Regarding the comment on the elasticity of yields with respect to newly converted lands, this issue was discussed at length in response to comment L-49 of the original FSOR. As noted above, the Board found that the staff's analysis reflected the best and most scientifically defensible information. However, the Board recognized the need to update these analyses as the science further develops. Thus, the Board directed staff in Resolution 09-31 to convene an expert workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels. This issue, among others related land use change analysis, can be investigated by the expert workgroup as part of its efforts.

VI-3. **Comment:** California law speaks to the need to create a clear record that is reviewable by the public. Government Code Section 11346.2 requires ARB to include in the Initial Statement of Reasons (ISOR): "[a]n identification of each technical, theoretical, and empirical study, report, or similar document, if any, upon which the agency relies in proposing the adoption, amendment or repeal of a regulation." Because the land use change assessment was not completed in time for the ISOR, the document references the GREET "direct effects" assessment of soy biodiesel (ISOR, p. IV-7). This document specifically says that the land use change assessment for soy-biodiesel is not included in the analysis, and provides no further documentation. Unfortunately, the soy-biodiesel work was also not completed in time for the Final Statement of Reasons (FSOR). The FSOR states: It was and is ARB's intent that the regulation identifies carbon intensity values for two additional fuel pathways biodiesel (fatty acid methyl esters -FAME) converted from Midwest soybeans, and renewable diesel converted from Midwest soybeans. However, by early November 2009 the development of the carbon intensity values had not yet been completed … [t]he Executive Officer determined it was appropriate to bifurcate adoption of the regulation so that the final regulation except or these two limited incomplete elements will enter into force as expeditiously as possible … because of the bifurcation, this Final Statement of Reasons (FSOR) includes only comments directed towards the regulation other than the two fuel pathways and severability clause noted above (FSOR, p. 8). (NFA4)

Comment: So the entirety of the record supporting ARB's quadrupling of the soy biodiesel CI Value with an iLUC adder amounts to four pages of largely conclusory and unsupported statements. NFA strongly encourages ARB to amend the record to provide substantive discussion of and support for the major issues involved with predicting iLUC for soy biodiesel, and to establish compliance with state law. To facilitate this process, ARB should extend the comment deadline appropriately so that stakeholders can provide substantive review of the technical merits of the iLUC results. (NFA4)

Response: The commenter misunderstands the rulemaking provisions of the Administrative Procedure Act (APA) (Government Code section 11340 et seq.). The section incorrectly cited by the commenter applies to materials relied upon for a proposed rulemaking prior to the Board hearing in April 2009. However, the soy biodiesel and renewable diesel pathways were added as 15-day changes after the Board hearing pursuant to the Board's direction. Therefore, the correct sections that apply are Government Code sections 11346.8 and 11347.1.

Section 11346.8(c) prohibits a state agency from adopting a regulation which has been changed from that which was originally made available to the public pursuant to section 11346.5 unless the change is either nonsubstantial (or grammatical in nature) or sufficiently related to the original text that the public was adequately placed on notice that the change could result from the originally proposed regulatory action. Here, the Board in Resolution 09-31 directed the Executive Officer to incorporate in the approved regulation the modifications described in Attachment B to the Resolution. Attachment B (at 7) specifies that "[a]s part of the 15-day change process, the final regulation will specify CI values for one or more pathways for each of the *additionally identified fuels*." [emphasis added]. The "additionally identified fuels" included, among others, biodiesel and renewable diesel. *Ibid.* Thus, the public was clearly on notice that the addition of fuel pathways for the conversion of Midwest soybeans to biodiesel and renewable diesel could result from the proposed regulatory action considered by the Board at the April 2009 hearing.

Section 11346.8(d) prohibits a state agency from adding any supporting material to a rulemaking record after the close of the public hearing or comment period unless the agency complies with section 11347.1. Section 11347.1(a) specifies that an agency that adds any technical, theoretical, or empirical study, report, or similar document to the rulemaking file after the close of the public hearing or comment period must make the document available for review, inspection, and comment for at least 15 calendar days before the proposed action is adopted by the agency.

In this case, there is no violation of the 15-day change requirements under section 11347.1 because the adoption of the rulemaking was bifurcated. In other words, the Executive Officer adopted the LCFS regulation without the soy biodiesel and renewable diesel pathways under Executive Order R-09-014 (November 12, 2009). The Executive Officer did not adopt the soy biodiesel and renewable diesel fuel pathways in that Executive Order. Instead, the Executive Officer adopted those two soybean pathways

in Executive Order R-10-003 (March 4, 2010); those two pathways and their supporting materials were subject to the requisite supplemental 15-day comment periods. Thus, the requirements of sections 11346.8 and 11347.1 of the Government Code were fully met.

With regard to the relative size of the land-use discussion that was attached to both the third and fourth 15-day change notices, the comment is a bit misleading. While the land-use attachment to those notices was indeed 4 pages long, that attachment represented a summary of the GTAP-SOY modeling runs. The GTAP-SOY model, which is the GTAP software package customized for Midwest soybeans, provided the bulk of the analysis from which the iLUC adder was derived. As noted previously, the GTAP-SOY model was made available to the public for inspection and comment in compliance with applicable APA requirements.

VI-4. **Comment:** ARB appears to arbitrarily reserve the product/co-product relationship for soy-biodiesel, does not provide adequate documentation to support their treatment of co-product and does not account for lower output scenarios. ARB appears to have reversed the product/co-product relationship between soybean meal and oil. In other words, instead of treating the oil as a coproduct of crushing soybeans for meal, ARB appears to treat the meal as a co-product of crushing soybean for oil. This difference may seem unimportant from a modeling perspective, as long as 80 percent of the bean is attributed to meal. But this reversal raises more fundamental questions related to causation. The whole causal ink between biodiesel and iLUC breaks down if farmers plant soybeans for meal (and the oil is the co-product). In other words, the land use conversion occurs as a result of meal production, not biodiesel production, with oil being (at most) a value-add when the economics are favorable. ARB seems to simply ignore the causal issues by reversing the relationship and treating the primary product (meal) as the co-product. ARB does not support this decision with any documentation. NFA requests answers to the following questions:

(1) What is the rationale for reversing the product/co-product relationship for soybeans?

(2) Presuming that reversing the relationship has little effect on ARB's co-product adjustment, is there any other component of the analysis that is sensitive to the real world relationship between meal and oil in soybean markets?

Response: The purpose of the soy biodiesel land use change analysis is to estimate the greenhouse gas emissions from lands converted to agriculture in response to an increase in demand for soy-based biodiesel. The model works by introducing an increased demand for soy biodiesel into the American market. This stimulates a soybean commodity price increase, which in turn stimulates increased soybean production. The increased production is driven by the demand for soy biodiesel—not by the demand for soybean meal products. Within the context of this model, therefore, soy oil is the primary product, and soy meal is the co-product. One would not model biodiesel market behavior by introducing an increased demand for soy meal. Soy meal

markets merely react to the increased production of soybeans for oil. ARB's soy biodiesel model is properly specified in terms of the relationship between primary products and co-products.

With regard to the materials made available during the two supplemental comment periods, this issue was addressed in response to comment VI-3 above.

VI-5. Comment: With regard to the actual technical treatment of co-products, it is our understanding that GTAP does not have an input or treatment for co-products. As a result, any treatment of co-products would be exogenous to the model run. It would need to be performed by a consultant (or ARB staff, if trained) and based on highly subjective assumptions. As discussed, this puts a high value on transparency and a discussion of rationale. It is impossible to provide substantive review based on the current supplemental package, which provides almost no references and little discussion of the key assumptions and rationale. NFA requests answers to the following questions: (1) Who did the GTAP runs for soy biodiesel? (2) Specifically, what methodologies were used for the co-product adjustment? (3) Was soy disaggregated from other oilseeds in the analysis? (4) How was unproductive, unmanaged, idle and marginal land treated in the analysis? (NFA4)

Response: The need to adjust for co-products exogenously in the model runs made available in the Third 15-Day Change Notice was one of the reasons ARB subsequently pursued additional soy biodiesel modeling. The resulting modeling runs, made available in the Fourth 15-Day Change Notice, were generated by a model in which all co-product calculations and data were endogenous to the model. Because the latter results replaced the former ones, we will respond to the four specific questions in this comment with reference to the latter results:

(1) Information on the source of the biodiesel modeling results which are the basis for the adopted soy biodiesel pathway is contained in Attachment 2, which was appended to the Fourth 15-Day Change Notice and was made available on ARB's internet rulemaking site.

(2) Information on how co-products were handled in the model can be found in the response to comment VI-18 below, as well as in Attachment 2 to the Fourth 15-Day Change Notice.

(3) Soy was not disaggregated from other oilseeds in the analysis. However, as Attachment 2 to the Fourth 15-Day Change Notice points out, the oil yield from oilseeds as a group is the same as the oil yield from soybeans alone.

(4) The biodiesel modeling results which are the basis for the adopted soy biodiesel pathway are based on the same land use categories that were used in all previous ARB land-use change modeling: cropland, forests, and grassland. The implications of the use of these land use categories are discussed in more detail in the response to comment VI-22 below.

VI-6. Comment: It appears that ARB used 1 billion gallons per year of soy-based biodiesel production (or a 750 MGY shock over 250 MGY) for its model runs, based on the federal Renewable Fuel Standard 2 program (RFS2). However, based on the current economy, this is a very high shock for biodiesel. Did ARB consider the likelihood that the U.S. Environmental Protection Agency will downgrade the original RFS2 numbers for soy-based biodiesel? If so, did ARB run lower shocks through the GTAP model? If not, why not? If ARB has not conducted a modeling approach to reflect a contracted RFS2 program, NFA strongly urges regulators to require such an assessment so that a more accurate picture can emerge prior to moving forward with the regulation. The obvious problem is biodiesel producers will be paying for a 750 MGY-induced iLUC penalty many years before reaching that level of output. This does not seem to be a reasonable application of the data in a direct regulation. (NFA4)

Comment: While ARB seems to have done a sensitivity run with 300 MGY fewer biodiesel gallons, all of its Scenarios A-G used to create the actual biodiesel iLUC average are based on the 750 MGY shock. Again, this biodiesel output is unreasonably high given real world conditions today and statements made by U.S. EPA. Why did ARB use only the high input value for its model runs, particularly in light of the potential change to the RFS2 program? Did ARB conduct model runs (other than the sensitivity analysis) at lower volumes at any point over the last 18 months? How does ARB rationalize penalizing a gallon of biodiesel that is part of a hypothetical 300 MGY total U.S. production market for iLUC penalties generated with a 750 MGY shock? (NFA4)

Response: Because the model expresses land use change impacts in units of emissions per unit of fuel energy produced, and because this impact value is not sensitive to the volume of biodiesel produced, the land use change carbon intensity value for soy biodiesel is not affected by the size of the shock used. Thus, both modeling results made available in the Third and Fourth 15-Day Change Notices were based on a 750-million-gallon production increase. Although production volumes are not a significant factor in land-use model used by ARB, we note that biodiesel volume mandates in the U.S. EPA's final RFS2 rule remained at 1 billion gallons per year by 2012.

A Second Opinion

VI-7. Comment: We are disappointed that the "Detailed California-Modified GREET Pathway for Conversion of Midwest Soybeans to Renewable Diesel", Stationary Source Division Release Date: December 14, 2009 Version: 3.0 continues to assume that the distribution pathway for renewable diesel fuel is identical to that of biodiesel, that its tank to wheel emissions are the same as ULSD and that you have chosen to allocate energy inputs and carbon emissions to the co-product renewable propane rather than just take credits similar to those taken for bagasse in the ethanol from sugar cane pathway.

Because renewable diesel is fully compatible with ULSD in all concentrations the carbon emissions associated with its distribution are going to be more like those of ULSD (much of which is pipelined) than those of biodiesel (most of which is trucked to terminals for blending).

The Biodiesel and Renewable Diesel Research Study confirms that renewable diesel reduces exhaust emissions relative to ULSD. This finding should be reflected in the renewable diesel fuel pathways. A renewable diesel pathway that takes renewable energy and carbon credits for renewable propane like the credits taken for bagasse in ethanol from sugar cane pathway is equally as valid as a pathway that allocates energy and carbon emissions to co-products. (A2O4NESTE6)

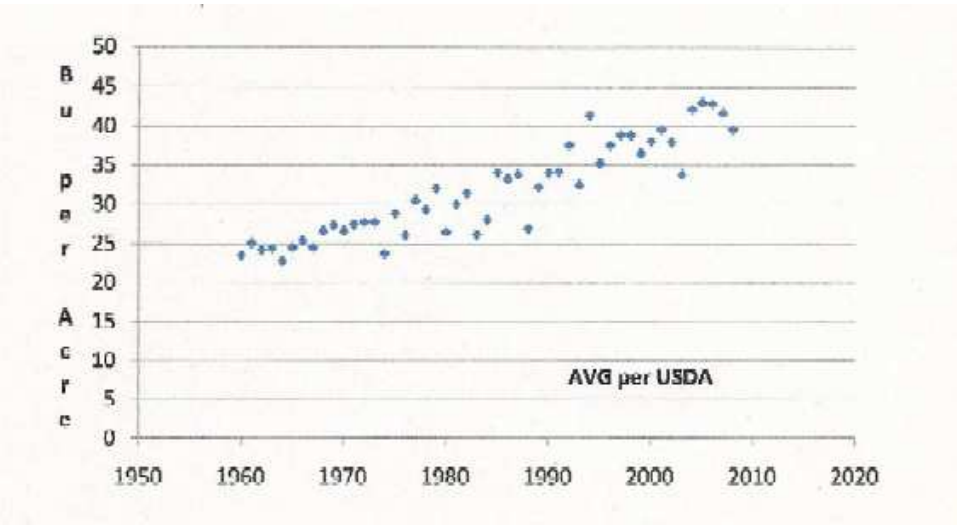
Response: Regarding the distribution of renewable diesel (RD), the CA-GREET model uses the same distribution model for RD as it does for biodiesel. This is because there are no existing facilities in California that use the model proposed by the commenter. If and when a facility is established in California with distribution as proposed by the commenter, appropriate considerations can be provided at that time.

In the lifecycle analysis for RD, the renewable component of exhaust emissions (CO2) is considered GHG neutral. N2O and CH4 emissions from combustion are assumed to be the same as that for ULSD given that blend ratios of RD in ULSD are expected to be small and no significant changes in emissions of these two species are likely to warrant making changes to contributions from these species.

For co-product credit, the energy allocation methodology was adopted and only 94.5% of the GHG emissions from the production process was allocated to renewable diesel. The balance (5.5%) was allocated to propane, a co-product in the RD production process. As for the commenter's recommendation that the propane be provided credit as in the case of bagasse, when a producer can demonstrate that the produced propane is being utilized as process fuel (thereby requiring less energy from an equivalent fossil fuel), it can be reviewed under Method 2A of the regulation (section 95486(c)) to assess if any differential credits could be awarded to the pathway.

VI-8. Comment: We noticed the comment "Since yields for soybean (three year running averages) have remained relatively stable since the baseline year of 2004, an external adjustment was not necessary for soy biodiesel." Is this a valid assumption? In the United States the average soy bean yield is about 40 bushels per acre and increasing at the rate of about 0.4 bushels per acre per year (See Figure below). There is no reason to assume that soy farmers have reached a maximum yield because the record yield was 139.4 in 2006 and 154.7 bushels per acre in 2007. Would changing this assumption to match long term yield trends result in a lower ILUC factor for soy renewable diesel? (A2O4NESTE6)

Figure: U.S. Soybean Yield



Response: ARB agrees that soybean yields should be adjusted to current levels, in a manner that is consistent with the adjustment performed in the corn ethanol analysis. Such an adjustment was performed for the updated soy biodiesel analysis made available with the Fourth 15-Day Change Notice. In that analysis, the oilseed yield increased by seven percent between 2001 and the three-year average for 2006-2008. Adjusting the GTAP results for this yield increase reduced the soy biodiesel land-use change carbon-intensity from 66 to 62 g CO2e/MJ.

VI-9. Comment: Crop rotation, in which soybeans are rotated with corn, increases corn yields per acre. See this website http://www.agry.purdue.edu/staffbiolVynPandC26.pdf. Does the GTAP model take this fact into account?

Intuitively it seems that the higher the energy yield per acre the lower the ILUC carbon factor should be. The ethanol yield per acre of sugar cane is almost twice the ethanol yield per acre of corn. The ILUC factors for corn ethanol (30) and sugar cane ethanol (46) are counter intuitive. This is important because soy has a relatively low diesel yield per acre and until we understand the basis for what seem to be counter-intuitive ILUC values we will not be able to estimate or defend preliminary ILUC values for alternative crops with much higher diesel yields but little or no GTAP data. So we will appreciate any assistance you can provide in increasing our understanding of this counter-intuitive finding. (A2O4NESTE6)

Response: Rotating corn with soybeans has long been a standard practice in the U.S. The corn yield boost this practice provides is captured in the average corn yield, which is used in the corn ethanol land-use change analysis. Soybeans, however, receive no credit for this boost. The only effect that an increased demand for soy biodiesel would have on this corn yield effect is to decrease it. The reason is that, as the price of soybeans rises relative to corn (stimulated by the increased demand for soybeans by

the biodiesel industry), the number of acres in a corn-soybean rotation will decrease as corn is removed from the rotation. The opposite effect occurs when the price of corn rises relative to soybeans: more and more soybeans are removed from the rotation. For this reason, corn receives no credit for its influence on soybean yields, and soybeans receive no credit for the benefit they convey to corn.

The energy yield of a biofuel feedstock crop determines the gross amount of land required for production of a given volume of biofuel. If all else were held constant, a fuel with a lower energy yield would have a higher carbon intensity than a fuel with a higher energy yield. Of course, all else is not equal in the commenter's comparison of sugar cane and corn energy yields. Other influences on the carbon intensities for these two fuels—influences such as the GHG emission rates of the land converted to agriculture and co-product credits—more than compensate for the higher energy yield of sugar cane.

Western States Petroleum Association

VI-10. Comment: Soybean processing to produce vegetable oil and byproduct soy meal for animal feed appears to be very similar to corn processing to produce ethanol and byproduct DGS. Therefore, these soy-based pathways should determine the carbon intensity of biodiesel and renewable diesel with a byproduct credit for soy meal using the substitution approach. It is important for a consistent approach to be employed for similar pathways in order to ensure that fuels are treated equitably.

In the proposed pathways, the methodology used to treat co-product credit for soybean meal was changed from an allocation approach based on energy content to an allocation approach based on mass. This had the effect of roughly halving the agricultural emissions associated with the growing and transport of soybeans relative to the previous analysis (i.e., the allocation fraction between soybean oil and soybean meal changed from about 45:55 under the energy allocation approach to 20:80 under the mass allocation approach).

Additionally, it appears that energy and emissions associated with the soy oil extraction step were allocated with the 20:80 ratio. Although the staff's report cited consistency with GTAP modeling to support this change, further discussion is warranted, particularly with respect to the following issues:

(1) Although GTAP may need to assign co-products based on mass, it is unclear that the ensuing economic analyses performed by GTAP would ultimately result in a GHG emissions allocation based on that same 20:80 split. (WSPA6)

Comment: It may not be appropriate to assign any of the GHG emissions from the oil extraction step to soybean meal. If the oil was not used for biodiesel or renewable diesel, would the soybeans be used directly as animal feed? If so,

should not all of the emissions from oil extraction be assigned to biodiesel or renewable diesel? Only the emissions that occur in the production of soy based animal feed in the absence of biodiesel production (e.g., "upstream" of the oil extraction step in this example) should be subject to the 20:80 allocation.

Note that this has a significant impact on the overall carbon intensity of the biodiesel and renewable diesel pathways. For example, Table A from the biodiesel pathway report lists the extraction step as contributing 3.83 gCO2e/MJ to the overall process. If the emissions from the entire oil extraction step are assigned to the oil instead of allocating 80% of them to the soybean meal co-product, the extraction step would contribute 19.15 gCO2e/MJ to the pathway, and the total carbon intensity of biodiesel derived from soybeans would be 98.57 gCO2/MJ (including land use change effects), or slightly higher than CARB diesel. (WSPA6)

Response: Worldwide, almost 90% of the soybeans produced are crushed to make soybean meal and oil. See Attachment 2, Fourth 15-Day Change Notice. Hence the meal produced has been traditionally used as an animal feed component and does not displace any existing soybean (whole). In the corn ethanol case, corn is diverted to make ethanol and a co-product DDGS of the production process is available to substitute for corn as animal feed. Hence the two cases are not directly comparable. As for the allocation methodology, the land use change analysis conducted with the GTAP model accounts for approximately 80% of the mass being available from the removal of oil from soybean as animal feed. To ensure consistency with the GTAP analysis, the modeling results made available with the Fourth 15-Day Change Notice consider the 80/20 allocation ratio on a mass basis for soybean based biodiesel.

The GTAP model explicitly models the cost minimizing feed ration decisions of livestock producers. It models soy biodiesel as a multiproduct process resulting in both biodiesel and soy meal outputs, and estimates penetration of both products into the relevant markets. Higher oilseed prices, coupled with increased availability of soy meal, reduce the amount of soybean that must be grown to produce livestock feed. Because soy meal can also substitute for other livestock feeds, other feed ration constituents also rise and fall in response to relative feed commodity prices. The GTAP model allows all affected markets to adjust to the price and quantity impacts of the soy meal co-product, based on relative prices, and the ease with which each feed product can be substituted for the others.

The current version of the soy biodiesel GTAP model (GTAP-SOY, Jan. 2010) handles the soy meal co-product by utilizing distinct commodity categories for processed food, processed feed, crude vegetable oil, refined vegetable oil, and oilseed meals. A new crude vegetable oil industry sector producing crude vegetable oil and oilseed meals is also included. The outputs from this sector are utilized by the biodiesel and refined vegetable oil industries. Additional modifications allowed the model to better account for the consumption of meals in livestock feed rations.

Because the co-product credit calculated in the GTAP model is the result of the interactions of several markets, it is fundamentally different from the more straightforward accounting approach taken in lifecycle analysis models such as CA-GREET.

VI-11. Comment: If mass is used for part of the pathway (in this case the soybean oil - soybean meal allocation), isn't there an inconsistency with the treatment of glycerin in the biodiesel pathway, which is allocated based on energy? (WSPA6)

Response: Co-product credit methods based on allocation can use either mass, energy, market pricing, etc., to proportionally allocate GHG emissions to the individual components of a pathway step in the lifecycle analysis of a transportation fuel. The commenter suggests a likely inconsistency in the analysis because the soybean meal/soyoil allocation was mass-based but the biodiesel/glycerin allocation was energy-based. For reasons described below, there is no inconsistency.

For soybean meal, its market pricing reflects its value as a protein source and not as an energy source. Hence, assigning an energy value for soybean to compare it against soyoil was not an optimal solution, and the original assignment (energy-based) was changed to reflect the current method of mass-based allocation. As for biodiesel/glycerin, both can be evaluated based on their inherent energy intensities. Accordingly, the energy-based allocation was used for this step in the soyoil to biodiesel pathway.

VI-12. Comment: CARB staff has included the combustion of fossil-based carbon in the biodiesel pathway, which is technically appealing. The fossil-based carbon comes from the methanol used in the trans-esterification process, which displaces bio-based carbon in the soybean oil feedstock in a ratio of about 1:18. The bio-based carbon cleaved from the soybean oil is then incorporated into the glycerin co-product from this process. Additional discussion of this issue is warranted, as one might argue that the bio-glycerin should receive a GHG credit if it would otherwise displace petroleum-based glycerin. (WSPA6)

Response: The glycerin produced from the biodiesel esterification process is crude glycerin. This need to be refined to produce refined glycerin which could be potentially be used as a substitute for petroleum-based glycerin. Conventional techniques to purify the crude glycerin, such as distillation, are energy intensive given that glycerin has a high heat capacity and demands higher energy inputs for vaporization. Ion-exchange techniques are uneconomical since the salt content from biodiesel approaches 5-7%. Processes to convert crude glycerin to refined glycerin require energy and therefore have corresponding carbon emissions related to the processing. In the staff's analysis, only the production of glycerin as a co-product has been considered. An appropriate energy credit has been provided in the pathway analysis. If supporting information for a given facility with all relevant information related to additional processing required before crude glycerin is refined is made available, consideration under Method 2A could

be provided. Glycerin could have other uses such as being used as fuel in the facility which could be reviewed under Method 2A.

VI-13. Comment: We also suggest that CARB clarify how biodiesel or renewable fuels from a mixture of feedstocks (e.g., soy and canola) should be treated under the Lookup Table. In addition, CARB should update the Lookup Table to add biodiesels and renewable diesels from other feedstocks, including corn oil, canola, tallow, used cooking oil, etc.

Response: Regulated parties must work with staff to establish carbon intensities when situations such as the one being requested by the commenter above. When the final fuel utilizes a mix of feedstocks for which the regulation already contains pathway carbon intensities, an appropriately weighted average may be considered. Regulated parties do have to provide verifiable information about the process. Also, when one or more of the feedstocks have not been considered by staff, then a Method 2B will likely be required for the pathway.

The regulation already includes fuel pathways for biodiesel and renewable diesel from used cooking oil, tallow, etc. Staff is currently working on including feedstocks such as corn oil for the production of biodiesel and renewable diesel. Other feedstocks will be considered in the future.

National Biodiesel Board

VI-14. Comment: We are extremely disappointed that a comment period totaling only 30 days has been provided for the Land Use Changes Effects for Soy Biodiesel report. Given the complexity of the issue, a more lengthy comment period would have proved beneficial. In addition, it should be noted that three key questions regarding GTAP assumptions were emailed to and received by ARB staff on December 29, 2009 (see Comment VI-15 below). As of this writing, neither staff at ARB nor U.C. Berkeley has been able to answer these questions. This has severely hindered Dr. Babcock's work, in particular. Perhaps with additional time, these questions could be answered. For these reasons, we wish to formally request an extension to the comment period of not less than 15 days for both the Soy Biodiesel Land Use Change and GREET Version 3.0 reports.

We are severely disappointed in the comment period for the ILUC soy model being only 30 days in duration, especially in light of the fact that the individual responsible for conducting the GTAP modeling at the University of California, Berkeley (U.C. Berkeley) was wholly unavailable during this time period and thus several key questions regarding assumptions that were used in the model remain unanswered (see Comment VI-15 below). Certainly this has hindered our experts' ability to provide comprehensive comments and is the chief reason we are formally requesting an extension to the comment period of not less than 15 days." (NBB3)

Response: As noted in response to comment VI-2, the Third 15-Day Change Notice actually provided 30 calendar days for public review, twice the amount of time required under Government Code section 11347.1. This provided ample time for public review and comment. Therefore, no additional time for public review is warranted. Contrary to the commenter's claim, staff were available during both supplemental comment periods to answer questions from interested stakeholders.

VI-15. Comment: The key questions regarding assumptions that were used in the model and remaining unanswered are:

- How does the land use modeling take into account the CARB assumption that 80% of the soybean mass is a co-product (soybean meal) and 20% of the mass is the product (soybean oil)? We have replicated CARB's numbers, but have not yet found these factors in the GTAP code.
- How exactly were soybeans split out from GTAP oilseeds? Can you explain how the model is shocked in regards to soybeans versus vegetable oils?
- Why is the fraction of the total land converted that is forest higher for the soybean oil shock than for the corn ethanol shock shown in the ISOR (for the same GTAP inputs)? (NBB3)

Response: As a preliminary matter, the soy biodiesel modeling results made available with the Third 15-Day Change Notice depended upon an external adjustment to account for co-products. By contrast, the improved modeling results made available with the Fourth 15-Day Change Notice were produced using a version of the GTAP model that had been revised to fully integrate co-product data algorithms into the model. This was accomplished by adding distinct commodity categories for processed food, processed feed, crude vegetable oil, refined vegetable oil, and oilseed meals. A new crude vegetable oil industry sector producing crude vegetable oil and oilseed meals was also added. The outputs from this sector are utilized by the biodiesel and refined vegetable oil industries. Additional modifications allowed the model to better account for the consumption of meals in livestock feed rations. These new sectors and industries are constructed from published U.S. economic data. Although the GTAP does not utilize an *a priori* meal-to-oil ratio, users can confirm that that the ratio of total revenues in the oil industry to total revenues in the meal industry matches the ratio calculated from official U.S. data.

With regard to the specific questions posed by the commenter, we respond as follows:

1. Soybeans were not split out from oilseeds in GTAP-SOY (January 2010). The modeling results made available with the Third 15-Day Change Notice was in error when it was reported that the model was capable of handling soybeans as a distinct commodity. The supporting documentation made available with the Fourth 15-Day change Notice points out, however, that the average oil extraction yield from oilseeds as a group is the same as the average oil extraction yield from soybeans alone.

2. Among the reasons ARB decided to seek a re-analysis of the soy biodiesel results made available with the Third 15-Day Change Notice was the relatively large proportion of forests converted to farmland in the those results. This problem was caused in part by the structure of the model at that time: the economic data used was from 2004, but the agro-ecological zone cover type data was from 2001. This problem was corrected in the modeling results made available with the Fourth 15-Day Change Notice. The relative contributions of forests and grasslands to agricultural conversion in that subsequent release are now consistent with the conversion results reported previously for corn ethanol production. This issue is further discussed in response to comments VI-21 and VII-7.

VI-16. Comment: One concerning aspect of the ARB's GTAP work that our experts have discovered, which should be noted very prominently, is that, while the GTAP model relies consistently on government data when it is available, numerous instances exist in which official government data has been replaced by data from other sources. It is particularly interesting to note that in each of these instances, this new data differs not slightly but wildly from the data which has been reported by official governments and the International Panel on Climate Change (IPCC). Additionally, in each and every instance, the data underestimates soy biodiesel's greenhouse gas (GHG) emissions benefit as an alternative to petroleum diesel. In some instances, our experts were able to identify the source of the data [e.g. Timothy Searchinger et al (2008); Woods Hole Oceanographic Institution]. In other instances, they were not. Our hope is that all these data, which are inconsistent with highly credible government and international sources, have been identified and can be addressed; but certainly this is an area that would benefit from additional analysis, which could be conducted during the requested 15-day extension. (NBB3)

Response: As noted in response to comment L-30 in the original FSOR, the emissions factors used in ARB's land-use change analysis were compiled by the Woods Hole Research Center. The primary advantages of the Woods Hole data set for the ARB's analysis are that it is global in scope and has undergone peer review in the scientific literature.

The ARB staff continues to analyze this issue to determine the most appropriate emission factors to use in calculating the carbon that is released to the atmosphere following land conversion. In recognition of this and other issues relevant to land use change calculations, the Board directed staff in Resolution 09-31 to convene an expert workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels. The scope of the work to be done by the expert workgroup includes investigating whether emission factors from other sources, such as the IPCC or the U.S. Forest Service, should be evaluated for possible inclusion in the GTAP model.

VI-17. Comment: Version 3.0 of the direct emissions model changes to using a mass allocation method for determining the emissions associated with soybean oil and soybean meal. The NBB agrees with this change. However, instead of using the precise figures from U.S. Department of Agriculture (USDA) data (81.1/18.9), the ARB uses approximate figures (80/20). This 0.45 g/MJ discrepancy between the ARB estimate/simplification and actual USDA data has the effect of artificially decreasing soy biodiesel's GHG benefit by 0.4 percent. (NBB3)

Response: The USDA data indicate that when soybeans are crushed to make meal and oil, approximately 79% of the mass is soybean meal, 19% is soy oil and 2% is loss from extraction. The lifecycle analysis proportions emissions between soybean meal and soy oil and not the loss component. This translates to 79/98 = 80.6% and 19/98 = 19.4%. Given that the values reported by the USDA are averages, rounding them to 80/20 is reasonable for this analysis.

VI-18. Comment: The ARB modeling essentially assumes that glycerin, a co-product of biodiesel production used to make cosmetics and pharmaceuticals (among other products), is discarded as waste. This appears to be the case because the model does not include the emissions credit resulting from displacement of petroleum produced glycerin. As such, biodiesel is charged for the carbon emissions related to that co-product (3.7 g/MJ). This is inappropriate because 99 percent of industry participants sell the glycerin that is produced at their facilities, according to a 2009 survey conducted by the NBB. The model's assumption that biodiesel producers do not sell glycerin, a co-product that has a demonstrated value in the marketplace, is counter to both commonsense and NBB survey data. For these reasons, the ARB should provide a co-product credit for glycerin in the model, which would decrease biodiesel's carbon intensity by 3.7 g/MJ, or 3.9 percent. (NBB3)

Response: The glycerin produced from the biodiesel esterification process is crude glycerin. Crude glycerin needs to be refined before it can substitute for petroleum-based glycerin. Conventional techniques to purify the crude glycerin such as distillation are energy intensive given that glycerin has a high heat capacity and demands higher energy inputs for vaporization. Ion-exchange techniques are uneconomical since the salt content from biodiesel approaches 5-7%.

Processes to convert crude glycerin to refined glycerin require energy and therefore have corresponding carbon emissions related to the processing. In the staff's analysis, only the production of glycerin as a co-product has been considered. An appropriate energy credit has been provided in the pathway analysis. If and when supporting information is made available for a given facility or process, with all relevant information related to additional processing required before crude glycerin is refined, an applicant can apply for consideration of that information under Method 2A in section 95486(c) of the LCFS regulation. Glycerin could have other uses, such as being used as fuel in the facility, which may also be reviewed under a Method 2A application.

VI-19. Comment: According to its report, the ARB chose not to make any type of yield adjustment for soy biodiesel because no yield improvement occurred between the years 2004 and 2007 (Notably, the ARB did include a yield adjustment for corn ethanol). There are a number of problems with this assessment. Two data points (2004 and 2007) is insufficient in terms of analyzing the historical trend of soybean yields, which have increased regularly for 70 years. 2004 represents an inappropriate baseline because it was a very good crop year (excellent weather) and subsequent years were average to below average.

Four years is far too short a time span from which to project results to 2020. Forecasts from the major seed companies project yields above 60 bushels per acre by 2020. These reliable forecasts should be part of the estimation of future land use; otherwise the modeling fails to be realistic. Recent data from USDA indicating the average yield in 2009 was 44 bushels per acre is not incorporated in the model. At an absolute minimum, the model should reflect current yields.

Notwithstanding the new data from USDA for 2009, a simple straight-line extrapolation from historical yield data supports a yield of 47 bushels per acre rather than the 42.2 figure the ARB uses. Doing so would reduce the indirect land use change (ILUC) factor by 10.2 percent. (NBB3)

Response: ARB agrees that soybean yields should be adjusted to current levels, in a manner that is consistent with the adjustment performed in the corn ethanol analysis. Such an adjustment was performed for the updated soy biodiesel analysis made available with the Fourth 15-Day Change Notice. In that analysis, the oilseed yield increased by seven percent between 2001 and the three-year average for 2006-2008. Adjusting the GTAP results for this yield increase reduced the soy biodiesel land use change carbon intensity from 66 to 62 g CO_2e/MJ. Future yield adjustments can be considered during the two formal LCFS program reviews, which are scheduled to occur by 2012 and 2015, respectively.

VI-20. Comment: The seven scenarios used for soybean biodiesel use exactly the same elasticity values as were used for corn ethanol. It is important to note, however, that soybeans and corn are different crops in many respects and, therefore, should be evaluated independently with respect to elasticity values. Relevant examples include: Soybean yields throughout the world are quite similar, while corn yields in the U.S. are significantly higher than in many other regions. One explanation for this disparity is the fact that soybeans produce their own nitrogen, a key fertilizer that is purchased and applied to corn in the U.S. to maximize yield and perhaps not applied in less developed nations due to cost constraints.

While double cropping is not an option for corn in the U.S., soybeans are an excellent candidate for this agricultural practice in the U.S. and Brazil. Data shows that double cropping soybeans is many farmers' first response when prices increase. This effectively boosts the soybean yield without adding planted

acres. While the GTAP model does not account for this, Dr. Babcock and Mr. O'Connor both recommend that the issue be addressed by using a crop elasticity of 0.4.

The ARB also assumes that yields will be lower on new lands brought into production as a result of renewable fuels policy. This hypothesis is contradicted by actual data collected by the governments of Brazil and Argentina. [footnote omitted]. Based on this data, Dr. Babcock recommends a value of 1.0 for soybeans for the elasticity of crop yields with respect to area expansion. Mr. O'Connor recommends a value of 0.9 to 1.0. In other words, based on the data, there is no reason to expect a yield loss, and certainly a significant one, on new lands that are planted with soybeans.

With regard to the elasticity of land transformation, the GTAP model results have been developed assuming that the percentage change in pasture land is the same as forest land. However, real-world data shows that pasture lands (and idle lands) are converted at a much higher rate than forest lands, likely because the costs of doing so are immeasurably lower. In his analysis, to reflect this fact, Dr. Babcock points out that GTAP supporting documentation (Ahmed et al, 2008) indicates that different elasticities should be used for each type of land. Using one elasticity value for both types of land overestimates the amount of land that would come from forest and underestimates the amount that would derive from pasture. The effect of this approach is to artificially increase the carbon intensity of soy biodiesel. (NBB3)

Response: The elasticities used in GTAP-SOY (January 2010) are constant across all crops—not just between corn and soybeans. *Yields* however *are* crop specific. This means that yield responses to price changes are also crop specific. It is important to keep this distinction in mind when evaluating modeling results from the GTAP. Elasticities determine a response *rate*, but the final response is determined by specific crop yields and commodity prices.

Double cropping is accounted for in the GTAP's agricultural production data. It is possible, however, that the model could underestimate the intensity of the double cropping response in some regions. Increasing the yield price response elasticity would be one method to compensate for this underestimation, if it is found to be significant.

The commenters have submitted data indicating that yields on newly converted farmland is at least as high as are yields on established agricultural land is some areas. Sufficiently robust data do not yet exist to assign accurately the elasticity of crop yields with respect to area expansion by specific region in all regions of the world. One value currently applies to all regions. ARB has received no data suggesting that this elasticity should be set to one for all regions. Future versions of GTAP may be capable of setting this elasticity on a regional basis. This issue is further discussed in response to comment VII-9 below.

With regard to the issues of elasticity of land use transformation and the relative contribution of forests and grasslands, these issues were addressed in the materials made available with the Fourth 15-Day Change Notice and are further discussed in response to comment VII-7 below.

As noted previously, the Board recognizes that the science of land-use change effects analysis is continuing to develop and evolve. Therefore, the commenter's points are best addressed through the expert workgroup process described in response to comment VI-16 above.

VI-21. Comment: One of the questions we asked ARB staff and Mr. Michael O'Hare from U.C. Berkeley that has, heretofore, gone unanswered is the following: "Why is the fraction of the total land converted that is forest higher for the soybean oil shock than for the corn ethanol shock shown in the ISOR (for the same GTAP inputs)?"

For reasons yet to be determined, the individuals at U.C. Berkeley who are working on this project assumed a rate of deforestation for soy biodiesel that is more than twice that of corn ethanol even though the total land use change area in the soy model is less. We have not been able to find an expert who can provide a justification for why this would be the case. Since the carbon loss on forest land is as much as ten times that of pasture land, this assumption has a tremendous impact on the model results and, at a minimum, should be explained. We would hope that the ARB would grant the 15-day comment extension we have requested so this – and the other questions we asked – can be answered. (NBB3)

Response: Among the reasons the ARB decided to seek a re-analysis of the soy biodiesel results made available with the Third 15-Day Change Notice was the relatively large proportion of forests converted to farmland in the those results. This problem was caused in part by the structure of the model. The economic data used were from 2004, but the agro-ecological zone cover type data were from 2001. This problem was corrected in the results made available with the Fourth 15-Day Change Notice. The relative contributions of forests and grasslands to agricultural conversion in those corrected results are now consistent with the conversion results reported previously for corn ethanol production. This is discussed further in response to comment VII-7 below.

VI-22. Comment: The fact that the GTAP model is incapable of taking idle lands into account, which comprise more than 30 percent of available agricultural lands worldwide, is a serious shortcoming which no one disputes. Obviously, if land expansion is to occur as a result of renewable fuels policy, it will likely take place on idle land or expiring CRP acres in the U.S. and on set-a-side land in Europe before occurring in forested regions. Far more than the 1.26 million acres of crop land that GTAP indicates are needed to accommodate the California LCFS are available from idle lands. The fact that GTAP ignores these available lands and assumes all needed land comes from forest and pasture creates a massive

artificial carbon penalty for soy biodiesel. In the attached analyses, Dr. Babcock and Mr. O'Connor recommend addressing this issue by changing the elasticity of crop yields. (NBB3)

Comment: The ARB and U.C. Berkeley ran the GTAP model for an alternate shock of 450 million gallons (versus 750 million gallons). This 40 percent reduction in biodiesel demand resulted in a mere 5 percent decrease in land use change emissions. This lack of sensitivity to biodiesel volume means: a) the GTAP model is not functioning properly; or b) the indirect land use change hypothesis is largely invalid, or at least is not triggered until biodiesel demand exceeds what would be required to meet the California LCFS.

The sensitivity analysis presented by ARB/U.C. Berkeley, and confirmed by our experts, shows that the land use change predictions from GTAP are far more sensitive to the data and assumptions made by the modelers than by varying the volume of biodiesel within the model. In fact, under certain scenarios, the model concludes that land use change emissions actually decrease as biodiesel volumes increase. This phenomenon is likely caused, in part, by GTAP's inability to consider idle farm land and soybean double cropping. Both Dr. Babcock and Mr. O'Connor recommend a way to address this issue in their reports. (NBB3)

Response: With regard to accounting of idle lands, ARB acknowledges that the GTAP does not currently account for all categories of potentially arable land. However, the extent to which that condition affects the results obtained is not obvious. Moreover, it is not obvious how best to address this in GTAP, if at all. Because of this, it is appropriate to investigate this issue further through the expert workgroup noted below.

With regard to the second issue, the GTAP biodiesel model's insensitivity to biodiesel production volumes is not indicative of a problem with the model. Because the model expresses land use change impacts in units of emissions per unit of fuel energy produced, an insensitivity to production volume simply means that each additional increment of fuel production results in largely equal land use change areas and that the relative proportions of grassland and forest in each increment remain relatively constant. This would be the expected outcome in a situation free of threshold effects such as the exhaustion of a reservoir of unused cropland.

In such a scenario, the increased demand for soybeans for biodiesel would be met by expansion into these unused lands, until the supply of such land was exhausted. At that point, non-agricultural land would begin to be converted to agricultural uses to support the increasing production of soybeans, as well as the crops displaced by soybeans. In order for this scenario to entail a significant threshold effect, however, the amount of carbon sequestered by the reservoir of unused crop land must be significantly different from the amount sequestered by either grasslands or forests. Unused cropland that has fully reverted to grassland status would, upon conversion, release the same amount of carbon as any other converted grassland. A similar threshold effect could be triggered

by a double-cropping regime: Increased demand could be met by double cropping until all available double-cropping capacity was being utilized.

The commenters maintain that both a reservoir of idle crop land and ample double-cropping opportunities exist for American farmers. This is based on an assessment of available agricultural land use categories and agricultural practices that both conditions exist in the U.S. If that reservoir of idle cropland is sufficiently large, and if its carbon sequestration levels are different from comparable grassland and forest levels, a threshold effect could be observed. A threshold effect could also be present if actual double-cropping practices are more intensive than the practices for which the GTAP model currently accounts.

The ARB is aware that the GTAP model does not currently account for all categories of potentially arable lands, and that double-cropping practices may not be fully accounted for in the model. It is unknown, however, whether revising the model to account for these areas would produce significantly different land use change impact estimates. In recognition of this and other issues relevant to land use change calculations, the Board directed staff in Resolution 09-31 to convene an expert workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels.

VI-23. Comment: The ARB assumes that the carbon stored in forests exists permanently. Unfortunately, this is not the case because trees, like all living things, have natural lifecycles and fall victim to death and natural disasters such as fire, disease, pests, and extreme weather. In other words, a portion of the carbon contained in forests is only stored temporarily. These factors, which shorten the life of carbon storage, should be accounted for because at the end of these cycles the carbon contained in the ground biomass decomposes and is recycled into the atmosphere. For these reasons, in a given 30-year time frame, it is likely that only one-third to one-half of the carbon that is removed from land in the first year due to deforestation would have been standing at the end of the time period. Additionally, no allowance has been made for the possibility that some of the wood is converted into wood products. Particularly for developed nations, this should be factored into the analysis as recommended by Mr. O'Connor in his report. (NBB3)

Response: The first part of this comment asserts that ARB erroneously assumes that the carbon stored in forest biomass is stored permanently. This assertion is incorrect. We agree that some portion of the above-ground biomass in forests decomposes and is recycled to the atmosphere each year. However, this decomposition of biomass is either offset (mature forests) or more than offset (growing forests) by growth of new biomass each year. The net effect of these opposing processes is that overall forest biomass increases over time to a steady state or equilibrium level achieved by mature forests. Emission factors used in the LCFS incorporate the initial loss of above-ground carbon as well as the net lost annual sequestration for those areas where forests continue to grow toward maturity. In regions where forest maturity has been reached, no net lost annual sequestration is included. In regions of the world where afforestation

is occurring and land use change reduces the amount of afforestation, the emission factors only include the net lost annual sequestration and do not include loss of above-ground carbon.

With regard to potential conversion of above-ground biomass from forests into wood products, ARB conservatively assumes that 100 percent of above-ground carbon is released to the atmosphere following land conversion. As stated in the Staff Report on page IV-46, we recognize the validity of the argument that when forests are converted to cropland, some of the above-ground biomass may be converted to wood products, paper, and other consumer goods. The carbon in these items will be stored while these products are used, and in many cases after they have been deposited into landfills. However, as also stated in the Staff Report on the same page, decay of biomass in landfills will more likely lead to release of methane (a more potent GHG) rather than carbon dioxide. This would have to be considered if a non-trivial percentage of biomass from converted lands is placed in landfills or otherwise allowed to decay anaerobically.

The ARB staff continues to analyze this complex issue to determine the most appropriate percentage of above (and below) ground carbon that is released to the atmosphere following land conversion. In recognition of this and other issues relevant to land use change calculations, the Board directed staff in Resolution 09-31 to convene an Expert Workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels.

VI-24. Comment: The carbon inventory of U.S. forest land used by the ARB is based on data from the Woods Hole Oceanographic Institution that was presented by Searchinger et al (2008). This data is less detailed than that which is available from the U.S. Forest Service and it contains carbon values that are more than twice as high as those provided by the Forest Service. Since the methodologies for collecting the data appear to be very similar, it is unclear why these significant discrepancies exist. But since they do exist, we wish to go on record as viewing data collected by the U.S. Forest Service as more appropriate for this purpose than data from the Woods Hole Oceanographic Institution, especially since the GTAP model consistently uses data from government sources when it is available.

The other major issue with the U.S. analysis is that no offset is provided for the portion of biomass that is stored as harvested wood products. If 40 percent of the above ground biomass was converted to wood products, the emission factor would be reduced by approximately 72 percent. Mr. O'Connor speaks at length about this issue in his analysis. (NBB3)

Comment: In Canada, almost all forest land is government owned and controlled. For this reason, it is extremely unlikely that clear cutting of forests would be allowed for crop production. Therefore, an adjustment to offset biomass used for wood products is merited and recommended. (NBB3)

Comment: The emission factors for forest land in the remainder of the world also appear to be overestimated. For example, in the instance of boreal forests, the Intergovernmental Panel on Climate Change (IPCC) reports that the carbon content of above ground biomass for boreal coniferous forests ranges from 10 to 90 t C/ha, and that other types of boreal forest have a maximum of 20 to 50 t C/ha.

Despite the fact that the carbon intensities of boreal forests range widely, the ARB has included only one figure for forest carbon intensity. That lone estimate of 90 t C/ha represents the absolute high end of the range of the most carbon intensive boreal forest in IPCC's database. The NBB recommends using a more appropriate mean value for boreal forest. 50 t C/ha would seem more representative of boreal conifer forests while still exceeding the maximum estimated carbon content of the other types of boreal forest described by the IPCC. (NBB3)

Comment: The assumptions related to pastureland come from Searchinger et al (2008). As in the above case, these figures depart significantly from IPPC default values. Therefore, it is recommended that these figures be amended to reflect international consensus on the issue. The IPCC figures are included in Mr. O'Connor's analysis (Table 3-8). (NBB3)

Table 3-8 IPCC Default values for Grassland Biomass

	Peak Aboveground Biomass, t dry mater/ha		
	Average	No. of Studies	Error
Boreal, wet & dry	1.7	3	+/- 75%
Cold temperate, dry	1.7	10	+/- 75%
Cold temperate, wet	2.4	6	+/- 75%
Warm temperate, dry	1.6	8	+/- 75%
Warm temperate, wet	2.7	5	+/- 75%
Tropical, dry	2.3	3	+/- 75%
Tropical, moist & wet	6.2	4	+/- 75%

Comment: The ARB uses a soil carbon content estimate for grassland in Canada of 189 t C/ha. The value reported by Environment Canada is only 75 t C/ha – less than half of that which the ARB is using in its version of GTAP. It is recommended that the ARB adopt the figure reported by Environment Canada. (NBB3)

Response: The emissions factors used in ARB's land use change analysis were compiled by the Woods Hole Research Center rather than by the Woods Hole Oceanographic Institute. The primary advantages of the Woods Hole data set for the ARB's analysis are that it is global in scope and has undergone peer review in the scientific literature. We agree that different emission factors may be calculated using

alternate data sources such as U.S. Forest Service or other governmental data mentioned by the commenter or using IPCC default values.

With regard to potential conversion of above-ground biomass from forests into wood products, ARB conservatively assumes that 100 percent of above-ground carbon is released to the atmosphere following land conversion. As stated in the Staff Report on page IV-46, we recognize the validity of the argument that when forests are converted to cropland, some of the above-ground biomass may be converted to wood products, paper, and other consumer goods. The carbon in these items will be stored while these products are used, and in many cases after they have been deposited into landfills. However, as also stated in the Staff Report on the same page, decay of biomass in landfills will more likely lead to release of methane (a more potent GHG) rather than carbon dioxide. This would have to be considered if a non-trivial percentage of biomass from converted lands is placed in landfills or otherwise allowed to decay anaerobically.

The ARB staff continues to analyze these complex issues to determine the most appropriate emission factors and percentage of above (and below) ground carbon that is released to the atmosphere following land conversion. In recognition of this and other issues relevant to land use change calculations, the Board directed staff in Resolution 09-31 to convene an expert workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels.

VI-25. Comment: The ARB GTAP modeling concludes that the low carbon fuel standard (LCFS) policy would increase the price of soybeans by 1.44 percent. The model indicates that this minor increase – less than the price change on many trading days – causes an additional 1.26 million acres of crop land to be brought into production. Put simply: the data does not support this level of expansion. (NBB3)

Response: This comment inappropriately compares changes in absolute land area (acres) to a *percentage* change in price. Expressing both the land area change and the price change in percentage terms places this relationship into its proper perspective. Depending upon the scenario, between 0.66 and 1.12 million hectares are converted to agriculture. These values represent 0.36 and 0.62 percent, respectively, of the total oilseed harvested area for 2001. Therefore, using the price change predicted by Scenario F (Attachment 2 at 5, appended to the Fourth 15-Day Change Notice), we see that a 2.89 percent price increase stimulates the conversion of an area of land that is between 0.36 and 0.62 percent of the 2001 oilseed harvested area.

VI-26. Comment: The ARB attempted to model the indirect land use changes from one billion gallons of soy biodiesel, assuming an initial volume of 250 million gallons and shocking the model for 750 million gallons of additional biodiesel demand. This overestimates the amount of soy biodiesel that would be required to meet the California LCFS.

When calculating demand for biodiesel, it is important to consider that the fuel is produced from many different feedstocks, including waste feedstocks such as used cooking oil, animal fats, and inedible corn oil which comprise nearly 40 percent of the market, according to the U.S. Census Bureau. It would appear that the ARB did not take this fact into account when determining the volume of soy biodiesel that should be modeled. (NBB3)

Response: In terms of the relationship between biodiesel production volumes and land use change, the GTAP results indicate that the size of the shock is relatively unimportant. The results obtained (greenhouse gas emissions per unit of fuel energy produced) were relatively insensitive to the size of the shock. It is only when the results are highly sensitive to the size of the shock that it becomes important to scale that shock to expected production volumes at a specific point in time. In the case of the current analysis, attempting to model actual expected production volumes would have little discernable impact on emission estimates.

See also response to comment VI-22.

VI-27. Comment: Because we are exceedingly confident in the objectivity and credibility of the reports drafted by Dr. Babcock and Mr. O'Connor, we would fully support enlisting their papers in an independent peer review process if the ARB views this as beneficial. (NBB3)

Response: ARB is fortunate to have the opportunity to benefit from the extensive and technical evaluations prepared by Dr. Babcock and Mr. O'Connor. We wish to thank the National Biodiesel Board for providing us with those comments. Although submitting those papers to an independent peer review process could, by generating additional perspectives and insights, increase the value of the original papers, it is not ARB's practice to submit third-party papers to a peer-review process. If the National Biodiesel Board submits the two papers to peer review, ARB would appreciate receiving copies of the results.

Growth Energy

VI-28. Comment: ARB cannot adopt a severability clause during the 15-day notice and comment period because there is no evidence that this was the Board's intent from the beginning. There is no statement by Board members as to intent to include a severability clause; no discussion of severability at the April hearing; and no explanation of circumstances for inadvertent omission.

The severability clause is a defensive measure. ARB cannot use the rulemaking procedure under APA to buttress arguments about the intent of Board. The Executive Officer cannot lawfully add a severability clause because there is no basis for doing so.

The Board has not delegated to the Executive Officer to make such change in the regulatory text on pg. 15-16 of Resolution 9-31. The change is not within the scope of section 11346.8 of the Government Code. It is not a routine practice by ARB to add severability clauses last minute.

A judicial order preventing implementation of some parts of the LCFS could affect the environmental impacts of the regulation. The inclusion of the severability term therefore is inconsistent with CEQA. (GE7)

Response: ARB intends that every rulemaking be severable to the extent permitted by law, and severability clauses are adopted as part of the regulatory text whenever appropriate. In this case, the regulation has been bifurcated, and changes made during the third 15-day notice, including the severability clause provision, will be adopted as part two of the bifurcated LCFS. The first part of the bifurcated regulation inadvertently omitted inclusion of a severability clause. The ARB referred to the severability clause as being inadvertently omitted in the FSOR (at page 8), in the Third 15-Day Change Notice (at page 2), and in adopting Executive Order R-09-007 (at page 3).

To correct that omission, ARB is including the severability clause as part of its secondary LCFS adoption. In Schenley Affiliated Brands Corp. v. Kirby, 21 Cal.App.3d 177, 199 (1971), the court points out that "a declaration of severability, although not conclusive, is persuasive evidence of the enacting body's intent." The Executive Officer will consider and adopt the amendments by a separate resolution document, which will reiterate ARB's intent that the LCFS be severable.

Further, the Executive Officer's modification to include a severability clause is entirely consistent with the Board's intent as expressed in Resolution 09-31. In Resolution 09-31, the Board found that the LCFS regulation "will achieve the maximum technologically feasible and cost-effective GHG emission reductions" and "meets the criteria set forth in section 38562 of the Health and Safety Code." Health and Safety Code section 38562(a) requires the Board, among other things, to:

> *"adopt greenhouse gas emission limits and emission reduction measures by regulation to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions in furtherance of achieving the statewide greenhouse gas emissions limit…"* (emphasis added).

As noted in its findings, the Board intended for the LCFS regulation to achieve the maximum feasible reductions in GHG emissions in compliance with Health and Safety Code 38562(a). It follows, therefore, that the Board must have intended for the LCFS regulation to be severable. Otherwise, if the regulation were not severable, the regulation could be struck down entirely if any one of its primary provisions were invalidated by a court of competent jurisdiction. Such a result would eliminate all the substantial benefits of the LCFS regulation. Clearly, this could not have been the Board's intent. Because of the Board's express intent to achieve the "maximum feasible" reductions, it defies logic to infer that the Board in Resolution 09-31 intended for the LCFS to be an "all-or-nothing" regulation.

Delegations of power to the Executive Officer by the Board to adopt this and other amendments are explicitly authorized by Health and Safety Code section 39516, which provides:

> *"Any power, duty, purpose, function, or jurisdiction which the state board may lawfully delegate shall be conclusively presumed to have been delegated to the Executive Officer unless it is shown that the state board, by affirmative vote recorded in the minutes of the state board, specifically has reserved the same for the state board's own action."*

Resolution 9-31 on page 15 in fact directs the Executive Officer to make changes as appropriate during supplemental comment periods:

> *"BE IT FURTHER RESOLVED that the Board directs the Executive Officer: (1) to incorporate into the approved regulations and incorporated document the modifications described in Attachment B hereto and such other conforming modifications as may be appropriate; (2) to make the modified regulations (with the modifications clearly identified) and any additional documents or information available for public comment for a period of at least 30 days; (3) to consider any comments on the modifications received during the supplemental comment period; and then (4) either to adopt the regulations as made available with any appropriate additional nonsubstantial modifications, to make additional modifications available for public comment for an additional period of at least 15 days, or to present the regulations to the Board for further consideration if he determines that this is warranted*" (emphasis added).

The amendment is also adopted in compliance with section 11346.8 of the Government Code which requires a 15-day comment period for substantially related changes, and requires that public comments be addressed in the final statement of reasons

document. This public notice and comment process, to which the commenter has availed itself, serves the purpose of providing the public an opportunity to comment on "nonsubstantial" regulatory modifications. The severability clause at issue is considered to be a "nonsubstantial" modification as it does not relate to the substance of the LCFS regulations themselves but rather is a condition that ARB expressly includes in regulations where it deems appropriate.[7] The process compelled by Government Code section 11346.8 has been satisfied.

The CEQA issues raised by the commenter regarding the severability clause are speculative, because they are dependent on the commenter's speculative hypothetical that some future unknown judicial determination will invalidate parts of the LCFS. ARB believes that the LCFS has been lawfully adopted, and thus the question of severability will not arise. Further, the commenter cites no legal authority for the proposition that ARB must provide additional analyses and make additional determinations regarding a potentially severed portion of a regulation before a severability clause can be given effect.

Private Citizens

VI-29. Comment: I have great concern about any regulation CARB comes up with will likely wreck what we in the bio-diesel production have done for the environment. Case in point we now have to have pay $400.00 per year for a license to pick up waste vegetable oil was done to make money and there is no need. All regulations end in for fees and forms and a huge regulatory agency to manage it. Instead of encouraging business why is the State and Governor continuing to discourage business? (MUELLER)

Response: Contrary to the commenter's suggestion, the LCFS actually incentivizes the use of waste or used cooking oil as a feedstock for the production of transportation fuels (or blends) in California. The ARB prioritized the development of such pathways to send a clear message to enhance early investments in either novel conversion technologies or scale-up processes. The LCFS will therefore incentivize the conversion of waste or used cooking oil to fuel blend components in California. And with regard to fees, the LCFS regulation in its current form has no fee provisions.

[7] See for example 13 CCR sections: 1962, 1962 (c)(4)(B)(7), 1962(k), 1962.1(c)(4), 1962.1(B)(9), 1969(c), 2025(aa), 2027(k), 2042, 2189. 2299.1(k), 2299.2(k), 2345, 2359, 2449(m), 2477(b)(4), 2479(m), 2773, 2775.1(h), 2775.2(g); and 17 CCR sections: 90804, 93101.5, 93109(c), 93115.15, 93118(k), 93118.2(k), 93118.3(i), 93118.5(l), 93119(f), 93120.11, 94516, 94527, 94810, 95108, 95311, 95326, 95346, and 95370.

VII. SUMMARY OF COMMENTS MADE DURING THE FOURTH 15-DAY COMMENT PERIOD AND AGENCY RESPONSES

This Section VII contains a summary of each comment that (1) was submitted during the fourth supplemental comment period and (2) was specifically directed at the proposed regulation or to the procedures followed by ARB in proposing or adopting regulation, together with ARB's responses. Comments not involving objections or recommendations specifically directed towards the regulation or procedures followed are generally not summarized. These included several comments by concerned citizens that involved completely unrelated rulemakings or topics.

As shown below, the comments are grouped by commenter, with agency responses following the summary of the comments.

List of Commenters

Comment Abbreviation	Commenter
NBB4	Shelby Neal, National Biodiesel Board Written testimony: February 15, 2010
WASON	Bill Wason, Private Citizen Written testimony: February 3, 2010

National Biodiesel Board

VII-1. Comment: It should be noted that these two modeling exercises [ARB posted two sets of soy biodiesel modeling results—one was released on December 15, 2009 and the other on February 1, 2010] predicted very different amounts of land use change, and they predicted very different carbon intensities for the land being converted. The fact that both models arrived at an identical overall value should be viewed as coincidental and not a validation of either modeling attempt. It should also be noted that both contractors used the same model (albeit slightly different versions) and were given the same set of rather severe restrictions from ARB staff. Most importantly, on the latter point, neither contractor was allowed to address so-called "structural issues" with the GTAP model which, among other things, include the fact that the model does not allow idle lands to be considered. These acres account for 30 percent of the land included in the model. So when new lands are needed as a result of renewable fuels policy, those acres derive from forest or pasture rather than lands that are readily available for agricultural use. This is one reason the ARB's final emissions figure for soy-based biodiesel is approximately four times higher than the RFS-2 analysis recently performed by the U.S. Environmental Protection Agency. (NBB4)

Response: ARB agrees that the similar results obtained from the two soy biodiesel runs may be coincidental. ARB also acknowledges that the GTAP model does not

currently account for all categories of potentially arable land. However, it is not obvious exactly how and to what extent that condition affects the results obtained.

If the inclusion of idle cropland in the model is going to make a difference in terms of the land use change carbon intensity, the amount of carbon sequestered by the reservoir of unused crop land must be significantly different from the amount sequestered by either grasslands or forests. For example, unused cropland that has fully reverted to grassland status, would, upon conversion, release the same amount of carbon as any other converted grassland. No net change in emissions would therefore occur if idle cropland rather than grassland were converted. On the other hand, if the inclusion of idle cropland replaced significant forest land conversion in the model, a significant decrease in carbon intensity could result.

Upcoming versions of the GTAP model may provide an opportunity to understand the effects of including additional categories arable land in the database: both idle cropland and retired Conservation Reserve Program land are to be added. In recognition of this and other issues relevant to land use change calculations, the Board directed staff in Resolution 09-31 to convene an expert workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels. This and other land-use related issues falls within the scope of the expert workgroup's activities.

VII-2. Comment: In our view, the two GTAP model runs for soy-based biodiesel should be described as "interim results" given the ARB's stated interest in addressing the extensive problems that exist with the model through the upcoming Expert Review process. (NBB4)

Response: As noted in response to comment VII-1, the ARB has stated its interest in refining and improving its land-use change analysis, including the analysis conducted for the soy biodiesel pathway, as part of an ongoing effort to use the best available information. The Board has also stated that, at this time, it considers the analyses conducted to date to be sufficiently robust to be included in the final LCFS regulation—subject to potential future revision based on ongoing developments in the field, including the recommendations of the expert workgroup convened pursuant to Resolution 09-31.

VII-3. Comment: The National Biodiesel Board is not alone in commenting to the ARB that the most robust lifecycle analyses are those with clear, consistent boundary conditions. This traditionally limits analysis to direct, measurable consequences. As long as the ARB maintains its position that an expansive approach to include indirect consequences must be part of the low carbon fuel standard, the agency has a responsibility to ensure that the predicted results are accurate. (NBB4)

Response: As discussed in response to comment VI-1, the Board found that the inclusion of indirect effects on a fuel's lifecycle carbon intensity is appropriate, scientifically defensible and reflects the best available scientific data at this time vis-à-vis the use of the GTAP model. Although the GTAP is the best available model, given

these criteria, ARB acknowledges that land-use change analysis is continuing to evolve and undergo a great deal of further development. In order to continue to benefit from the ongoing work in this area, the Board directed staff in Resolution 09-31 to convene an expert workgroup to provide guidance in refining and improving the land use and indirect effect analysis of transportation fuels.

VII-4. Comment: In his latest analysis, Donald O'Connor quantifies that indirect land use change emissions from expanded soy-based biodiesel actually create a net greenhouse gas benefit. This is a dramatic departure from the assumptions that have influenced ARB's thinking to-date. In our view, it would be prudent to use the Expert Review process to identify inconsistencies between analysis reported by the ARB, the U.S. EPA, and Donald O'Connor, who manages Canada's lifecycle modeling.

Until these inconsistencies are thoughtfully explored and documented, the analysis is neither sufficient nor robust. One such inconsistency between the ARB process and the U.S. EPA analysis is that the ARB is utilizing a much simpler approach by employing a single model that was created to predict global trade and simply repurposing it in an attempt to predict global land use changes. On this point, it should be noted that the individual who manages the unit at Purdue University responsible for maintaining the model has himself stated publicly that GTAP is not appropriate for the purpose for which it is being used by the ARB. Further, as a bottom line indication of the truth inherent in his statement, the ARB's "final" results were more than 40 percentage points lower than the analysis conducted by U.S. EPA, which recently concluded that soy-based biodiesel is 57 percent better than petroleum-based diesel in terms of net greenhouse gas emissions. (NBB4)

Response: Although we find that some of Mr. O'Connor's points merit additional investigation, we take issue with others, as discussed below.

We agree that a comparison of the ARB's results with those obtained by U.S. EPA would be helpful. However, any such comparison must consider the very different time frames and study designs used by the two modeling efforts. One of the most significant of these differences is that the ARB is modeling emissions from ***current*** production processes, while the U.S. EPA is modeling production processes expected to be in place in the year 2022.

The EPA's analysis did, however, consider the effects of two factors that the ARB's analysis did not: changes in the size of the livestock industry, and changed cropping patterns. We do not believe this difference merits adoption of the U.S. EPA's methodology at this time. But this difference merits additional consideration, and ARB staff will evaluate these factors as part of the refinements and consideration of ongoing developments in this field which the Board directed the Executive Officer to monitor through the expert workgroup and periodic formal program reviews built into section 95489 of the regulation.

Contrary to the commenter's statement, Dr. Tom Hertel (who built and maintains the GTAP model) stated that those who use the GTAP for regulatory purposes should make substantial investments in the long-term development of the model.[8] Not only does Dr. Hertel support the use of the model for the purpose of estimating land use change emissions, he was instrumental in the effort to develop of the model's land use change estimation capabilities. Dr. Hertel argued that outputs from the GTAP are best presented in the context of confidence intervals, or other measures of uncertainty. We have no record of Dr. Hertel stating that attempts to use the GTAP to establish regulatory greenhouse gas emissions levels should be abandoned.

The GTAP has consistently confirmed that certain categories of fuels do produce significant land use change impacts. Any regulation that seeks to reduce the greenhouse gas emissions from transportation fuels must, if it is to succeed, account for such impacts. Therefore, as noted in Resolution 09-31, the Board found that it is appropriate and scientifically defensible to include land-use change analysis and the associated GHG emissions in the LCFS regulation and commit to an ongoing effort to refine and improve our ability to estimate such emissions. A primary component of this effort is the formation of the expert workgroup, which is being convened to assist the Board in refining and improving its land use and indirect effect analysis.

VII-5. Comment: I would like to state for the record the NBB's interest in completion of pathways for all virgin vegetable oils. It is unclear, for example, how regionally grown, sustainable crops such as camelina and canola would be treated under the regulation. (NBB4)

Response: It has always been ARB's intention to include pathways for significant oilseed-based fuels in the LCFS pathway lookup table. The ARB staff may undertake to develop some of these pathways internally pursuant to the Board's directive for the staff to develop a list of prioritized pathways (Reso. 09-31 at 15). But we also welcome and encourage fuel producers who wish to develop such pathways through the Method 2A/2B process.

VII-6. Comment: The CARB approach to estimating land use change is not consistent with actual agricultural land use changes in the United States since 1996. Since that time, enough idle crop land has become available to accommodate significant agricultural expansion without the need to convert non-agricultural grasslands and forests to cropland. (NBB4)

Response: ARB acknowledges that the GTAP does not currently account for all categories of potentially arable land. The extent to which that condition affects the model outputs (greenhouse gas emissions), however, is not obvious. The reason for this is that the carbon intensity (CI) of idle croplands has not been established. If that carbon intensity turns out to be essentially the same as the existing grassland CI, and if converted grassland acres are replaced with idle cropland acres, there will be no net

[8] Board Hearing Transcript, April 23, 2009, at 64.

change in emissions. The addition of idle cropland areas to the model could, however, reduce the amount of forest land that would need to be converted, thereby reducing net emissions. Upcoming versions of the GTAP may provide an opportunity to understand the effects of including additional categories arable land in the database: both idle cropland and retired Conservation Reserve Program land are to be added. This and other issues relevant to land use change estimation are within the scope of the Expert Workgroup formed to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels. The Board directed staff in Resolution 09-31 to convene an Expert Workgroup to consider issues such as those raised in this comment.

VII-7. Comment: The restrictions imposed by use of the Constant Elasticity of Transformation supply function are not consistent with the data used to estimate the land transformation elasticity. (NBB4)

Comment: The commodity price changes predicted for the U.S. by GTAP Scenario A do not produce corresponding adjustments in international markets. This result is at odds with the historical behavior of international soybean, soy meal, and soy oil markets. Because these markets are well-integrated and not impeded by significant trade barriers, market changes occurring in any one national economy have historically rippled through other soybean producing and consuming countries. Market movements within the major soybean-producing countries have historically been highly correlated. (NBB4)

Response: The constant elasticity of transformation function (CET) is common to all computable general equilibrium models. Its wide use is due both to its computational efficiency, and it its ability to produce results that are generally consistent with economic theory and empirical observation. In ARB's GTAP biodiesel runs shown in Attachment 2 to the Fourth 15-Day Change Notice, the global land area converted contains between 24 and 42 percent forest. Regional variation is high, with some regions well below 24 percent.

These results are not inconsistent with expectation. The proportion in the U.S. is generally higher than in the rest of the world, but this is due to economic imperatives rather than to the behavior of the CET function. Increased production of biodiesel in the U.S. creates an advantage for the domestic livestock industry – the availability of less expensive soy meal relative to other countries stimulates expanded production. Access to this lower-priced feed is limited outside the U.S.

Because soybean meal provides protein but little energy, livestock feed rations containing soy meal must be supplemented with other food sources. Pasture is often used in conjunction with soy meal to provide the necessary food energy. Soy meal, therefore, is not a significant substitute for pasture. This condition effectively removes significant amounts of pasture from the land use types available to support the cropland expansion driven by biodiesel demand. This shortage of available pasture drives a higher proportion of this expansion into forested land.

VII-8. Comment: Although GTAP cannot explicitly account for double cropped acres, the yield elasticity with respect to price can be adjusted to account for the expansion of double cropping in response to increased crop demand. (NBB4)

Response: Double cropping is accounted for in the GTAP's agricultural production data. The issue of double cropping is discussed in response to comments VI-20 and VI-22.

VII-9. Comment: There is no empirical support in Brazil for the assumption that yields in Brazil on new land are lower than yields on old land. For the United States, large overall acreage declines and significant shifts between crops since 1996 suggest that one parameter cannot capture important differences between crop yields on new land. (NBB4)

Response: The commenters have submitted data indicating that yields on newly converted farmland is at least as high as are yields on established agricultural land in some areas. ARB does not currently possess authoritative yield data for enough specific regions to customize this elasticity by region. In response to the data that has been submitted, however, ARB increased the general elasticity value it uses for all regions. This was reflected in the modeling results made available with the Fourth 15-Day Change Notice. Future versions of GTAP may include region-specific values for the elasticity of yields on newly converted lands.

VII-10. Comment: The commodity price changes predicted by GTAP Scenario A do not constitute a sustainable equilibrium. The predicted price declines for soy meal more than offset the predicted increases for soy oil, leaving crushers operating at a loss during most periods. As crushers cease operating, the supply of soy oil will drop off, preventing biodiesel production from reaching the levels being modeled. (NBB4)

Response: We disagree with the commenter in that GTAP can only solve for an equilibrium solution. Like any computable general equilibrium (CGE) model, the GTAP model calculates equilibrium solutions. By definition, costs equal sales at equilibrium. Therefore, if GTAP predicts a price decline for soy meal, that decline would be perfectly offset by a price increase for soy oil. In other words, a predicted price decline for soy meal would not exceed the price increase for soy oil, contrary to the commenter's claim. This is explained in more technical detail below.

Consistent with other CGE models, the GTAP model defines equilibrium in terms of zero profit; i.e., all sectors must meet costs only. None of the sectors must experience either positive or negative profit margins. The condition described by the commenter—a loss of soybean crushing capacity that prevents the necessary volume of soy biodiesel from being produced—could never emerge as a solution under GTAP and other CGE models. In fact, an examination of ARB's soy biodiesel modeling results reveal that the sales experienced by the U.S. crude vegetable oil industry exactly

equaled its costs. If the model were unable to balance these accounts, the model would not yield an equilibrium solution.

This equilibrium condition extends to both soy oil and soy meal. As the commenter notes, the increased biodiesel production levels modeled produce a price increase for soy oil and a price decrease for soy meal. The commenter, however, incorrectly applies these price changes to *market prices* for these primary soybean products. Had the commenter correctly applied these price changes instead to the oil and meal *revenue shares* from the GTAP model results, the equilibrium conditions would have been achieved (i.e., the price increase for soy oil would have exactly offset the price decrease for soy meal).

VII-11. Comment: The use of exactly the same elasticity factors for soybeans as was used for corn is inappropriate as the different crops have different production characteristics. Soybeans can be double cropped, whereas corn cannot be. Soybean yield is less influenced by fertilizer requirements and thus expansion into new areas does not suffer a significant yield impact. (NBB4)

Response: All elasticities used in the GTAP model should be crop-specific. Unfortunately, the data from which elasticity values are derived are not readily available for most crops. However, relatively more data are available for corn than for most other crops, including soybeans. Therefore, rather than use speculative elasticities for soybeans, ARB decided to use corn elasticities as a baseline surrogate for soybeans. These will be changed to soybean-specific values as the data from which such values can be derived becomes available.

VII-12. Comment: The yield used for soybean is too low compared to the expected yield when the LCFS is expected to require the greatest amount of biodiesel. The soybean yield that CARB model has been assumed to be static over time. In the CARB modeling of corn ethanol an updated value for the corn yield was used, but the update was only for the current yield and did not consider the potential for future yields. Soybean yields have been increasing for more than 70 years and all forecasts have the yields continuing to increase. The issue should be therefore not if the yield will increase in the future but by how much, and what is the appropriate year to use. The NBB believes that since the LCFS will be fully implemented by 2020, that 2020 is the year for which the soybean yield should be modeled with.

Since the premise of indirect land use change is to forecast what might happen in the future with an increase in demand for soybean oil for the production of biodiesel, it is more important to consider the future yield of soybeans. Since the LCFS is being phased in between 2010 and 2020, it is more appropriate to use the projected yield in 2020 as the yield for GTAP modeling. This is a simple calculation that CARB can do outside of the model as it did when it adjusted corn yields for the ethanol case. (NBB4)

Response: As designed, the GTAP model has no time dimension. It does not model conditions at any specific point in time. The modeler introduces a disequilibrium (a "shock," such as increased biodiesel production), and the model calculates what the economy described by the underlying dataset would look like when it reaches a new equilibrium ("equilibrium" being defined as the point at which supply and demand are balanced in all affected markets). The model does not specify how much time it would take to reach a new equilibrium. As such, the modeling done to determine the carbon intensity of the land use change induced by soy biodiesel production does not simulate conditions in any specific year. The shock introduced into the soy biodiesel model happened to be projected 2020 production volumes, but it could have been a lower production volume: outputs were not sensitive to the size of the initial shock. In fact, the resulting equilibrium is most accurately described as an altered 2001 economy at equilibrium, rather than some future economic state.

The lack of an explicit time dimension associated with the analysis, along with the insensitivity of the results obtained to the size of the shock applied, do away with any need to attempt to account for projected future yields in the current model. Moreover, ARB's lifecycle assessments are designed to reflect current technology and agricultural practices and are not meant to predict future technologies or practices. Just as the current model was updated to reflect known current crop yields, LCFS fuel lifecycle assessments will be periodically updated to reflect production technologies and agricultural practices that are current at the time of the update.

VII-13. Comment: From GTAP it is not possible to extract the soybean yield in other countries for the base case. The yield that can be extracted appears to be the incremental soybean yields so it has been multiplied by the elasticity with respect to area expansion. However, there are some discrepancies in this reported information with the FAO reported yield data. . . . If the GTAP data were up to date, one would have expected a constant percentage difference between the GTAP results and the FAO results. (NBB4)

Response: Soybean yields for the regions which are involved in trading within the current model run are easily retrieved from the GTAP. ARB staff have been and are available to provide guidance on the procedure for retrieving this information from GTAP.

The agricultural data found in GTAP comes originally from the Food and Agriculture Organization of the United Nations.[9] However, that base data is subject to updates and corrections from the international GTAP community. When appropriate, knowledgeable community members provide improved data for their regions of origin. All such data are extensively and formally reviewed before being added to the model.

VII-14. Comment: The CARB emission factors for forest land converted to crop land are far higher than they should be. There are several reasons for this:

[9] UN. (2009). "Food and Agriculture Organization of the United Nations." Retrieved, from http://www.fao.org/.

1. The biomass and soil carbon inventories are far higher than official national inventories for the US and Canada, and for other countries the high end of ranges provided by the IPCC appear to have been used.
2. It is possible that some of the overestimation results from the inclusion of deadwood and litter in the inventories and this material will be converted to CO2 (and perhaps some methane) whether there is a change in land use or not.
3. No allowance is made for harvested wood products in the inventory, even in developed countries where slash burning is illegal.
4. No consideration is given for natural losses of living trees due to mortality, diseases, pests, or natural forest fires. It has been assumed that trees live forever and, unfortunately, this is not the case. Some of the forest carbon would have been lost even if no land conversion had occurred. (NBB4)

Response: Our responses to the specific questions are as follows:

1. The land use change emission factors used in the GTAP model were compiled by the Woods Hole Research Institute. This greenhouse gas emission factor data set has the advantage of global coverage. The use of emission factors compiled by individual countries introduces the possibility of data incompatibility from dataset-to-dataset. With the Woods Hole data, we are assured that a unit of greenhouse gas emissions from a land use change in any one country will be fully comparable to a unit of emissions from any other country. The use of IPCC data may also afford this advantage. If so, and if the IPCC data is otherwise superior to the Woods Hole data, ARB may consider using the IPCC data in the future as appropriate. In recognition of this and other issues relevant to land use change calculations, the Board directed staff in Resolution 09-31 to convene an expert workgroup to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels.

2. The Woods Hole emission factors include all sources of greenhouse gas emissions in all cover types. Litter and deadwood are included in the above ground fraction. Although litter and deadwood do decompose naturally, some of the carbon they contain is taken up by soil microorganisms, some is taken up by plants, and some is released to the atmosphere. ARB's modeling assumes that this and all ongoing releases are in a state of equilibrium: releases to the atmosphere are balanced and offset by the atmospheric carbon fixed by the forest. Although no forest carbon is permanently fixed, the net fixed amount does not vary significantly over time. This assumption is discussed more fully in item 4, below.

3. ARB agrees that, for future refinements in the modeling, there may be merit in accounting for the harvest and use of forest biomass following the conversion of forested land to agriculture. This issue is a good candidate for study that falls within the scope of the expert workgroup noted previously.

4. We agree that some portion of above-ground forest biomass decomposes each year, releasing stored carbon to the atmosphere. In mature forests, however, these emissions are offset by the growth of new biomass. In forests that have not reached a mature ("climax") state, more atmospheric carbon is taken up by new growth than is released by decomposition. As a young forest matures, the net amount of carbon sequestered in forest biomass increases over time until a state of equilibrium is reached. It is this equilibrium state that defines a mature forest. In an unhealthy forest, or a forest undergoing encroachment by urban development, net carbon sequestration levels decline over time.

   The emission factors used in GTAP assume that the mean forest condition is equilibrium; that is, gains in forest biomass generally offset losses year over year. So long as this assumption is found to be valid, land use change emissions from forests do not need to be adjusted to account for emissions from decomposing biomass. ARB believes this assumption is valid at this time, but the expert workgroup noted above may consider examining the issue of net forest carbon sequestration levels to determining if the assumption remains valid or needs adjustment.

VII-15. Comment: The CARB emission factors for pasture land overestimate the GHG emissions. This is caused by at least three factors, including the loss of vegetative carbon, which is overestimated and is not permanent in any case, (as described in the following paragraph), overestimating the soil carbon contents of grassland soils, and not considering the different management practices that will employed for future land use compared to historical practices.

Regarding the vegetative carbon content, the commenter states that this biomass is not permanent because the majority of it tends to die off each year to be replaced by new growth the following year. The dead growth eventually decomposes to CO_2 and is recycled through the atmosphere. Thus, the conversion of grassland to cropland does not result in any significant change in vegetation carbon inventories and should not be included in the GTAP emission factors. (NBB4)

Response: See the response to comment VII-14. Item 1 of that response explains the advantage of using the same set of carbon emission factors for all vegetative cover types and all regions in the model: using different factors for different regions or cover types runs the risk of data incompatibility. Different jurisdictions are likely to use different data collection and compilation methods. ARB avoids this pitfall by employing data from the Woods Hole Research Center for its analysis. However, other datasets, such as that compiled by the Intergovernmental Panel on Climate Change (IPCC), are also global in scope. The use of alternative datasets can be considered by the expert workgroup convened under Resolution 09-31 to assist the Board in refining and improving the land use and indirect effects analysis.

Regarding the impermanence of grasslands, this was discussed in Item 4, response to comment VII-14. As with the forest sequestration mechanisms described in that response, carbon cycles into and out of grasses and grassland soils on an annual basis. Over the course of the year, however, the net effect is the beneficial sequestration of significant volumes of carbon. Individual carbon molecules do not have to be permanently fixed in order to be considered sequestered. Clearly, the long term carbon content of the atmosphere would increase if a grassland were destroyed. Destruction puts an end to the net sequestration that occurs in a healthy grassland.

Regarding the observation that our modeling does not consider future land management practices, It is important to reiterate that a primary design consideration in our land use change modeling is to base our projections on current conditions to the extent possible. We are avoiding speculative inputs, whether they pertain to future crop yields, future land use policies, or future land use practices. This is discussed further in response to comment VII-17.

VII-16. Comment: As the market responds to changes in demand there will be changes in GHG emissions associated not only with land use changes (e.g., pasture to cropland) but also with cropping patterns. The per-unit-area GHG emissions associated with different crops are quite variable. Soybeans have the lowest emissions of any traditional crop. CARB has not accounted for emissions changes due to crop shifting in its land use change modeling. Doing so would produce a substantial decrease in the land use change carbon intensity of soy biodiesel. In its final rulemaking, the EPA did go through a similar calculation for domestic agriculture production and did find that domestic agriculture emissions decreased when soybean biodiesel was expanded. (NBB4)

Response: In Resolution 09-31, the Board committed to ensuring that the LCFS reflects the most up-to-date scientific information available. As part of this effort, the Board directed the Executive Officer to convene an expert workgroup to look at issues such as those raised by the commenter. We can also consider the crop shifting effect described in this comment as the regulation's mandated program reviews are undertaken. We expect some factors to decrease carbon intensity and others to increase it. Consideration of these factors is within the scope of the expert workgroup formed to assist the Board in refining and improving the land use and indirect effect analysis of transportation fuels.

Private Citizens

VII-17. Comment: While there is some correlation in Indonesia and jungle destruction so that indirect land use change can be more clearly linked there, this is no reason not to be better in your scientific analysis of policy issues and in trying to make a universal global link between issues. Even in Indonesia there is a backlog of 7 million hectares of land not being used that was supposed to be cut to clear land for palm plantations. Forests are being cut to sell trees or charcoal! Brazil land can be bought dirt cheap in the Northeast ($100 or less per acre).

> The sale of land for sugar cane production in Sao Paulo and land for biofuel feedstocks is not what is driving forest destruction. It is logging, charcoal and ranching, and ranch expansion is occurring after logging and charcoal production have destroyed the forests and usually with lots of corruption and free land thrown in. In addition, this is no longer happening. You cannot get free land from INCRA anymore in the legal Amazon and there is now serious enforcement of laws in Brazil. You cannot grow either sugar cane or soybeans in the Amazon. The country has committed to 80% cut in deforestation. Brazil has made real commitments to climate change reductions. And this is how you treat them? [There is] clearly a disconnect. (WASON)

Response: ARB's soy biodiesel model is designed to locate projected, agricultural land-use conversion events in areas where conversion has historically occurred. Projected land use change is allocated to these areas in proportion to the amount of change that each has experienced in the recent past. This approach allows conversion projections to follow established historical patterns. To date, ARB has seen no compelling data indicating that future patterns are likely to depart significantly from observed historical trends. If land use change practices do begin to depart significantly from historical norms, and those departures are both widespread and lasting, ARB can consider revising its models accordingly. It would be inappropriate to make such changes, however, to reflect expressed intentions, verbal or written commitments, newly enacted policies, or forecasts. Our approach is to rely on known historical trends until such time as credible evidence of a significant and lasting change comes to light.

It is important to note that the mere existence of multiple threats to forests (charcoal production, logging, ranching, etc.) has no bearing whatsoever on agricultural conversion stimulated by increased production of crop-based biofuels. Regardless of the existence of those threats, crop-based biofuel production places additional pressure on forests. The mechanisms by which this occurs are well-known, and compelling evidence that it does occur exists. See responses to the comments in Section L of original FSOR and Chapter IV of the ISOR for more detailed discussions of the connections between crop-based biofuels and the conversion of forests to agriculture.