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18-3-3

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April 26, 2018

Via Hand Delivery

Clerk of the Board
CALIFORNIA AIR RESOURCES BOARD
1001 "I" Street, 23rd Floor
Sacramento, CA 95812

Re: California Air Resources Board
April 27, 2018, Public Meeting, Agenda Item No. 18-3-5: Public Meeting to Consider Proposed Voluntary NOx Remediation Measure Funding

Dear Madam Clerk:

I am submitting the following comments on behalf of Growth Energy, related to the California Air Resources Board's ("ARB") April 27, 2018, public meeting to Consider Proposed Voluntary NOx Remediation Measure Funding, Agenda Item No. 18-3-5.

The agenda for the April 27, 2018, meeting describes Agenda Item No. 18-3-5 as follows:

> The Board will consider approving a voluntary measure to provide immediate funding to air districts to achieve further reductions in emissions of oxides of nitrogen (NOx). This initiative arises from CARB's response to a 2017 court order in the ongoing POET litigation challenge to the 2009 adoption of the Low Carbon Fuel Standard (LCFS). This measure aims to remediate conservatively estimated historical emissions potentially related to increased use of biodiesel in California

> that may be attributable to incentivization of biodiesel use by the LCFS regulation. The voluntary measure is consistent with CARB's mission to promote and protect public health and welfare through the effective and efficient reduction of air pollutants.

(April 27, 2018, Agenda, California Air Resources Board.)[1]

Growth Energy supports the notion that CARB should mitigate estimated historical NOx emissions that were incentivized by the LCFS regulation. Growth Energy likewise supports the funding of local projects in the geographic areas most directly affected by such increased NOx emissions.

However, because this measure appears to be related to mitigation identified in the Initial Statement of Reasons, Appendix G, for the proposed amendments to the low carbon fuel standard (the "LCFS"), it should be considered concurrently with the rulemaking process for the amendments. This is necessary to ensure the proposed mitigation will be efficacious, and consistent with the requirements of the California Environmental Quality Act, Pub. Resources Code, § 21000, *et seq.* ("CEQA"), and that segmentation of the environmental review process would not occur.

Moreover, because the agenda did not include a staff report, and Agenda Item No. 18-3-5 does not include a complete description of the proposed action, there are several questions regarding the proposed action that relate to its adequacy as a mitigation/remedial measure for historical NOx emissions that should be answered before CARB considers this item:

- What is the amount of NOx CARB intends to mitigate through the program?
- How will local projects be selected for receipt of funding?
- How will CARB confirm selected local projects will reduce NOx emissions in a way that would offset the impacts associated with historical NOx emissions from biodiesel use on a ton-for-ton basis?
- How will CARB allocate funding between the various local air districts that would receive funding from the program, and what is the nexus between any such allocation and the historical NOx emissions from biodiesel use?
- What is the source of funding for the program?

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[1] The agenda does not include a link to the Staff Presentation, which the website states will not be available under the time the item is heard. (Exhibit "A.")

- To the extent a funding source has been identified, (i) what efforts have CARB made to ensure the funding is adequate to reduce historical NOx emissions from biodiesel use, and (ii) what evidence supports any such conclusion?

- Does CARB contemplate separately reporting in a publicly available manner the expenditures it makes under the program to mitigate historical NOx emissions from biodiesel use? How will any such information be made available to the public?

I look forward to your response to each of the above questions. Thank you for your attention to this matter.

Respectfully submitted,

John P. Kinsey

Enclosures

EXHIBIT "A"

THE CARB SLIDE PRESENTATION WILL BE AVAILABLE THE DAY OF THE BOARD MEETING AT THE TIME THE ITEM IS HEARD.

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April 26, 2018

By Electronic Mail
Clerk of the Board
California Air Resources Board
1001 I Street, 23rd Floor
Sacramento, California 95812

Re: Proposed Amendments to the California Low-Carbon Fuel Standards Regulation and the Regulation on the Commercialization of Alternative Diesel Fuels

Dear Madam:

Growth Energy, an association of the nation's leading ethanol manufacturers and other companies who serve the nature's need for alternative fuels, is submitting to you the enclosed materials in response to the notice of proposed amendments to California Low-Carbon Fuel Standards Regulation and the Regulation on the Commercialization of Alternative Diesel Fuels. These materials also include environmental comments being submitted to the Air Resources Board and the Executive Officer pursuant to the California Environmental Quality Act and the Board's implementing regulations.

Growth Energy may file additional materials in one or both rulemaking files for consideration in connection with this agenda item at a later time, as permitted by the California Government Code and the Public Resources Code.

If there are logistical questions concerning these submittals, please contact Mr. John P. Kinsey of Wanger Jones Helsley PC at 559-233-4800.

Thank you for your consideration and assistance.

Sincerely,

Chris Bliley
Vice President of Regulatory Affairs
Growth Energy

STATE OF CALIFORNIA

AIR RESOURCES BOARD

PROPOSED AMENDMENTS TO THE LOW CARBON FUEL STANDARD REGULATION AND TO THE REGULATION ON COMMERCIALIZATION OF ALTERNATIVE DIESEL FUELS

GROWTH ENERGY'S RESPONSE
TO THE NOTICE OF PUBLIC HEARING DATED FEBRUARY 20, 2018
2018 CAL. REG. NOTICE REG.10Z, 392 (MARCH 9, 2018)

APRIL 27, 2018

For further information contact:
Mr. Chris Bliley
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Growth Energy
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Comments of Growth Energy on the Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels

Growth Energy respectfully submits these comments on the proposed amendments to the low carbon fuel standard ("LCFS") regulation and the regulation on commercialization of alternative diesel fuels ("ADF"). Growth Energy is an association of the leading ethanol producers in the United States and other companies that serve America's need for renewable fuels. Growth Energy promotes the use of alternative fuels to reduce transportation-sector greenhouse gas emissions and consumer costs, among other benefits.

Growth Energy's comments to the California Air Resources Board ("CARB" or, the "Board") on the proposed modifications to the LCFS and ADF regulations (collectively, the "Proposed Amendments") are contained in this summary document, which includes several appendices and exhibits that provide an extended analysis of certain issues.

As an initial matter, Growth Energy would like to thank CARB staff for recommending several amendments to the LCFS regulation that update the scientific basis of the program, particularly with respect to the calculation of the carbon intensity ("CI") for corn starch ethanol. Since CARB first considered the LCFS regulation for adoption, Growth Energy has expressed concern that the CI for corn ethanol is too high – particularly with the incorporation of land use change ("LUC") impacts – and that the CI for Brazilian sugarcane ethanol is too low. While more work is needed, Growth Energy recognizes the Proposed Amendments show progress on CARB's part in aligning the treatment of corn starch ethanol and sugarcane ethanol with "the best available economic and scientific information . . . ." (Health & Saf. Code, § 38562, subd. (e).)

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That said, Growth Energy remains concerned about several aspects of the LCFS regulation and the ADF regulation, which CARB should address in the instant rulemaking. To assist CARB with these efforts, Growth Energy offers the following comments, which are summarized as follows:

Part I of these comments summarizes the Statutory Framework applicable to CARB's consideration of the Proposed Amendments, and discusses the various procedural steps that must be taken prior to the Board's consideration of the Proposed Amendments for approval.

Parts II and III of Growth Energy's comments address the governing statute, the Global Warming Solutions Act ("AB 32") as it applies to this rulemaking; the California Administrative Procedure Act, Govt. Code, § 11350, *et seq.* (the "APA"); and other statutes. This portion of the comments addresses, *inter alia*, the duty to analyze regulatory alternatives under the APA; the Standardized Regulatory Impact Assessment (or "SRIA") prepared for the Proposed Amendments; the external peer review process required under Section 57004 of the Health & Safety Code; AB 32's requirement to ensure no increase in criteria pollutant emissions would occur as a result of the LCFS regulation and the Proposed Amendments; and the requirement to provide a complete rulemaking file available to the public.

Part IV addresses the California Environmental Quality Act, Pub. Resources Code, § 21000, *et seq.* ("CEQA"), including the duty to analyze and mitigate NOx emissions that must be attributed to the LCFS program; the analysis of new or modified facilities that would be constructed as a result of the LCFS regulation; the unintended but still adverse effects of "fuel shuffling"; the discussion of alternatives to the Proposed Amendments (and the LCFS

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regulation); the estimated CI for various alternative fuels; and the mitigation measures proposed in CARB's functional equivalent environmental document.[1]

I. STATUTORY FRAMEWORK AND BACKGROUND

As a rulemaking subject to the California Administrative Procedure Act, (Govt. Code, § 11340, *et seq.*), the Proposed Amendments must be demonstrated to be consistent with and reasonably necessary to accomplish the purposes of AB 32 and SB 32, which codifies a statewide greenhouse gas target of at least 40 percent below 1990 levels by 2030. (Govt. Code, § 11342.2; see also Health & Saf. Code, § 38500, *et seq.*)

Several provisions of AB 32 are important to determine whether the LCFS is consistent with and reasonably necessary to accomplish the purposes of SB 32 and AB 32. First, regulations to implement AB 32 must not "interfere with . . . efforts to achieve and maintain federal and state ambient air quality standards" to the extent feasible, in addition to being adopted in a manner that complies with CEQA. (Health & Saf. Code, § 38562, subd. (b)(4).) In addition, the emissions reductions that CARB attributes to a regulation promulgated under AB 32 must be "real, permanent, quantifiable, verifiable and enforceable." (*Id.*, § 38562, subd. (d)(1).)[2] Moreover, AB 32 directs that the Board "shall" rely upon "the best available economic and scientific information" when adopting regulations to implement AB 32. (See Health & Saf.

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1 Each Appendix enclosed herewith is a part of Growth Energy's comments. Consistency with the APA requires a full and complete response to each objection and recommendation in the appendices to the main text of these comments, regardless of whether those objections or recommendations are discussed in the main text of these comments, or explain why those objectives or recommendations are "irrelevant." (See Govt. Code, § 11346.9, subd. (a)(3).) To ensure compliance with that requirement of the Government Code, California courts will conduct de novo review using independent judgment. (Cf. *POET LLC v. California Air Resources Bd.* (2013) 218 Cal.App.4th 681, 747-48.) Particularly when the facts concerning CARB's actions in the regulatory process cannot be a subject of genuine dispute, "the independent standard of appellate review" applies. (*Id.* at 748.)

2 Notably, the requirements in subsection (d) of section 38562 are not qualified by the limitation in subsection (b), *i.e.*, "to the extent feasible."

Code, § 38562, subd. (e).) AB 32 also mandates that any "market-based compliance mechanism" – such as the LCFS regulation – must be designed "to prevent any increase in the emissions of . . . criteria air pollutants." (Health & Saf., § 38570(b)(2).) For the reasons explained in these comments and the appendices, the proposed amendments to the LCFS regulation are not currently consistent with these provisions of AB 32.

The APA also contains several other requirements to (i) help avoid potential unintended consequences of a regulation, (ii) promote informed decision-making, and (iii) ensure public participation in the rulemaking. For example, the APA prohibits state agencies from proposing regulations unless they have determined no alternative to their own proposal would be "as effective and less burdensome to affected private persons and equally effective in implementing the statutory purpose or other provision of law." (Govt. Code, § 11346.5, subd. (a)(13).) Thus, a state agency may not adopt a proposal unless it can properly affirm and explain, with "supporting information," that "no alternative" it has considered "would be more effective and less burdensome to affected private persons than the adopted regulation, or would be more cost effective to affected private persons and equally effective" in meeting the proposal's legislative objective. (*Id.*, § 11346.9, subd. (a)(4).)

As explained below, in response to a public solicitation for alternatives by CARB, the Western States Petroleum Association ("WSPA") submitted a proposed alternative to the LCFS regulation under which GHG emissions currently attributable to the LCFS program would "instead be achieved by the Assembly Bill (AB) 32 Cap and Trade program in the most cost-effective manner to address GHG emissions." (EA at 207; see also ISOR at IX-1.) Although WSPA states this alternative would avoid many of the potential adverse consequences of the LCFS regulation – including significant and unavoidable environmental effects; an increase in

gasoline prices by $0.36/gallon; over 25,000 lost jobs by 2030; and a 0.1% decline in California's Gross Domestic Product (GDP) – the ISOR does not consider any alternative other than variations of the LCFS. Growth Energy asks that, consistent with the APA, CARB fully consider the WSPA Alternative, or explain why it is choosing not to and provide the public with requisite opportunity for notice and comment with respect to that reasoning.[3]

The APA likewise directs state agencies to perform an assessment of "the potential for adverse economic impact on California business enterprises and individuals," (Govt. Code, § 11346.3, subd. (a)), and declare in the notice of proposed action any initial determination that the action will not have a significant statewide adverse economic impact directly affecting business. (Govt. Code, § 11346.5, subd. (a)(8); *Western States Petroleum Assn. v. Bd. of Equalization* (2013) 57 Cal.4th 401, 428 ["*WSPA*"].) The APA requires that the SRIA evaluate several issues, including "elimination of jobs within the state," "the elimination of existing businesses within the state," and "[t]he competitive . . . disadvantages for businesses currently doing business within the state." (Govt. Code, § 11346.3, subds. (c)(1)(A)-(C).) Here, while the SRIA includes several figures regarding the adverse economic impacts of the LCFS, the SRIA does not explain how these negative impacts will affect existing businesses; rather, the SRIA merely states there will be no change in competitive advantage or disadvantage based on the assumption that other states could adopt versions of the LCFS. If the Executive Officer adds such an explanation now, including by way of testimony or presentations to the Board, or other communications, the requirements of Section 11347.1 (a) would apply.

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3 See Govt. Code, § 11347.1 subds. (a), (b). This would apply, for example, to an explanation included in testimony or presentations to the Board by the Executive Officer or staff (hereinafter, "the Executive Officer"), or to an ex parte communication by the Executive Officer to the Board.

The APA also requires transparency so that the public can participate effectively in the rulemaking process. (See, e.g., Govt. Code, § 11347.3; Health & Saf. Code, § 39601.5.) The APA thus obligates the agency to prepare and maintain a rulemaking file. (Govt. Code, § 11347.3.) These provisions require that the public have the same access to all the data and analysis used by an agency in developing regulations, as well as all external input provided to an agency in connection with the adoption or amendment of a regulation. In this case, the rulemaking file does not appear to have been made "available to the public for inspection" at the time when the first notice of the proposed rulemaking was published in the California Regulatory Notice Register, (*id.*, subd. (a)), which occurred in this proceeding on March 9, 2018. Growth Energy is also concerned the rulemaking file does not contain the documents required under Section 11347.3 of the Government Code.

In addition to complying with the APA, CARB must also commission peer reviewers to evaluate the "scientific portions" of the rule. (Health & Saf. Code, § 57004(d).) Specifically, Section 57004 of the Health & Safety Code requires that: (1) CARB "submit[] the scientific portions of the proposed rule, along with a statement of the scientific findings, conclusions, and assumptions on which the scientific portions of the proposed rule are based and the supporting scientific data, studies, and other appropriate materials, to the external scientific peer review entity for its evaluation," and (2) the peer reviewer "prepare[] a written report that contains an evaluation of the scientific basis of the proposed rule." (*Id.*, subd. (d).) Section 57004 of the Health and Safety Code defines the "scientific portions" of a proposed rule to include "those foundations of a rule that are premised upon, or derived from, empirical data or other scientific findings, conclusions, or assumptions establishing a regulatory level, standard, or other requirement for the protection of public health or the environment." (*Id.*, subd. (a)(2).) It is not

clear whether CARB has sought external peer review to evaluate the scientific portions of the rule, consistent with Section 57004, and if so, what steps CARB will take to permit adequate public review and comment. Parties attempting to comply with the Executive Officer's request in the Notice of Public Hearing that comments be sent to him several days before the scheduled hearing have no means to review and comment on peer review materials not yet published.

Moreover, the California Environmental Quality Act, Pub. Resources Code, § 21000, *et seq.* ("CEQA"), and its regulations governing the environmental review process require compliance. (See 17 Cal. Code Regs., § 60005–60007.) Generally speaking, CEQA directs that, prior to approving the Proposed Amendments, CARB must first "identify the environmental effects of projects, and then to mitigate [any] adverse effects through the imposition of feasible mitigation measures or through the selection of feasible alternatives." (*Sierra Club v. State Bd. of Forestry* (1994) 7 Cal.4th 1215, 1233.)

As a state agency, CARB has adopted a certified regulatory program under which it is exempt from some provisions of CEQA. Nevertheless, agencies with certified programs like CARB's must prepare a functional[ly] equivalent environmental document that "include[s] '[a]lternatives to the activity and mitigation measures to avoid or reduce any significant or potentially significant effects that the project might have on the environment.'" (*City of Arcadia v. State Water Resources Control Board* (2006) 135 Cal.App.4th 1392, 1422 [quoting CEQA Guidelines, § 15252(a)(2)(A)].) CARB's functional equivalent document is the "staff report," which "shall be prepared and published by the staff of the state board." (17 Cal. Code Regs., § 60005(a).) Any action "for which significant adverse environmental impacts have been identified during the review process shall ***not*** be approved or adopted as proposed if there are feasible mitigation measures or feasible alternatives available which would substantially reduce

such adverse impact." (*Id.*, § 60006.) If CARB receives comments raising "significant environmental issues associated with the proposed action," staff must "summarize and respond to the comments either orally or in a supplemental written report. Before taking final action on any proposal for which significant environmental issues have been raised, the decision maker shall approve a written response to each such issue." (*Id.*, § 60007.) As explained below in Part IV, Growth Energy believes further work is needed before the Proposed Amendments can be considered for Board action.

II. REGULATORY ANALYSIS

The Legislature has directed that programs like the LCFS regulation rely on the "best available economic and scientific information." (See Health & Saf. Code, § 38562, subd. (e).) This mandate includes CARB's use of lifecycle analysis ("LCA") in assessing greenhouse gas emissions under the LCFS regulation, the creation of carbon intensity ("CI") values assigned to various renewable fuels in the LCFS regulation,[4] and all other parts of the rulemaking.

The use of the most scientifically defensible CI values is critical to the rulemaking effort. The CI values provide what the 2009 Initial Statement of Reasons ("2009 ISOR") for the LCFS regulation called "signals" to the downstream oil industry. Those "signals" direct regulated entities to achieve reductions in the CI of the fuels they sell in the most cost-effective manner. Insofar as the intent of the LCFS regulation is to reduce GHG emissions, the regulation must establish "the maximum technologically feasible and cost-effective" method of doing so. (Health & Saf. Code, § 38561, subd. (a).) If the CI values send the wrong "signal" to the downstream regulated parties, then the LCFS regulation will result in the use of pathways that

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[4] The Legislature has not directed CARB to use CI as a regulatory mechanism; that is a choice the Board made in the 2009 LCFS regulation and that the CARB staff proposes to continue.

may increase GHG emissions above the levels that would result if the best possible CI values had been assigned to various renewable-fuel pathways in the regulation. As one witness affiliated with the University of California stated at the April 2009 Board hearing on the LCFS regulation:

> [I]f we make a mistake in one direction in estimating these numbers, we'll use too much of a biofuel that's actually higher carbon [than] we thought and will therefore increase global warming. And if we use numbers that are too low, then we'll use too little of a biofuel that's lower carbon than we thought and will therefore increase global warming.

(Transcript of Public Meeting of the Air Resources Board, April 23, 2009, at 73-74.)

As explained below, the "signals" that CARB's new California GREET 3.0 and indirect land-use change models provide for corn-starch, corn-stover, sugarcane ethanol, and electricity do not reflect the best available scientific and economic information, and therefore do not provide the "signals" to the downstream industry needed to maximize reductions in greenhouse gas emissions while minimizing costs. Put in terms of the above quote: the "numbers" for sugarcane ethanol and electricity are "too low," and the "numbers" for corn starch ethanol are "too high." As a result, "too little" corn-starch and corn-stover ethanol would be used in California gasoline under the Proposed Amendments.

In addition, if the Proposed Amendments were to be adopted, fuel shuffling would continue to occur. The evidence, for example, shows the LCFS program is simply causing entities to reorganize their delivery patterns, with no reduction in output from its high-CI facilities (which are now simply delivering to states other than California), and no increase in production from low-CI facilities (which are delivering to California in higher volumes). (See Appendix "C.")

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A. Calculation of Direct Emissions from Corn Ethanol & Sugarcane Ethanol [CA-GREET 3.0]

To calculate the CI value assigned to a fuel's direct greenhouse emissions under the LCFS regulation, the Executive Officer uses the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation model, as staff has modified it for use in California (the "CA-GREET"). Recently, the developer of the GREET model, Argonne National Lab, published a new version of the GREET model: "GREET 2016." (ISOR at III-76.) CARB staff has developed a new version of the GREET model for the LCFS regulation (which the ISOR refers to as ("CA-GREET 3.0"), and through the Proposed Amendments seeks to incorporate CA-GREET 3.0 into the LCFS regulation. (*Id.*)

In Appendices D and F, Growth Energy comments on the portions of CA-GREET 3.0 used in CARB staff's new LCFS proposal to generate direct-CI values pertaining to corn and sugarcane ethanol. The following are among the issues that must be addressed adequately, with explanations to be included in the rulemaking file:

- GREET 2016 includes a distillers' grains methane credit, which is not included in CA-GREET 3.0. Growth Energy understands this credit was not included based on the belief that DGS (distillers grain with solubles) was included in livestock ratios in LCFS ethanol pathways, and that the animals consuming the DGS are not currently in the LCFS LCA ethanol system boundary. That position, however, is inconsistent with CARB's issuance of a pathway under the LCFS for methane produced from livestock manure where the pathway is allowed a substantial credit for methane avoidance similar to the methane avoidance credit for DGS. That position is also inconsistent with ISO LCA standard 14044, which

addresses environmental impacts throughout a product's life cycle (*i.e.*, cradle to grave). To ensure the methane credits are consistently applied throughout the LCFS regulation, and that CA-GREET 3.0 is consistent with ISO LCA standard 14044, the distillers' grains methane credit in GREET 2016 should be included in CA-GREET 3.0. (See Appendix D.)

- CA-GREET 3.0 includes values for energy use per ton-mile for medium-duty trucks that are lower than those for heavy-duty trucks. This is not logical, and it thus appears CA-GREET 3.0 (and GREET 2016) have overestimated the fuel use for medium duty trucks. (See Appendix D.)
- CA-GREET 3.0 overstates transportation emissions because it presumes the load size for heavy duty trucks in CA-GREET 3.0 is 15 tons. This value is too low; a typical value is 20 tons for a heavy duty truck. (See Appendix D.)
- CA-GREET 3.0 also overstates transportation emissions because it uses the same energy per ton-mile for delivery as the return trip (backhaul), even though the load on return trips is reduced (approximately 50%). (See Appendix D.)
- By the mid-2020s, the ISOR estimates that the CI for corn ethanol will drop from approximately 70 g/MJ to 45 g/MJ. While significant reductions in CI could be achievable through new innovative fuels such as fuels derived from corn fiber, CARB has not yet acted on any such proposals. As a result, Growth Energy urges CARB to swiftly consider the approval of the proposed pathways for such fuel to help provide

evidentiary support for CARB's 45 g/MJ estimate. In addition, Growth Energy understands the 45 g/MJ figure derives from an assumption that corn ethanol facilities would install carbon capture and sequestration ("CCS") at a rate of approximately 150 million gallons per year. It is unclear what evidence the Executive Officer relied upon to determine corn ethanol facilities would install CCS systems at the rate necessary to reduce their CI to 45 g/MJ.[5]

- CA-GREET 3.0 understates the CI for sugarcane ethanol because the quantity of nitrogen in sugarcane in aboveground residues has been set to the lowest value found in literature. This value, however, is based on a 2007 study, which has been superseded by more recent studies, including Leite (2016), which concluded the quantity of nitrogen is much higher. (See Appendix D.)
- CA-GREET 3.0 also does not include nitrogen in the roots of sugarcane, which likewise understates the CI for sugarcane ethanol. (See Appendix D.)
- The Virtual Sugarcane Biorefinery (VSB) modeling system (Bonomi et al, 2016) shows that the CI for sugarcane ethanol in CA-GREET 3.0 is also understated because it underestimates nitrogen levels in synthetic fertlizers. (See Appendix D.)

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[5] This apparent omission is one of the reasons why Growth Energy is concerned that the public rulemaking file is not complete.

- When each of the above issues is taken into consideration, the CI for the sugarcane ethanol pathway should be increased from 51.11 to 55.89. (See Appendix D.)
- There are several errors in the existing Tier 1 simplified calculators under the CA GREET 3.0 model for sugarcane and corn ethanol. (See Appendix F.)

In the past, the Executive Officer has sometimes indicated that important issues like those listed above with respect to CA-GREET can be deferred to a later proceeding. Growth Energy respectfully submits that deferral of the above issues and others explained in Appendix D would not comply with AB 32 or CEQA, as it would defer analysis and mitigation, and the consideration of feasible alternatives.

B. Calculation of Indirect Land Use Emissions

One of the most significant aspects of the LCFS program has been the regulation's incorporation of the specific theory of indirect land-use change ("ILUC").[6] By incorporating ILUC into the LCFS regulation, CARB remains bound by AB 32, as well as its obligation to use the "best available" scientific and economic information under the APA. In each iteration of the rulemaking, Growth Energy has commented that the ILUC factor for corn ethanol is too high. In each subsequent iteration of the of the LCFS regulation, Growth Energy's comments have proven accurate, and the ILUC has been lowered significantly. Despite this, CARB staff has continued to ignore efforts by stakeholders, such as Growth Energy, to improve the quality of CARB's ILUC and indirect-emissions models, as well as recommendations of the Expert

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[6] It remains Growth Energy's position that the ILUC theory and the methods used to quantify the impacts of biofuel usage on land change, as well as the emissions model used by CARB to estimate emissions from land change, are too unreliable for use in regulation.

Working Group ("EWG") that CARB established when it first adopted the LCFS regulation. The consensus among technical experts is that these ILUC values remain overstated, and should be further reduced. (Appendix E.)

The APA requires either the adoption of each of the recommendations presented in Appendix E, and in Growth Energy's other appendices to these comments, or an adequate explanation of the reasons for not doing so, which must be made available for public review and comment prior to Board consideration. (See Govt. Code, §§ 11346.9, subd. (a)(3), 11347.1, subds. (a), (b).) In the text below, Growth Energy summarizes some of the key issues in the Executive Officer's new ILUC analysis:

- The consensus among technical experts is that an ILUC for corn ethanol of 19.8 g/MJ is too high; rather, current estimates for the ILUC of corn ethanol in the U.S. range from 7.8-12 g/MJ. (Appendix E.)
- Although the ISOR at III-86 suggests that "[s]taff has not observed sufficient evidence in the literature to justify modifying the LUC CI values for the proposed regulation," significant work has been performed by Babcock and Iqbal at the University of Iowa, which shows significantly less global land conversions due to biofuel policies than previously thought and estimated by the CARB staff. Notably, this work has been reviewed extensively by Global Trade Analysis Project (GTAP) researchers at the University of Purdue, which was published in a peer-reviewed journal publication in July of 2017. (Appendix E.)

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- The current ILUC for corn ethanol does not accurately reflect the best available evidence, because it is based on year 2011 conditions, a drought year in the US, which negatively impacted crop yields.
- Because higher yields mean that less land use change is required to satisfy the new demand resulting in lower ILUC values, the use of 2011 conditions overstates ILUC significantly. (Appendix E.)

C. Treatment of Electricity under the LCFS Regulation

The LCFS uses an "Energy Economy Ratio" ("EER") to account for differences in energy efficiency among different types of fuels and vehicles. "The EER is defined as the ratio of the number of miles driven per unit energy consumed for a fuel of interest to the miles driven per unit energy for a reference fuel." (2009 ISOR at ES-18.) Growth Energy has evaluated the development of the EERs, and has determined that several corrections should be made:

- The Chassis dynamometer ("dyno") tests used to develop the EERs were "conducted with all accessories off and at an ambient temperature of 70 to 75 F, which are conditions where EER for electric vehicles may be the highest. Because these conditions may be experienced for only short periods of time in much of California, EER values developed from dyno test data do not reflect real world conditions for much of the time such vehicles will be operating." (Appendix B at 2-3.; see also *id.* 4-6, 7.) Instead, the EERs should be based on testing performed under real world conditions, including performance under a greater variety in temperatures.

- The efficiency of conventional gasoline and diesel engines that form the baseline for comparison for developing EERs are understated. (Appendix B at 3.)
- The EER for CNG and propane engines was assumed to be 1.0; however, "the tanks used for propane and CNG fuel are quite heavy and a CNG tank capable of providing over 200 miles range can weigh over 250 lbs. which is a significant weight increase." (Appendix B at 3; see also *id.* at 7.) This weight increase causes the net EER to decline to 0.9.
- The ISOR does not consider modifications to the EER required to accurately characterize electric drivetrain and battery losses. (Appendix B at 4.)
- Because "accessory loads are not switched on during dynamometer testing," and "increased loads on the battery make it less efficient," the EERs for electric vehicles are underestimated. (Appendix B at 4.)
- The EER for fuel cell vehicles is overestimated. (Appendix B at 6.)
- The test cycles used for the track tests of LPG buses and trucks "do not resemble normal driving in that the cycles consist of a simple pattern of steady accelerations cruise at constant speed, and steady deceleration to idle," which would decrease the EER. (Appendix

B at 7-8.) The same issue exists for electric trucks and buses. (Appendix B at 10-12.)

- The EER for transport refrigeration units is overestimated. (Appendix B at 9.)
- Because the method of testing electric motorcycles included a very slow speed test with gentle accelerations and stops, this is unlikely "to represent the driving cycle for most motorcycle owners," resulting in an overstatement of the EER for electric motorcycles. (Appendix B at 9-10.)
- As summarized on page 13 of Appendix B, numerous EERs used under the LCFS should be adjusted downward to more accurately reflect the evidence. (Appendix B at 13.)

In sum, the CI values assigned to corn ethanol, sugarcane ethanol, and electricity are not based on "best available economic and scientific information," reliable data and methodologies, and need to be corrected before CARB tries to move forward with the Proposed Amendments.

D. Treatment of Renewable Electricity for Fuel Pathways

We understand CARB staff has proposed amendments to "expand opportunities for accounting for renewable/low-CI electricity used in zero emission vehicle (ZEV) applications," as CARB states it has "seen very little interest in such pathways under the current rule." (ISOR at EX-4–EX-5.) As a result, the ISOR "proposes to allow renewable power generated in the same balancing authority as the ZEV load to be used in EV charging and H_2 production."[7] (*Id.* at EX-5.) In other words, to receive credit for renewable electricity associated with electricity

[7] A map of California Balancing Authorities is located on the California Department of Energy's website: http://www.energy.ca.gov/maps/serviceareas/balancing_authority_areas.pdf

usage, reporting entities need not demonstrate the source of the renewable electricity is co-located with the charging station. (See *id.*)

The text of the existing LCFS regulation appears to allow renewable fuels to receive credit for renewable electricity, regardless of whether the plant is co-located with the source of the renewable electricity:

> No indirect accounting mechanisms, such as the use of renewable energy certificates, can be used to reduce an energy source's CI. Innovative, low-CI energy sources include, but are not limited to renewable electricity ***from a dedicated (non-grid) form of generation***, such as wind turbines and photovoltaic arrays.

(See 17 Cal. Code Regs., § 95488(b)(2)(F)(1) [emphasis added].) In other words, so long as the "renewable electricity" is a "dedicated" form of generation, credits are available.

This is confirmed in CARB's regulatory guidance, which states:

> Electricity from a renewable energy source utilized in a fuel pathway may only be included in the CI determination if the energy from that source is directly consumed in the production process. No indirect accounting mechanisms, such as the use of Renewable Energy Certificates (RECs), can be used in determining the CI from electricity consumption. The applicant must provide evidence that the generation source is dedicated, generally by showing that the source is onsite/co-located, ***or was developed by the fuel producer with the sole intention of providing renewable power to the fuel pathway.***

(*Guidance Documents and FAQs* [emphasis added].)[8] In other words, under the existing regulation, the applicant need only "provide evidence that the generation source is dedicated." (*Id.*) And while that standard is generally satisfied through evidence of co-location, the guidance materials suggest credits may also be received if the renewable electricity source was "developed by the fuel producer with the sole intention of providing renewable power to the fuel pathway." (*Id.*)

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8 https://www.arb.ca.gov/fuels/lcfs/guidance/guidance.htm

This position makes sense, as it would be counter-productive to the goals of AB 32 and SB 32 if the LCFS program were to distinguish between co-located and other dedicated renewable energy production when both reduce carbon emissions and promote innovation at fuel production facilities (as long as concerns such as additionally and the like are adequately addressed).

Unfortunately, however, the Proposed Amendments seek to delete Section 95488(b)(2)(F)(1), and replace the provision with new requirements governing renewable or low-CI process energy. (See ISOR, Appendix A at 155, *et seq.*) Those provisions appear to restrict the reduction of CI to those facilities that are co-located with the production facility:

> The generation equipment [must be] directly connected through a dedicated line to a facility ***such that the generation and the load are both physically located on the customer side of the utility meter.*** The generation source may be grid-tied, but a dedicated connection must exist between the source and load.

(*Id.* at 156 [emphasis added].)

Growth Energy urges CARB to reconsider these amendments, and clarify that the CI of a pathway may be reduced if the fuel provider is able to demonstrate the dedicated use of renewable electricity as process energy, regardless of whether the generation equipment is specifically co-located with the facility. As an initial matter, this would align the treatment of electricity under the LCFS with the production of other renewable fuels. In addition, reconciling the treatment of electricity and other renewable fuels would help CARB meet the objectives of SB 32, which codifies a statewide greenhouse gas target of at least 40 percent below 1990 levels by 2030. (Govt. Code, § 11342.2; see also Health & Saf. Code, § 38500, *et seq.*; see also ISOR at EX-5 [stating the goal of "incent[ing] the installation of additional low carbon electricity supply" would result in greater greenhouse gas benefits].) It would also achieve CARB's goal of

being fuel-neutral, with greenhouse gas reductions driving the LCFS, rather than other preferences for one technology or another.

III. THE BOARD'S GOVERNMENT CODE AND RELATED OBLIGATIONS

A. Analysis of Alternatives under the Government Code

Although the Legislature provides California administrative agencies discretion in achieving the purposes of the statutes it enacts, it also requires that agencies avoid unnecessary or unduly burdensome regulation. Agencies therefore may not propose regulations unless they have determined that no alternative to their own proposal would be "as effective and less burdensome to affected private persons and equally effective in implementing the statutory purpose or other provision of law." (Govt. Code, § 11346.5, subd. (a)(13).) Nor can an agency finally adopt its own proposal unless it can properly affirm and explain, with "supporting information," that "no alternative" it has considered "would be more effective and less burdensome to affected private persons than the adopted regulation, or would be more cost effective to affected private persons and equally effective" in meeting the proposal's legislative objective. (*Id.*, § 11346.9, subd. (a)(4).)

There is no question that the Proposed Amendments will affect "private persons." CARB staff estimates the Proposed Amendments would cause consumer fuels prices to rise significantly (up to $0.36/gallon for gasoline and up to $0.44/gallon for diesel), (ISOR, Appx. E at 50); a loss of over 25,000 jobs, (*id* at 63); and a 0.1% decline in the GDP. (*Id.* at 68.) As such, there is a burden of demonstrating that no alternative to the Proposed Amendments would be "as effective and less burdensome to affected private persons and equally effective in implementing the statutory purpose or other provision of law." (Govt. Code, § 11346.5, subd. (a)(13).) And before CARB may consider whether to take action on the Proposed Amendments, it would be

necessary to demonstrate, with "supporting information," that "no alternative" that the Board has considered "would be more effective and less burdensome to affected private persons than the adopted regulation, or would be more cost effective to affected private persons and equally effective" in meeting the proposal's legislative objective. (*Id.*, § 11346.9, subd. (a)(4).)

CARB's Government Code alternatives analysis, located pages IX-1–IX-3 of the ISOR, does not substantially discharge CARB's duties under Sections 11346.5 and 11346.9. This section of the ISOR does not itself articulate the "statutory purpose" of the LCFS regulation, or evaluate each alternative against the statutory purpose. For this reason alone, the alternatives analysis is not adequate as an informational document, and does not include the analysis required under Sections 11346.5 and 11346.9. To find the "statutory purpose" of the LCFS, it is necessary to look outside the ISOR and to the text of SB 32. (See ISOR at EX-1, EX-2.) SB 32 states that:

> [i]n adopting rules and regulations to achieve the maximum technologically feasible and cost-effective greenhouse gas emissions reductions authorized by this division, the state board shall ensure that statewide greenhouse gas emissions are reduced to at least 40 percent below the statewide greenhouse gas emissions limit no later than December 31, 2030.

(Health & Saf. Code, § 38566.) Thus, the "statutory purpose" behind the LCFS regulation is to ensure GHG emissions will be "reduced to at least 40 percent below the statewide greenhouse gas emissions limit no later than December 31, 2030," in a manner that is technologically feasible and cost-effective. (*Id.*) The discussion of alternatives likewise falls short of statutory requirements.

The WSPA Alternative. WSPA submitted a proposed alternative in response to CARB's solicitation of alternatives. The WSPA Alternative contemplates that GHG emissions currently attributable to the LCFS program would "instead be achieved by the Assembly Bill (AB) 32 Cap

and Trade program in the most cost-effective manner to address GHG emissions." (EA at 207; see also ISOR at IX-1.) This proposal would be "paired with incentives to foster innovation." (ISOR at IX-1.) The ISOR, however, rejected this alternative, and declined to further analyze it, "because it is less likely to accomplish the innovation and fuel substituting benefits intended by the LCFS," (ISOR at IX-1–IX-2), and because CARB had not "been appropriated funding for such incentives." (*Id.* at IX-2.) The WSPA Alternative would also minimize leakage by avoiding "fuel shuffling." (See *supra,* § IV. B. 3.) By failing to consider the WSPA Alternative, the ISOR does not comply with the Government Code. First, the issue under Section 11346.5(a)(13) is not whether a proposed alternative meets each and every project objective articulated by an agency for a regulation. Rather, Section 11346.5(a)(13) requires CARB to evaluate whether the alternative would be "equally effective in implementing the statutory purpose . . . ." Here, the statutory purpose is ***not*** fostering innovation in fuel, (*cf.* ISOR at IX-2), but rather ensuring GHG emissions will be "reduced to at least 40 percent below the statewide greenhouse gas emissions limit no later than December 31, 2030," in a manner that is technologically feasible and cost-effective. (Health & Saf. Code, § 38566.) As such, "innovation" cannot be a proper basis to reject an alternative under Section 11346.5(a)(13).

In any event, the WSPA Alternative will spur innovation. Indeed, WSPA's strategy to use financial incentives to promote innovation is the same strategy that CARB itself has used to achieve the same goals. (Appendix A, Attachment 2.)

The WSPA Alternative would also be effective in achieving reduced emissions required under SB 32. As previously recognized by CARB when Growth Energy proposed a similar alternative in 2015, a cap-and-trade alternative would "likely" achieve the same "estimated GHG emissions reductions" as the LCFS regulation during the relevant period. (2015 ISOR (LCFS),

Appx. F at 26-27.) There is no evidence or analysis to suggest that the WSPA Alternative would not be equally efficacious. It should also be noted that a demonstration that there are no superior alternatives to a proposed regulation, as required under Section 11346.9(a)(4), must be based on "supporting information." To date, however, there is no such "supporting information" in the rulemaking file of which Growth Energy is aware. If the Board intends to add such information to the rulemaking file in order to try to carry its burden under Section 11346.9(a)(4), it must comply with section 11347.1 of the Government Code.

The E15 Alternative. CARB should also consider an alternative under which CARB would concurrently adopt fuel specifications for E15, and incorporate E15 into the LCFS. This alternative would be more than "equally effective in implementing the statutory purpose," (Govt. Code, § 11346.5, subd. (a)(13)), of reducing greenhouse gas emissions "to at least 40 percent below the statewide greenhouse gas emissions limit no later than December 31, 2030," in a manner that is technologically feasible and cost-effective. (Health & Saf. Code, § 38566.)

Specifically, ethanol is a low CI fuel, and using greater percentage of ethanol would thus help reduce greenhouse gas emissions further. Moreover, the incorporation of E15 would be cost-effective because it would allow "greater use of low CI ethanol, [which] will result in the generation of greater volumes of credits under the LCFS program helping to ensure and further reduce the cost of LCFS compliance." (Appendix A, Attachment 3.) Further, because E15 is already being produced and is actively being used in at least 28 states, E15 is both "technologically feasible," (*id.*), and would help avoid the "significant and unavoidable" impacts identified in the EA resulting from the construction and/or modification of new facilities. As a result of the foregoing, CARB should not on the current record proceed to a final action because it cannot, among other things, comply with Section 11346.9(a)(4) of the Government Code. If

the Board intends to pursue the Executive Officer's proposal, the record must demonstrate that it has addressed the issues raised here, both substantive and procedural.[9]

B. Adequacy of the Economic Analysis in the SRIA

Under the APA, state agencies proposing to "adopt, amend, or repeal any administrative regulation" must first perform an assessment of "the potential for adverse economic impact on California business enterprises and individuals." (Govt. Code, § 11346.3, subd. (a).) Among other things, the APA requires that agencies such as CARB prepare a Standardized Regulatory Impact Assessment ("SRIA") analyzing "the potential adverse economic impact on California business and individuals of a proposed regulation," (Govt. Code, § 11346.3), and declare in the notice of proposed action any initial determination that the action will not have a significant statewide adverse economic impact directly affecting business. (Govt. Code, § 11346.5, subd. (a)(8); *WSPA*, *supra*, 57 Cal.4th at 428.) The APA requires the SRIA to evaluate several issues, including "elimination of jobs within the state," "the elimination of existing businesses within the state," and "[t]he competitive . . . disadvantages for businesses currently doing business within the state." (Govt. Code, § 11346.3, subds. (c)(1)(A)-(C).) The SRIA must be circulated with the 45-day materials (here, the ISOR), and must be supported by "facts, evidence, documents, [or] testimony," and made available for public review and comment for at least 45-days before an agency approves a regulation. (Govt. Code, §§ 11346.5, subds. (a)(7), (a)(8), 11347.3(b)(4).) The SRIA cannot be based on "mere speculati[on]." (*WSPA*, *supra*, 57 Cal.4th at 428.) "A regulation . . . may be declared invalid if . . . [t]he agency declaration . . . is in conflict with substantial evidence in the record." (*Calif. Ass'n of Medical Products Suppliers v. Maxwell-Jolly* (2011) 199 Cal.App.4th 286, 306.)

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[9] If the Board does not agree with Growth Energy's analysis of the obligations of section 11346.9(a)(4), Growth Energy requests that the Board explain its reasons for disagreement.

The current SRIA for the Proposed Amendments does not meet the applicable standards. The analysis of the LCFS regulation's "potential adverse economic impact on California business and individuals of a proposed regulation," (Govt. Code, § 11346.3), is contained on pages 69-70 of Appendix E to the ISOR.

The ISOR's discussion of the "the elimination of existing businesses within the state," and "[t]he competitive . . . disadvantages for businesses currently doing business within the state," (Govt. Code, § 11346.3, subds. (c)(1)(B)-(C)), does not fully address and take into account the ISOR's estimate that the LCFS regulation is projected to increase the price of gasoline up to $0.36/gallon and diesel by up to $0.44/gallon as early as 2025. (ISOR, Appx. E at 50.) The projected increase in the price of gasoline, which is directly attributable to the fact that the costs of the LCFS regulation are expected to be passed on to California consumers and businesses, is three-times higher than the controversial $0.12/gallon tax increase recently approved by the Legislature in 2017. (See SB 1: The Road Repair and Accountability Act of 2017.) In addition, the SRIA estimates that the LCFS regulation could result in a loss of over 25,000 jobs, (*id* at 63), and a 0.1% decline in the GDP. (*Id.* at 68.)

Although impacts of this nature would dramatically affect small businesses,[10] the SRIA does not consider whether the increase in the price of gasoline or diesel could result in "the

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10 Various entities have expressed concern about the impact of the $0.12/gallon increase on small businesses and families, many of which are summarizes in the following documents:

- *http://www.next10.org/sites/default/files/transportation-funding-brief-final.pdf*
- *http://www.nfib.com/content/news/california/small-business-reacts-to-passage-of-senate-bill-1/*
- *https://www.nfib.com/content/analysis/california/senate-bill-1-will-hurt-small-businesses-and-working-families/*
- *http://www.sacbee.com/news/politics-government/capitol-alert/article191161034.html*

elimination of existing businesses within the state . . . ." (Govt. Code, § 11346.3, subd. (c)(1)(B); *cf.* ISOR, Appx. E at 70.)

The SRIA's discussion of "[t]he competitive . . . disadvantages for businesses currently doing business within the state," (Govt. Code, § 11346.3, subd. (c)(1)(C)), also requires augmentation. While the SRIA does recognize that "California sectors that rely heavily on transportation fuel may face higher prices, resulting in a competitive disadvantage relative to out of state entities that are not subject to the LCFS," the SRIA makes no attempt to quantify the extent of the competitive disadvantage a $0.36/gallon increase in gas prices or a $0.46/gallon increase in the price of diesel fuel would create.

The SRIA relies on the suggestion that other jurisdictions will adopt their own versions of the LCFS regulation. The SRIA states that "due to the 2015 Paris Agreement reached by the Conference of Parties in Paris, which is aimed at keeping the global temperature rise below 2°C, staff expects signatories (which include all of the U.S.'s trading partners) to take action to reduce GHG emissions." (ISOR, Appx. E at 69.) This assertion, however, is not supported by any "facts, evidence, documents, [or] testimony" to suggest the adoption of LCFS-like regulations by other jurisdictions would decrease the price of fuels, or otherwise reduce competitive harm to "businesses currently doing business within the state . . . ." (Govt. Code, § 11346.3, subd. (c)(1)(C).) Further, there is no evidence that a critical mass of states have actually adopted regulations similar to the LCFS, nor are there statutes like AB 32 in other states that might be used to try to justify programs in addition to the RFS program. The only state to which the ISOR

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- *http://www.latimes.com/politics/la-pol-ca-gas-tax-repeal-20171229-story.html*

points to adopting an LCFS regulation is Oregon, and at least one other state has declined to adopt an LCFS program like the one in California.[11]

C. External Peer Review

The Health & Safety Code provides that CARB shall not "take any action to adopt the final version of a rule unless" it undertakes a peer review to evaluate the "scientific portions" of the rule. (Health & Saf. Code, § 57004(d).) Section 57004 requires that: (1) CARB "submit[] the scientific portions of the proposed rule, along with a statement of the scientific findings, conclusions, and assumptions on which the scientific portions of the proposed rule are based and the supporting scientific data, studies, and other appropriate materials, to the external scientific peer review entity for its evaluation," and (2) the peer reviewer "prepare[] a written report that contains an evaluation of the scientific basis of the proposed rule." (*Id.*, subd. (d).) Section 57004 of the Health and Safety Code defines the "scientific portions" of a proposed rule to include "those foundations of a rule that are premised upon, or derived from, empirical data or other scientific findings, conclusions, or assumptions establishing a regulatory level, standard, or other requirement for the protection of public health or the environment." (*Id.*, subd. (a)(2).)

Numerous aspects of the proposed amendments "are premised upon, or derived from, empirical data or other scientific findings, conclusions, or assumptions establishing a regulatory level, standard, or other requirement for the protection of public health or the environment." (*Id.*, subd. (a)(2).) These "scientific portions" include, but are not limited to:

- The accuracy of each of the components of CA-GREET 3.0, and the effect on the CI for corn ethanol and sugarcane ethanol;
- The ILUC for corn ethanol;

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11 http://www.biofuelsdigest.com/bdigest/2015/07/03/washington-state-nixes-low-carbon-fuel-standard-via-transport-bill-poison-pill/

- The EER for electricity;
- The efficacy of NTDEs to reduce NOx emissions from biodiesel;
- The accuracy of CARB's compliance scenario, including but not limited to the adaptation of alternative jet fuels, solar steam projects, and renewable diesel; and
- The potential impacts associated with CARB's compliance scenarios not coming to fruition, particularly with respect to alternative jet fuels, solar steam projects, and renewable diesel.

It is unclear whether CARB has sought external peer review to evaluate the scientific portions of the rule, consistent with Section 57004. As such, the subject of any such peer review is unknown. If CARB has not sought peer review under Section 57004, Growth Energy requests an explanation of the reason why none was sought and completed.

D. The Proposed Amendments Are Not Consistent with AB 32

The Proposed Amendments are an "implementation measure" that would be adopted under color of AB 32. When the Legislature adopted AB 32, it wanted to ensure that criteria pollutants – such as NOx – would not increase. (Health & Saf. Code, § 38501.) As a result, AB 32 makes clear that any "market-based compliance mechanism" by CARB – such as the LCFS regulation – must be designed "to prevent any increase in the emissions of . . . criteria air pollutants." (Health & Saf., § 38570(b)(2).) Likewise, CARB must "[e]nsure" that any such activity does "not interfere with[] efforts to achieve and maintain federal and state ambient air quality standards . . . ." (Health & Saf., § 38562(b)(4).) In addition, implementation measures must "minimize leakage," defined as "a reduction of emissions of greenhouse gases within the

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state that is offset by an increase of emissions of greenhouse gases outside the state." (Health & Saf. Code, § 38562, subd. (b)(8); *id.*, § 38505, subd. (j).)

The LCFS regulation and the Proposed Amendments do not comply with AB 32 for several reasons:

- Using an accurate 2007 baseline, the LCFS regulation has resulted in increased and unmitigated NOx emissions from biodiesel since its inception. While ISOR Appendix G suggests these emissions would be mitigated through the payment of funds to local air districts for NOx mitigation projects, there is nothing in the Proposed Amendments that requires this to occur, and there is no analysis showing (i) where, (ii) in what amounts, (iii) for what specific purpose such funds would be spent, and (iv) how they will be funded. (See Appendix A, Attachment 4.)
- Substantial evidence suggests NOx emissions associated with biodiesel will increase in the future. The proposed mitigation to continuing NOx emissions is not consistent with CEQA, and the ISOR's conclusions are based on assumptions concerning industry's use of renewable diesel and alternative jet fuel, and the development of solar steam projects, none of which are required to occur, and all of which are speculative. (See Appendix A, Attachment 4.)
- The LCFS regulation will result in the construction of new or modified facilities for alternative fuels incentivized by the regulation. This will lead to increased criteria pollutant emissions, which CARB states are "significant and unavoidable." (See Appendix A, Attachment 4.)

- The LCFS regulation will continue to result in fuel shuffling, which increases emissions. (See Appendix C.)

It has been suggested the Proposed Amendments will "not interfere with[] efforts to achieve and maintain federal and state ambient air quality standards," (Health & Saf., § 38562(b)(4); see also *id.* § 38570(b)(2)), because the LCFS regulation is an "early action" under AB 32. (*Cf.* Health & Saf. Code, § 38560.5.) Specifically, pursuant to Section 38570.5(d) of the Health & Safety Code, "early action" measures were required to be "enforceable no later than January 1, 2010." The Proposed Amendments, however, will not be enforceable until after 2018. As such, Section 38570.5 does not apply to the Proposed Amendments.

Even if the Proposed Amendments to the LCFS regulation could be considered an "early action" measure, there is nothing in Section 38560.5 that exempts "early action" measures from the requirements of Section 38652. Prior rulemaking documents characterize Section 38562 as applying to "early action" measures, such as the LCFS. In the 2009 rulemaking, for example, the ISOR analyzed whether the LCFS regulation conformed to Section 38562's requirements, (2009 ISOR at ES-32–ES-34), including whether the LCFS regulation increased criteria pollutant emissions. (2009 ISOR at ES-33; see also 2009 ISOR at VII-35 [applying Section 38562]; see also 2015 FSOR at 974.)

E. Requirements of Transparency

Section 11347.3 of the Government Code requires CARB to maintain a "file of [the] rulemaking proceeding" for any proposed regulatory action subject to the APA, including the LCFS regulation. The rulemaking file must include, *inter alia*:

> (6) All data and other factual information, any studies or reports, and written comments submitted to the agency in connection with the adoption, amendment, or repeal of the regulation.

(7) All data and other factual information, technical, theoretical, and empirical studies or reports, if any, on which the agency is relying in the adoption, amendment, or repeal of a regulation, including any cost impact estimates as required by Section 11346.3.

(Govt. Code, § 11347.3, subds. (b)(5), (b)(6).) The rulemaking file must also include an index to the rulemaking that identifies each item contained in the file. (*Id.*, subd. (b)(12).)

The entire rulemaking file, including the foregoing material, must be "available to the public for inspection" from the time when the first notice of the proposed rulemaking is published in the California Regulatory Notice Register, (*id.*, subd. (a)), which occurred in this proceeding on March 9, 2018. (See Govt. Code, § 11346.3, subd. (a); see also *Administrative Rulemaking* (1999) 29 Cal. Law Rev. Comm'n Rep. 459, 469 [making the rulemaking file available upon the publication of the notice of the proposed rulemaking promotes meaningful public participation in the rulemaking process].)

As Section 11347.3(b) makes clear, rulemakings at CARB must include the creation of a rulemaking file that includes "***[a]ll*** data and other factual information, any studies or reports, and written comments submitted to the agency" in connection with the proposal. (Govt. Code, § 11347.3, subds. (a), (b)(6) [emphasis added].) To assure immediate public access to the supporting materials as soon as the 45-day materials are released, the APA requires that the 45-day notice include a statement that the agency on the date of the notice "has available ***all*** information upon which [the] proposal is based." (*Id.*, § 11346.5, subds. (a)(16) [emphasis added].) A separate provision confirms the agency must in fact make those records, and any other "public records, including reports, documentation, and other materials, related to the proposed action," available. (*Id.*, § 11346.5, subd. (b).)

The "written comments" that must be placed in the record are not simply those submitted to the agency in a particular manner or at a particular time, such as during the period between

publication of the notice of a public hearing and public hearing – an agency must put "all" it receives "in connection with" a regulatory proposal in the rulemaking file. The Legislature's choice of words to describe what comments must be placed in the file – "in connection with" – sweep with intentional breadth, and require inclusion of any comments that bear on the subject of the regulatory effort. In addition, the period of public availability must "[c]ommenc[e] ***no later than*** the date that the notice of the proposed action is published." (*Id.*, § 11347.3, subd. (a) [emphasis added].) The use of the term "no later than" makes it clear that the Legislature expects written comments submitted in connection with a proposed regulatory action and received before publication of the required notice to be included in the rulemaking file.

Growth Energy has substantial concerns about the completeness of the rulemaking file for the proposed amendments, as it did in the prior rulemakings. The Court of Appeal made clear in *POET v. CARB* that neglect to include even a limited number of relevant documents in the rulemaking file would violate the Government Code.

As such, Growth Energy urges CARB to maintain a full and complete rulemaking file, and to make that file available for public review. Among other things:

- The rulemaking file must include external communications submitted to the staff, the Executive Officer or the Board prior to the date when the rulemaking file is formally opened must be included in the rulemaking file. If those communications are not included, it should explained why.
- Growth Energy urges CARB to take all necessary measures to ensure all external submittals (not within the scope of section 11347.3(b)(7)) concerning this regulatory process have been included in the rulemaking file.

- Growth Energy also urges CARB to ensure all factual information relied upon by CARB staff in connection with the consideration of the Proposed Amendments is included in the rulemaking file.

IV. ENVIRONMENTAL ANALYSIS

A. CARB's Certified Regulatory Program

CEQA requires that public agencies, such as CARB, "refrain from approving projects with significant environmental effects if there are feasible alternatives or mitigation measures that can substantially lessen or avoid those effects." (*City of Arcadia, supra*, 135 Cal.App.4th at 1421 [citing *Mountain Lion Found. v. Fish & Game Comm.* (1997) 16 Cal.4th 105, 134].) To perform this evaluation, "CEQA compels government first to identify the environmental effects of projects, and then to mitigate [any] adverse effects through the imposition of feasible mitigation measures or through the selection of feasible alternatives." (*Sierra Club, supra*, 7 Cal.4th at 1233.) "The CEQA process is intended to be a careful examination, fully open to the public, of the environmental consequences of a given project, covering the entire project, from start to finish. This examination is intended to provide the fullest information reasonably available upon which the decision makers and the public they serve can rely in determining whether or not to start the project at all, not merely to decide whether to finish it." (*NRDC v. City of Los Angeles* (2002) 103 Cal.App.4th 268, 271.)

State regulatory programs, such as CARB's, "that meet certain environmental standards and are certified by the Secretary of the California Resources Agency are exempt from CEQA's requirements for preparation of EIRs, negative declarations, and initial studies." (*City of Arcadia, supra*, 135 Cal.App.4th at 1421.) The scope of this exemption, however, is narrow, and only excuses a certified regulatory agency from complying with the requirements found in

Chapters 3 and 4 of CEQA (*i.e.*, Pub. Res. Code, §§ 21100-21154) in addition to Public Resources Code § 21167. (Pub. Res. Code, § 21080.5(c).) However, "[w]hen conducting its environmental review and preparing its documentation, a certified regulatory program is subject to the broad policy goals and substantive standards of CEQA." (Kostka & Zischke, *Practice Under Cal. Env. Quality Act* (2016 update) § 21.10] ["Kostka & Zischke"] [citing *City of Arcadia*, *supra*, 135 Cal.App.4th at 1422; *Sierra Club, supra,* 7 Cal.4th 1215; *Californians for Native Salmon & Steelhead Ass'n v. Dept. of Forestry* (1990) 221 Cal.App.3d 1419; *Envt'l Protection Info. Ctr. v. Johnson* (1985) 170 Cal.App.3d 604, 616].) The CEQA Guidelines implementing section 21080.5 provide that, "[i]n a certified program, an environmental document used as a substitute for an EIR must include '[a]lternatives to the activity and mitigation measures to avoid or reduce any significant or potentially significant effects that the project might have on the environment.'" (*City of Arcadia*, *supra*, 135 Cal.App.4th at 1422 [quoting CEQA Guidelines, § 15252(a)(2)(A)].)

CARB's functional equivalent document is the "staff report," which "shall be prepared and published by the staff of the state board." (17 Cal. Code Regs., § 60005(a).) The regulations require the staff report to be "published at least 45 days before the date of the public hearing" on the rulemaking, and to "be available for public review and comment." (*Id.*) Staff reports must be prepared "in a manner consistent" "with the goals and policies of" CEQA, and "shall contain":

> a description of the proposed action, an assessment of anticipated significant long or short term adverse and beneficial environmental impacts associated with the proposed action and a succinct analysis of those impacts. The analysis shall address feasible mitigation measures and feasible alternatives . . . which would substantially reduce any significant adverse impact identified.

(17 Cal. Code Regs., § 60005(b).)

The regulations also provide that an action "for which significant adverse environmental impacts have been identified during the review process shall ***not*** be approved or adopted as proposed if there are feasible mitigation measures or feasible alternatives available which would substantially reduce such adverse impact." (*Id.*, § 60006 [emphasis added].) "Feasible" means "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors, and consistent with the state board's legislatively mandated responsibilities and duties." (*Id.*)

If CARB receives comments raising "significant environmental issues associated with the proposed action," staff must "summarize and respond to the comments either orally or in a supplemental written report. Before taking final action on any proposal for which significant environmental issues have been raised, the decision maker shall approve a written response to each such issue." (*Id.*, § 60007.) CARB must respond to the issues raised by the public by providing a "good faith, reasoned analysis in response, and at a level of detail that matches the level of detail in the comment." (CEQA Guidelines, § 15088(c); *Pfeiffer v. City of Sunnyvale* (2011) 200 Cal.App.4th 1552, 1568.) If CARB disagrees with the "recommendations and objections raised in the comments," the "recommendations and objections" "must be addressed in detail," with the agency "giving reasons why specific comments and suggestions were not accepted." (CEQA Guidelines, § 15088(d).) "Conclusory statements unsupported by factual information will not suffice." (*Id.*)

CARB may not take "final action on any proposal which raise significant environmental issues associated with the proposed action" until the state board "approve[s] a written response to each" issue raised. (Cal. Code Regs., § 60007(a).) As such, CARB staff's responses to

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environmental comments must be presented to the state board before consideration of the Proposed Amendments for approval. (*Id.*)

B. Compliance with CEQA and CARB's Certified Regulatory Program

1. Analysis of NOx Emissions Associated with Biodiesel

The Causal Connection between the LCFS Regulation and Increased NOx Emissions. In its decision in *POET I*, the Court of Appeal found CARB did not adequately consider potential NOx emissions from biodiesel incented by the LCFS regulation. The Court thus directed CARB to:

> Address whether the project will have a significant adverse effect on the environment as a result of increased NOx emissions, make findings (supported by substantial evidence) regarding the potential adverse environmental effect of increased NOx emissions, and adopt mitigation measures in the event the environmental effects are found to be significant.

(*POET I, supra*, 218 Cal.App.4th at 767.) Thereafter, the Superior Court issued a Peremptory Writ in February 2014 that included the following language in Paragraph 3:

> ARB shall address whether the project will have a significant adverse effect on the environment as a result of increased NOx emissions, make findings (supported by substantial evidence) regarding the potential adverse environmental effect of increased NOx emissions, and adopt mitigation measures in the event the environmental effects are found to be significant.

(February 10, 2014, Peremptory Writ of Mandate ¶ 3, *POET, LLC v. CARB*, Fresno County Superior Court, Case No. 09 CE CG 04659.)

CARB attempted to take corrective action to address Paragraph 3 in its 2014-15 rulemaking that sought to modify and readopt the LCFS regulation. The Court of Appeal, however, found CARB did not adequately address the NOx emissions caused by the LCFS regulation in effect in 2014; rather, the Court found that CARB made a comparison of emissions "between (1) an estimate of the emissions of all diesel fuel and its substitutes used in 2014 and

(2) a hypothetical emissions profile that would have been generated if conventional diesel had replaced all of the biodiesel and renewable diesel fuel used in 2014." (*POET, LLC v. California Air Resources Board* (2017) 12 Cal.App.5th 52, 68 ["*POET II*"].) By engaging in this method of analysis, the Court found CARB did not adequately assess the impacts of the original LCFS regulation on the environment.

The Fifth District found CARB erred by proceeding in this fashion. (*Id.* at 100.) The Court found the original LCFS regulation adopted in 2009 and the LCFS regulation readopted by CARB in 2015 were the same "project" under CEQA. (*Id.* at 75.) The Fifth District also found CARB's use of a 2014 baseline was error because that baseline did "not describe the conditions existing when the environmental analysis of the project commenced," (*id.* at 80), and that CARB instead should have identified "the conditions that existed before any impacts of the original LCFS regulations began to accrue and, thus, would provide a solid foundation for identifying those impacts." (*Id.* at 81.) Appendix G to the ISOR appears to be the document prepared to address the ruling in *POET II*. Appendix G states, *inter alia*, that it considers "biodiesel NOx emissions for the entire history of LCFS regulations to date," (ISOR, Appx. G at G-2), using a 2007 baseline. Appendix G also states CARB has developed "remediation measures CARB proposes to take to address" both past NOx emissions attributable to the LCFS, as well as forward-looking mitigation measures. (*Id.*)

Growth Energy has several concerns with the analysis and mitigation identified in Appendix G. As an initial matter, the ISOR continues to underestimate the amount of NOx caused by biodiesel emissions allowed by the LCFS regulation based on the ISOR's analysis regarding incentives under the federal Renewable Fuels Standard ("RFS"). In addition, the mitigation measures proposed by CARB for past and future NOx emissions do not contain all of

the components required under CEQA. The ISOR's proposal to provide "backward-looking" mitigation for past NOx emissions impermissibly defers mitigation, and does not ensure the proposed mitigation will actually occur. The mitigation identified to reduce future NOx emissions likewise does not comport with CEQA's standards. For example, the adoption of New Technology Diesel Engines ("NTDE") engines is not based on a legally binding requirement. Moreover, while the ISOR relies upon assumptions regarding renewable diesel displacing biodiesel in sufficient quantities to effectuate a net benefit as to NOx emissions, there is no legally binding mechanism to ensure renewable diesels will be used in such quantities, nor are there any additional measures identified and imposed upon CARB in the event the ISOR's projections regarding renewable diesel never come to pass.

The Role of the RFS Regulation on Biodiesel Use in California. According to the ISOR, "Congress and the United States Environmental Protection Agency (U.S. EPA) have strongly encouraged, and even required, the use of progressively increasing volumes of [biodiesel and renewable diesel] fuels since 2009." (ISOR, Appx. G at G-10.) In Section C of Appendix G, the ISOR attempts to differentiate between biodiesel usage incentivized by the LCFS regulation, and biodiesel usage attributed to other incentives, such as federal regulations.

This analysis is based on the incorrect suggestion that CARB was powerless, in either the original LCFS regulation or subsequent regulations, to address NOx emissions from biodiesel incentivized by federal programs. The ISOR's analysis also presumes that wide-scale biodiesel usage in California would have been permissible without action by CARB. Neither assumption is supported by the evidence, as CARB wielded considerable authority as a gatekeeper, regardless of any federal incentives. Among other things, CARB must perform a multimedia

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evaluation under Section 43830.8 of the Health & Safety Code for certain new fuels, including biodiesel.

In addition, armed with its contemporaneous understanding in 2009 (and earlier) that increased biodiesel usage would result in increased NOx emissions, (2009 ISOR at VII-19), and that the federal RFS would incentivize biodiesel in California, CARB could have taken any number of actions within the LCFS to address increased NOx from biodiesel usage:

- CARB could have adopted mitigation to avoid increases in NOx emissions from biodiesel. For example, CARB could have adopted a version of the ADF regulation in 2009 to help ensure legally enforceable mitigation existed prior to the wide-scale introduction of biodiesel to California.
- CARB could have likewise prohibited wide-scale biodiesel usage in California until such mitigation was adopted.
- CARB could have declined to include biodiesel in the original LCFS regulation, removing the additional state-based incentives to any fuels allegedly being incented by federal regulations.

CARB, however, did not consider this issue in 2009. Instead, the Court of Appeal found CARB "sidestepped and never reached the question of whether any increase would constitute a 'significant effect on the environment." (*POET II*, *supra*, 12 Cal.App.5th at 64.) CARB also conducted the multimedia evaluation for biodiesel, and provided biodiesel a favorable CI value compared to traditional diesel fuel, further incentivizing its use. (See 2009 Final Regulation Order at 49.) In other words, even assuming, *arguendo*, some portion of increased NOx from biodiesel usage was attributable, in part, to federal incentives, the LCFS in fact exacerbated the issue by authorizing biodiesel usage without mitigation, and incorporating biodiesel into the

program. (*Calif. Bldg. Industry Assn. v. Bay Area Air Quality Mgmt. Dist.* (2015) 62 Cal.4th 369, 388 ["CEQA calls upon an agency to evaluate existing conditions in order to assess whether a project could exacerbate hazards that are already present."]; *East Sacramento Partnership for a Livable City v. City of Sacramento* 5 Cal.App.5th 281, 296 ["What must be analyzed under CEQA is a project's potentially significant exacerbating effects on existing environmental hazards . . . ."] [internal quotations omitted]; *Visalia Retail, LP v. City of Visalia* (2018) 20 Cal.App.5th 1, 13 [stating that the requirement of CEQA review is triggered if a project "affects the physical environment . . . by causing or increasing" a significant impact]; *Joshua Tree Downtown Business Alliance v. County of Sen Bernardino* (2016) 1 Cal.App.5th 677, 685 [same].)

In addition, the attribution of most NOx emissions from biodiesel to the RFS is not supported by the facts. "[T]here is nothing in the ADF regulation, the LCFS regulation, or the proposed amendments . . . that mandates the use of any volume of biodiesel in California, much less the use of the exact ratio of renewable diesel to biodiesel assumed by [the ISOR] in its emissions analysis." (Appendix A, Attachment 4 at 5.) And even if the ISOR generates the anticipated volumes of renewable diesel, CARB "has already formally committed to taking credit for those NOx reductions as part of a "Low-Emission Diesel" requirement as of the agency's Mobile Source State Implementation Plan (SIP) Strategy." (*Id.*) As such, "those reductions cannot be claimed to offset potential NOx increases from the use of biodiesel resulting from the LCFS." (*Id.*)

And even if it could be argued that the LCFS is not responsible for some of the biodiesel usage in California, and that such usage was the sole responsibility of the RFS program, this does not mean the EA can avoid mitigation for such emissions. CEQA requires that CARB's

functional equivalent environmental document discuss the cumulative effect on the environment of the subject project in conjunction with other closely-related ***past***, present, and reasonably foreseeable probable future projects. (See, e.g., Pub. Resources Code, § 21083, subd. (b).) "The purpose of this requirement is obvious: consideration of the effects of a project or projects as if no others existed would encourage the piecemeal approval of several projects that, taken together, could overwhelm the natural environment and disastrously overburden the man-made infrastructure and vital community services. This would effectively defeat CEQA's mandate to review the actual effect of the projects upon the environment." (*Citizens to Preserve the Ojai v. County of Ventura* (1985) 176 Cal.App.3d 421, 432.) Thus, even if it could be argued that increased past and future NOx emissions were caused ***solely*** by the RFS, those emissions must still be addressed, analyzed, and mitigated as cumulative impacts under CEQA.

The Adequacy of Mitigation Measures Identified for Past NOx Emissions from Biodiesel. Appendix G proposes mitigation for historic NOx emissions that the ISOR attributes to the LCFS regulation (which, as explained above, are understated). To mitigate for these emissions, the ISOR states "CARB will offset historical potential LCFS-attributed biomass-based diesel NOx emissions through a remedial measure that funds air district-level NOx mitigation projects targeting engines, such as the replacement of existing diesel engines with low-NOx engines." (ISOR, Appx. G at G-56.) Appendix G, in turn, states that CARB "cannot speculate as to the ultimate locations or specific projects selected for funding under this measure," but that the "remedial measure itself ***would be*** designed to result in beneficial environmental impacts" by reducing "NOx emissions in an amount sufficient to remediate historical potential LCFS-attributed biomass-based diesel NOx emissions." (*Id.* [emphasis added].)

The ISOR states that, due to the alleged benefits of biodiesel to Particulate Matter ("PM") emissions, CARB could use this as an "overriding consideration[] related to potentially significant and unavoidable historical air quality impacts . . . ." (ISOR, Appx. G at G-57.) In *Mission Bay Alliance v. Office of Community Investment and Infrastructure* (2016) 6 Cal.App.5th 160, however, the court explained:

> Under CEQA, an agency may approve a project with significant, unavoidable environmental impacts if it adopts a statement of overriding considerations finding that particular economic, social, or other considerations make the alternatives and mitigation measures infeasible and that particular project benefits outweigh the adverse environmental effects . . . [but first] an agency must show that it has considered the mitigation measures and project alternatives identified in the EIR that would lessen the significant environmental effects.

(*Id.* at 183–184.)

Moreover, the proposed mitigation is not sufficient under CEQA for several reasons. First, agencies usually cannot defer formulation of mitigation measures to some point in the future. (See CEQA Guidelines, § 15126.4(a)(1)(B); *POET I*, *supra*, 218 Cal.App.4th at 735.) As such, the ISOR's suggestion that this remedial measure "would be" designed at some point in the future to create "beneficial impacts" is inconsistent with CEQA.

In addition, the proposed mitigation measure for past NOx emissions is essentially a fee-based mitigation. A commitment to pay fees, however, is not adequate mitigation if there is no evidence the mitigation will actually result. (See *Calif. Clean Energy Comm. v. City of Woodland* (2014) 225 Cal.App.4th 173, 197; *Gray v. County of Madera* (2008) 167 Cal.App.4th 1099, 1122; *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 727.) Here, the ISOR identifies no specific projects, and provides no explanation as to how the programs it references would actually result in a ton-for-ton mitigation of past NOx emissions. Nor is there anything in the record to show exactly which air districts would be the focus of these

funding efforts, and that the selected districts would be located in the areas most affected by increases in NOx (*i.e.*, the San Joaquin Valley Air Pollution Control District or the South Coast Air Quality Management District). Likewise, there is no evidence as to how the mitigation would be funded.

The ISOR also contains no evidence to suggest CARB would be legally bound to provide any specific amount of funding as a condition of approving the Proposed Amendments. (See *Anderson First Coalition v. City of Anderson* (2005) 130 Cal.App.4th 1173, 1187; *Save Our Peninsula Comm. v. Monterey County Bd. of Supervisors* (2001) 87 Cal.App.4th 99, 141.) This is important because an agency must ensure a mitigation measure will actually be implemented. (*Federation of Hillside & Cyn. Ass'ns v. City of Los Angeles* (2000) 83 Cal.App.4th 1252, 1261.)

The Adequacy of Mitigation Identified to Reduce Future NOx Emissions from Biodiesel. To mitigate future NOx emissions from biodiesel, the ISOR generally relies on the in-use requirements under the current ADF regulation. Those in-use requirements, however, are currently subject to sunset provisions. As a result, CARB intends to expand the sunset provisions in the ADF regulation to incorporate NTDEs by off-road diesel vehicles:

> 1. The vehicle miles traveled (VMT) by NTDE heavy-duty on-road diesel vehicles in California reaches 90 percent of total VMT by the California heavy-duty on-road fleet, based on the most current CARB mobile source emissions inventory; and
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> 2. The hours of operation of NTDE off-road diesel engines in California reaches 90 percent of total hours of operation by the California heavy-duty off-road diesel engine fleet (exclusive of OGVs),[] based on the most current CARB mobile source emissions inventory.

(ISOR, Appx. G at G-58.)

This mitigation is based upon the conclusion that NTDEs using biodiesel blends of B20 or less would result in ***no*** increase in NOx emissions. This conclusion, however, is not supported by the evidence. Specifically, the consensus within the scientific literature is that

NTDEs using biodiesel blends of B20 or less ***caused NOx emissions to increase***, and that such increases could total as much as 9.73 additional tons per day of NOx emissions statewide in 2020. (Appendix A, Attachment 4.) The only study it appears the ISOR has relied upon is the 2012 Lammert study (the "Lammert Study"). Although CARB in a prior ISOR recognized that Lammert was not consistent with other existing studies – all of which showed increased NOx emissions would result – the 2015 ISOR dismissed the remaining studies on the grounds that they were performed on "either retrofit engines or non-commercial engines . . . ." (2015 ISOR (ADF) at 44/87.) This position, however, is no longer relevant because CARB staff and CARB contractors have now published several studies – performed with testing on OEM production vehicles, and not retrofits – that biodiesel increases NOx emissions from NTDEs. (Appendix A, Attachment 4.)

As such, CARB cannot rely upon the use of NTDEs by industry as a mechanism to sunset the in-use biodiesel requirements under the LCFS.

The Role of Renewable Diesel in Mitigating/Offsetting NOx Emissions. One of the methods contemplated under the LCFS regulation and the ADF regulation to reduce NOx emissions from biodiesel is the increased use of renewable diesel. (See EA at 65.) This mitigation, however, is based upon the assumption that renewable diesel will gradually displace biodiesel as an alternative diesel. (See, e.g., EA at 65.) Thus, the efficacy of the mitigation contained in the ISOR to reduce NOx emissions is based upon assumptions about what industry "may" do as a "possible pathway" to comply with the LCFS regulation. Nothing ***requires*** industry to do anything to use renewable diesel at any particular level, or assures the public the alleged reductions in NOx will occur.

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CEQA, however, requires mitigation measures to be enforceable through means that are legally binding. (Pub. Resources Code, § 21081.6(b); CEQA Guidelines, § 15126.4.) This requirement is designed to ensure that mitigation measures will actually be implemented, not merely adopted and then ignored. (*Fed. of Hillside & Cyn, supra*, 83 Cal.App.4th at 1261; *Anderson First, supra*, 130 Cal.App.4th at 1186.) In addition to being legally enforceable, a lead agency must also demonstrate the identified mitigation measures would be effective in reducing the identified impact to a less than significant level. (*Gray, supra*, 167 Cal.App.4th at 1115.) While an agency is not precluded from adopting a mitigation measure that might not be effective in minimizing a significant effect, it must acknowledge the uncertainty and adopt a statement of overriding considerations. (*Citizens for Open Govt. v. City of Lodi* (2012) 205 Cal.App.4th 296, 322; *Fairview Neighbors v. County of Ventura* (1999) 70 Cal.App.4th 238, 242.)

Here, the conclusions in the ISOR that NOx emissions will decrease are based upon assumptions regarding the displacement of biodiesel by renewable diesel. These assumptions are insufficient to establish the ADF Regulation will result in "effective" or "enforceable" mitigation under CEQA.

In any event, the conclusion that the expected levels of renewable diesel usage would occur in sufficient volumes to offset NOx emissions from biodiesel is unsupported by the evidence. (Appendix A, Attachment 4.) But even if California experienced such levels of renewable diesel levels, "CARB has already formally committed to taking credit for those NOx reductions as part of a "Low-Emission Diesel" requirement as part of the agency's Mobile Source State Implementation Plan (SIP) Strategy." (*Id.*)

Accordingly, the ISOR cannot presume NOx emissions from biodiesel will be offset through greater use of renewable diesels.

Solar Steam Projects. The EA also suggests total NOx emissions associated with biodiesel would be reduced through decreases in NOx emissions from the implementation of solar steam projects at oil fields. (EA at 66.) Specifically, the ISOR projects a "decrease in both NOx and PM2.5 emissions due to" a "large reduction in emissions from natural gas-fired steam generators as solar steam projects are implemented," which would "primarily occur in the San Joaquin Valley air basin." (*Id.*)

The reference to solar steam projects is insufficient to serve as mitigation because the conclusion as to how industry will react to the LCFS regulation is merely based on "assumptions" in the compliance scenarios supporting the LCFS. There is nothing in the LCFS regulation actually requiring that solar steam projects will be built. As such, to the extent CARB seeks to rely upon solar steam projects to confirm there will be no increase in NOx emissions, such projects cannot be considered an effective mitigation measure under CEQA because they are not based upon an enforceable obligation, (Pub. Resources Code, § 21081.6(b); CEQA Guidelines, § 15126.4), and there is no assurance such projects will actually be implemented. (*Fed. of Hillside & Cyn. Ass'ns*, *supra*, 83 Cal.App.4th at 1261; *Anderson First*, *supra*, 130 Cal.App.4th at 1186.) There is likewise no assurance that a sufficient number of solar steam projects will be implemented to ensure they will result in a reduction of NOx emissions to a less than significant level. (*Gray*, *supra*, 167 Cal.App.4th at 1115.) Nor does the EA articulate any performance standards.

In addition, the conclusion that the benefits from solar steam projects would offset NOx emissions from biodiesel is unsupported by the evidence, as there is nothing in the LCFS that actually requires the completion of solar steam projects. (Appendix A, Attachment 4.)

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Accordingly, the ISOR cannot rely upon an assumption that the development of solar steam projects will offset NOx emissions from biodiesel.

Alterative Jet Fuel. The ISOR also posits that the "Proposed Amendments would result in an increased use of" Alternative Jet Fuel ("AJF") at California airports, and that "slight or negligible reductions in NOx relative to conventional jet fuel" would help offset NOx emissions from biodiesel. (EA at 63, 66-67.)

Using assumptions regarding industry's adaptation of AJF to offset NOx emissions from biodiesel does not serve as adequate mitigation. As with solar steam projects, a reliance on AJF cannot serve as mitigation because the conclusion as to how industry will react to the LCFS regulation is merely based on the assumptions in the LCFS compliance scenarios. The LCFS, however, does not require that AJF be used in any particular quantity. As a result, any offset for AJF use is not based upon an enforceable obligation, (Pub. Resources Code, § 21081.6(b); CEQA Guidelines, § 15126.4), and there is no assurance AJF will displace conventional jet fuels at any particular quantity or rate. (*Fed. of Hillside & Cyn. Ass'ns*, *supra*, 83 Cal.App.4th at 1261; *Anderson First*, *supra*, 130 Cal.App.4th at 1186.) There is likewise no assurance that AJF will displace conventional jet fuels at sufficient quantities to ensure that displacement will reduce NOx emissions associated with biodiesel usage to a less than significant level. (*Gray*, *supra*, 167 Cal.App.4th at 1115.)

Moreover, any assumption that AJF displacing conventional jet fuel would offset NOx emissions from biodiesel is unsupported by the evidence, since there is nothing in the LCFS that actually requires the use of AJF at any particular level. (Appendix A, Attachment 4.)

Thus, the ISOR cannot rely upon AJF as a method to offset increased NOx emissions from biodiesel.

2. Potential Impacts Associated with the Construction of New or Modified Facilities

The EA states that the Proposed Amendments would result in the construction of a large number of new and modified facilities needed to produce alternative fuels. For a wide range of resources, the EA finds the impacts of these new facilities to be significant. Although in several instances the EA identifies potential mitigation to offset these impacts, and notes that these measures could reduce the impacts to a less-than-significant level, the EA ultimately does not identify any mitigation measures that would provide enforceable mechanisms to lessen the significant impacts of the LCFS regulation – even though CARB enjoys the authority to approve new pathways under the LCFS for such facilities. Instead, for each of the resources, the EA finds the impact would continue to be significant and unavoidable because CARB does not possess land use authority over new facilities.

Before Finding the Impacts of a Project Are Significant and Unavoidable, an Agency must First Adequately Analyze the Issue. As an initial matter, an environmental document cannot simply label an impact "significant and unavoidable" without first providing a discussion and analysis. Such an approach "allows the agency to travel the legally impermissible easy road to CEQA compliance." (*Berkeley Keep Jets Over the Bay Comm. v. Bd. of Port Comm'rs* (2001) 91 Cal.App.4th 1344, 1370.) Rather, the lead agency must quantify the impact, and consider feasible mitigation based on that analysis. (See, e.g., *Sundstrom v. County of Mendocino* (1988) 202 Cal.App.3d 352, 311 ["CEQA places the burden of environmental investigation on government rather than the public," and a lead agency "should not be allowed to hide behind its own failure to gather data."].)

Any such analysis would not be speculative. By recognizing that the construction and modification of these facilities is a "reasonably foreseeable" consequence of the Proposed

Amendments by identifying the impact as a potentially significant effect of the project in the EA, the EA concedes CARB should analyze these impacts, at least at a general level. (CEQA Guidelines, § 15358 [lead agency must consider "[i]ndirect or secondary effects which are caused by the project and are later in time or farther removed in distance, but are still ***reasonably foreseeable***."] [emphasis added].) Moreover, the EA does not include the "same kind of health risk assessment of potential California biofuel facilities that was presented in the 2015 LCFS ISOR as part of" its analysis of air quality impacts in the 2018 EA. (Appendix A, Attachment 5.)

The Estimate of Impacts of New or Modified Facilities is Understated. In addition, the EA's estimate of potential impacts associated with the construction of new or modified facilities appear to be understated. In prior rulemakings, CARB has estimated that a single "Potential California Celluosic Ethanol Facility" in Northern California would have operational NOx emissions of 1,435 tons per year (an amount equal to approximately 3.9 tons per day). (See 2015 ISOR (LCFS) at IV-7.) This "is well in excess of any local California air quality district's threshold for a significant impact and would require extensive mitigation," and "is over 120 times greater than the NOx emission factor that CARB staff used for the 2018 LCFS analysis which is presented in Table F-3 of Appendix F to the 2018 ISOR." The current EA contains no explanation as to why NOx emissions from the facility described in the 2015 ISOR – which were estimated based on information "derived directly from data for a biomass plant as shown in Table IV-15 of the 2015 ISOR" – are not included in the analysis of such facilities in the current EA. (See Appendix A, Attachment 5.)

Feasible Mitigation Exists to Lessen the Impacts of New or Modified Facilities. In its discussion of environmental impacts associated with new or modified facilities, the EA states mitigation is necessary, and in some sections appears to recommend mitigation to avoid the

significant impacts of the Proposed Amendments. However, while the EA refers to specific mitigation measures, these discussions do not include any actual mitigation measures.

For instance, the section of the EA that concerns long-term operational air quality emissions includes a header that suggests the EA is identifying a specific mitigation measure – *i.e.*, "Mitigation Measure B.3.b" – to lessen such impacts. The EA, however, does not actually include any language suggesting what the text of that mitigation measure might be; rather, the discussion under the header "Mitigation Measure B.3.b" merely argues no mitigation is necessary. (See EA at 69-71.)

This renders the entire discussion somewhat confusing because it is unclear whether the EA is seeking to identify potential mitigation measures to reduce the impacts of the Proposed Amendments, and the LCFS regulation as a whole, or asserting no mitigation is necessary (which is not consistent with the title and format of the document).

In addition, although Appendix G references specific mitigation/remedial measures designed to lessen the potentially significant environmental impacts associated with NOx emissions from biodiesel, the air quality section of the EA does not itself identify any mitigation measures. In fact, the conclusion on pages 69-71 of the EA that no mitigation is available appears to be inconsistent with the identification of potential mitigation in Appendix G.

The same issues appear in most of the resource impact sections of the EA. (See, e.g., EA at 47 [aesthetics], 50 [agricultural and forest resources], 55 [air quality], 72 [biological resources], 77 [cultural resources], 80 [energy demand], 82 [geology and soils], 87 [greenhouse gas emissions], 89 [hazards and hazardous materials], 96 [hydrology and water quality], 101 [land use and planning], 104 [mineral resources], 107 [noise], 112 [population and housing], 113

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[public services], 114 [recreation and traffic], 115 [transportation and traffic], 120 [utilities and service systems].)

The analysis of these new facilities should be revised and augmented for several reasons. As an initial matter, CARB should consider reorganizing the EA and ensuring the conclusions stated therein are consistent to promote CEQA's basic informational and organizational requirements. In the related statutes that concern the preparation of environmental impact reports, CEQA makes plain that lead agencies are required to organize their environmental documents in a manner that will make them "meaningful and useful to decision-makers and to the public." (Pub. Resources Code, § 21003, subd. (b).) The data presented in the environmental document must adequately inform the public and the decision-makers. (*Vineyard Area Citizens for Responsible Growth v. City of Rancho Cordova* (2007) 40 Cal.4th 412, 442.) The environmental document may not be written is such a manner that forces readers "to sift through obscure minutiae or appendices" to find important components of the analysis. (See *San Joaquin Raptor Rescue Ctr. v. County of Merced* (2007) 149 Cal.App.4th 645, 659; see also *Calif. Oak Found. v. City of Santa Clarita* (2005) 133 Cal.App.4th 1219, 1239.)

In addition, having identified potential mitigation for the impacts of the LCFS regulation, CARB should attempt to find a way to make those measures enforceable. CARB's CEQA regulations provide that "[a]ny action or proposal for which significant adverse environmental impacts have been identified during the review process ***shall not be approved*** or adopted as proposed ***if there are feasible mitigation measures*** . . . available which would substantially reduce such adverse impact." (17 Cal. Code Regs., § 60006 [emphasis added].)

The EA states that "CARB does not have the authority to require implementation of mitigation related to operation of new or modified facilities that would be approved by local

jurisdictions." (EA at 69.) While it may be technically true that CARB is not the local land use agency that would approve discretionary land use entitlements for new or modified facilities, this does not mean that CARB could not develop mitigation measures to lessen the impacts of any such future projects.[12] (See Appendix A, Attachment 5.)

For example, "in approving the fuel production pathway CI values for modified and new California facilities, CARB could modify the LCFS regulation to withhold approval unless all significant environmental impacts of a facility were adequately mitigated." In addition, CARB could require that "project proponents and operators engage in Voluntary Emission Reduction Agreements (VERAs) like those that are currently being required in the San Joaquin Valley," to ensure their emissions do not exceed a particular level.

Accordingly, the EA should be augmented to properly address the potentially significant impacts of the Proposed Amendments, and recirculated for public review.

3. Fuel Shuffling

Although the LCFS regulation and the Proposed Amendments are intended to implement the Legislature's mandate in AB 32 to reduce greenhouse gas emissions in order to address the issue of global warming, CARB has admitted that the LCFS regulation would have "little or no" impact on CO_2 emissions:

> [F]uel producers are free to ship lower-carbon fuels to areas with [LCFS] standards, while shipping higher-carbon fuels elsewhere. The end result of this fuel 'shuffling' process is little or no net change in fuel carbon content on a global scale.

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12 The EA relies upon assumptions regarding future solar steam projects and displacement of conventional jet fuel with AJF to offset emissions associated with NOx emissions from new or modified facilities. As explained above, however, the EA cannot rely upon these assumptions to offset NOx emissions from other sources. (See *supra*, § IV.B.1.)

(2009 ISOR at ES-27.) There is no environmental advantage to fuel shuffling, as the same fuels are still produced and consumed, and similar amounts of greenhouse gas are still emitted from those processes. Rather, because the LCFS regulation encourages the shipment of fuels to alternative locations that are further from origin facilities, fuel shuffling actually causes emissions of greenhouse gases to increase. Shuffling is a form of "leakage," which AB 32 requires CARB to avoid or minimize. (Health & Saf. Code, § 38562, subd. (b)(8).)

As explained in Appendix C, significant fuel shuffling is occurring at the domestic level. As Growth Energy previously predicted, shortly after the enactment of the LCFS regulation, domestic fuel providers began "rationalizing" or "shuffling" their shipments. Higher CI facilities ceased shipping to California, and instead redirected their fuel output entirely to other states. Conversely, lower CI facilities began increasing the volume of their shipments to California, resulting in a concentration of California deliveries in a limited number of low CI plants. These adjustments have continued to occur as the regulatory levels under the LCFS regulation continue to decrease, magnifying the effects of fuel shuffling.

Despite the extensive evidence of "fuel shuffling," neither the EA nor the ISOR discusses this important issue. There is no explanation in either the ISOR or the EA to suggest that fuel shuffling would not occur. Further, neither document attempts to ascertain the extent to which fuel shuffling is occurring, or seeks to quantify the increase in greenhouse gas emissions caused by the fuel shuffling. Adoption of the WSPA Alternative over the current LCFS program would, of course, avoid the leakage in greenhouse gas controls caused by the program; the ISOR and the EA do not address that important difference between the LCFS program and the WSPA Alternative.

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The EA likewise does not evaluate whether fuel shuffling caused by the Proposed Amendments would result in additional increases in criteria pollutant emissions. Because transportation of fuels by rail, truck, and sea indisputably create emissions of criteria pollutants, both inside and outside[13] California, the EA must analyze those potential impacts to determine whether they are significant. (See, e.g., *Sundstrom*, *supra*, 202 Cal.App.3d at 311 ["CEQA places the burden of environmental investigation on government rather than the public," and a lead agency "should not be allowed to hide behind its own failure to gather data."].)

Thus, to accurately identify and analyze the impacts of the Proposed Amendments, the EA must be revised to address impacts associated with fuel shuffling, and the EA should be recirculated for public review.

4. Analysis of Feasible Alternatives to the LCFS Regulation

The requirement that environmental documents identify and discuss alternatives to the project stems from the fundamental statutory policy that public agencies should require the implementation of feasible alternatives or mitigation measures to reduce the project's significant impacts. (See, e.g., Pub. Resources Code, § 21002.) The lead agency must focus on alternatives that can avoid or substantially lessen a project's significant environmental effects. (See *id.*) The CEQA Guidelines specifically recognize that comments raised by members of the public on an environmental document are particularly helpful if they suggest "additional specific alternatives . . . that would provide better ways to avoid or mitigate the significant environmental effects." (CEQA Guidelines, § 15204.)

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13 The EA analyze both in-state and out-of-state impacts caused by the Regulation. CEQA defines "environment" to include "the physical conditions that exist within the area which will be affected by a proposed project, including land, air, water, minerals, flora, fauna, noise, or objects of historic or aesthetic significance." (Public Resources Code, § 21060.5.) That definition includes no geographic limitation. We also understand CARB has considered out-of-state impacts in prior rulemakings.

The WSPA Alternative. Pursuant to Section 15126.6(c) of the CEQA Guidelines, the EA eliminates the WSPA Alternative from consideration. The alternative presented by WSPA contemplated that GHG emissions currently attributable to the LCFS program would "instead be achieved by the Assembly Bill (AB) 32 Cap and Trade program in the most cost-effective manner to address GHG emissions."[14] (EA at 207.)

The EA should not reject consideration of the WSPA Alternative, but should instead discuss the alternative and allow the Board to make the decision as to whether or not to approve the alternative instead of the Proposed Amendments. The WSPA Alternative would avoid most, if not all, of the significant impacts identified in the EA associated with the construction of new or expanded fuel production facilities in California. Because the WSPA Alternative would lessen the "significant and unavoidable" effects of the Proposed Amendments, and the LCFS regulation generally, it must include, as an alternative in a recirculated EA.[15] (Pub. Resources Code, § 21002.)

The EA, however, rejects the WSPA Alternative from inclusion as an alternative under CEQA because it would supposedly not meet the project objectives. (See EA at 208.) This is not accurate. First, the assertion that the WSPA Alternative would not reduce the CI of transportation fuels by 20% of 2010 levels by 2030 is not supported by any citation to evidence. And even if this were so, WSPA contemplates that the Cap & Trade Program would be modified to reduce the CI of transportation fuels further. Moreover, CARB has previously noted that an alternative based upon the adaptation of the Cap & Trade program would achieve the same

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14 The EA refers to this alternative as the "No LCFS Alternative," even though it actually contemplates the LCFS would be replaced by modifications to the Cap & Trade program. (See EA at 208.) Growth Energy also notes that this alternative is similar to that presented by Growth Energy in connection with the 2015 rulemaking, which CARB also impermissibly rejected.

15 It should also be noted that the WSPA Alternative would not result in fuel shuffling. (See Appendix A, Attachment 2.)

emissions reductions contemplated under the LCFS and ADF regulations. (See CARB 2015 SRIA at 26-27.)

The EA also suggests the WSPA Alternative would not promote "greater diversification of the State's fuel portfolio," or promote "greater innovation and development of cleaner fuels." (EA at 208.) Again, there is no evidence in support of these assertions. In any event, the WSPA Alternative would provide market-based incentives to diversify alternative fuels, (Appendix A, Attachment 2), which we understand CARB itself has used to promote innovation in the fuel sector. (*Id.*) The WSPA Alternative also would not modify, foreclose or otherwise eliminate any pathways to the commercialization of alternative fuels.[16]

Even if the EA could conclude that the WSPA Alternative would not meet some of the project objectives, this conclusion alone does not provide a sufficient basis to exclude consideration of the alternative. The CEQA Guidelines themselves do not require that a proposed alternative meet all of the project objectives. (CEQA Guidelines, § 15126.6(c); *Mira Mar*, *supra*, 119 Cal.App.4th at 489.) Rather, a feasible alternative that would substantially reduce the project's significant impacts should not be excluded from the analysis simply because it would not fully achieve the project's objectives.[17] (See *Habitat & Watershed Caretakers v. City of Santa Cruz* (2013) 213 Cal.App.4th 1277, 1304.) Here, as discussed above, the WSPA Alternative would essentially eliminate all of the "significant and unavoidable" impacts of the Regulations.

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16 The EA also suggests the WSPA Alternative would not reduce dependence on petroleum, or decrease volatility in oil prices. (EA at 208.) Again, there is no evidence in support of these statements in the record.

17 This is particularly true given that, in its solicitation of comments, it does not appear that it's the asserted project objectives were articulated to the public in a manner that allowed the public to use these objectives to propose feasible alternatives to CARB.

Further, to the extent the EA relies upon this objective to reject mere analysis of the WSPA Alternative, this would not be consistent with CEQA because it would essentially limit the range of alternatives described to regulations that are nearly identical to the Proposed Amendments. Because agencies may not "give a project's purpose an artificially narrow definition," (*In re Bay-Delta Programmatic Envt'l Report Coordinated Proceedings* (2008) 43 Cal.4th 1143, 1166), and we believe it is important that CARB seek to avoid any argument that it is prejudging the continued implementation of the LCFS regulation prior to completing the environmental review process, (see *POET I, supra*, 218 Cal.App.4th at 714-26), CARB should eliminate any appearance that it is artificially tailoring its objectives to limit the range of alternatives to variations of the LCFS regulation. (See, e.g., *North Coast Rivers Alliance v. Kawamura* (2015) 243 Cal.App.4th 647.)

In short, the WSPA Alternative better achieves the project objectives than the Proposed Amendments, and is environmentally superior to the project at hand. As a result, the EA must analyze the WSPA Alternative and be recirculated for public comment.

E15 Alternative. In addition to considering E15 as an alternative under the APA, the E15 Alternative should also be considered as a project alternative under CEQA. Specifically, the requirement that environmental documents identify and discuss alternatives to the project stems from the fundamental statutory policy that public agencies should require the implementation of feasible alternatives or mitigation measures to reduce the project's significant impacts. (See, e.g., Pub. Resources Code, § 21001.) As such, the lead agency must focus on alternatives that can avoid or substantially lessen a project's significant environmental effects. (Pub. Resources Code, § 21002.) The CEQA Guidelines specifically recognize that comments raised by members of the public on an environmental document are particularly helpful if they suggest "additional

specific alternatives . . . that would provide better ways to avoid or mitigate the significant environmental effects." (CEQA Guidelines, § 15204.)

In addition, Section 15043 of the CEQA Guidelines provides that a "public agency may approve a project even though the project would cause a significant effect on the environment" ***only if*** the agency makes a finding that (a) there "is no feasible way to lessen or avoid the significant effect," ***and*** (b) the benefits of the project outweigh the policy of reducing or avoiding the project's significant environmental impacts. (CEQA Guidelines, § 15043.) This is important in the context of E15 because, on the one hand, an alternative that incorporates E15 would authorize a "greater use of low CI ethanol" that would reduce greenhouse gas emissions. On the other hand, by incorporating a fuel that is already in widespread use throughout the United States, the E15 Alternative would allow existing ethanol plants to meet much of the higher demand for ethanol in E15, thus minimizing the environmental effects found "significant and unavoidable" in the EA.

In short, because the EA states the Proposed Amendments would result in "significant and unavoidable" effects due to the construction of new and/or modified facilities, and the E15 Alternative would lessen the need for such facilities, CARB should incorporate the E15 Alternative as a project alternative under CEQA, and approve the E15 alternative instead of the Proposed Amendments. (See CEQA Guidelines, § 15043.)

The EA Should Consider Alternatives Other than the Continuation of the LCFS. The EA does not discuss a reasonable range of alternatives. Specifically, each of the project alternatives identified in the EA is simply some iteration of the LCFS regulation. Alternative 1 is the continuation of the existing LCFS; Alternative 2 is a version of the LCFS with greater CI reductions; Alternative 3 is the LCFS without biodiesel; Alternative 4 is the LCFS without the

Carbon Capture and Sequestration Protocol; and Alternative 5 is the LCFS without alternative jet fuels. This does not represent a reasonable range of alternatives because none of the alternatives contemplates a regulation that does not substantially resemble the current LCFS.

To range of alternatives should be expanded to ensure compliance with CEQA. By limiting the alternatives to minor variations to the same project, the EA does not promote informed decision-making and public participation, (CEQA Guidelines, § 16126.6, subds. (a)-(f); *Bay Area Citizens v. Assoc. of Bay Area Govts.* (2016) 248 Cal.App.4th 966, 1018; *Fed. of Hillside & Cyn. Ass'ns, supra*, 83 Cal.App.4th at 1264), and essentially makes the continuation of the LCFS a predetermined outcome. This is particularly true given that the "no project" alternative contemplates a continuation of the LCFS regulation in its current form.

To avoid the danger of what now appears to be irreversible momentum associated with the continuation of the LCFS regulation,[18] the range of alternatives should be expanded to include an alternative that does not involve continuation of the LCFS regulation.

The EA's Formulation of Project Objectives. To the extent the EA relies upon the project objectives to reject ***all*** alternatives other than the continuation of the LCFS, the project objectives are far too narrowly drawn. CEQA requires that an environmental document include a statement of project objectives to help identify the purpose of a project. (See, e.g., CEQA Guidelines, § 15124(b); *Ctr. for Biological Diversity v. County of San Bernardino* (2016) 247 Cal.App.4th 326, 347.) The project objectives are used, *inter alia*, to evaluate the mitigation measures and alternatives identified in the environmental document. (See, e.g., CEQA

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18 *Cf. POET II, supra*, 12 Cal.App.5th 52, 96 ["Plaintiffs' arguments about bureaucratic momentum are realistic and have some merit."]; *Bakersfield Citizens for Local Control v. City of Bakersfield* (2004) 124 Cal.App.4th 1184, 1203 ["Has the danger of irreversible momentum in favor of the shopping centers . . . been realized?"] [citing *San Joaquin Raptor, supra*, 27 Cal.App.4th at 742].

Guidelines, §§ 15126(a), 15126.4(a)(1).) While agencies have some discretion in formulating a project's objectives, CEQA prohibits a lead agency from giving "a project's purpose an artificially narrow definition." (*Bay–Delta, supra,* 43 Cal.4th at 1166; see also *North Coast Rivers Alliance*, *supra*, 243 Cal.App.4th at 668.)

Since 2009, CARB has used its narrowly-drawn project objectives to reject project alternatives that would have reduced the environmental effects of the LCFS regulation. In this rulemaking, the EA again relies upon narrow project objectives, (see EA at 200), to reject alternatives other than some iteration of the LCFS. (*Cf.* EA at 201-07 *with id.* at 207-08.) To avoid an inference that the continuation of the LCFS program is a foregone conclusion, the project objectives should be aligned with the statutory objectives identified in AB 32 and SB 32 to allow alternatives in the EA other than variations of the LCFS program.

5. Accuracy of CIs of Various Alternative Fuels under the LCFS Regulation

As explained above, if CARB implements an LCFS program that inaccurately states the CI for any particular fuel, this will send the wrong "signal" to the downstream regulated parties, resulting in the use of fuels that result in higher GHG emissions. For example, if CARB overestimates the CI for an alternative fuel, it disincentivizes the use of that fuel in favor of other fuels with higher carbon intensity, increasing GHG emissions beyond what they would be under a more accurate LCFS regulation. Alternatively, if CARB underestimates the CI of alternative fuel or electricity, it encourages the use of a more carbon-intensive fuel at the expense of other fuels with lower carbon intensity, likewise increasing GHG emissions. Thus, to avoid unnecessary GHG emissions, it is critically important that CARB accurately calculate the CI of alternative fuels and electricity.

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It does not appear that the Proposed Amendments contemplate an accurate CI for corn starch ethanol, which remains far higher than the evidence supports. Likewise, the CI for Brazilian sugarcane ethanol and electricity are significantly understated. To avoid unnecessary GHG emissions, CARB must correct each of the issues below:

- As explained above and in Appendix D, using CARB's AEZ-EF model in conjunction with GTAP to estimate emissions associated with the various land use changes, researchers have determined that the ILUC for corn starch ethanol should be reduced from 19.8 g/MJ to 10.3 g/MJ. (See *supra*, § II.A.)
- The current ILUC for corn starch ethanol is based on 2011 conditions, which correspond to a drought year in the U.S. that negatively impacted corn yields. When a three-year average is used, the ILUC should be reduced significantly. (See *supra*, § II.A; see also Appendix E.)
- Unlike the Proposed Amendments, the most current version of the GREET model includes a distillers' grains (DDG) methane avoidance credit, which equals 2.1 g/MJ, and which is not incorporated into CA GREET 3.0 under the Proposed Amendments. (See *supra*, § II.A; see also Appendix E.)
- The CI for corn starch ethanol under CA GREET 3.0 contains a value for the electricity that is used in transportation and distribution with an emission factor developed using US average power, even though most such emissions are likely to be in California. (See *supra*, § II.B; see also Appendix E.)

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- The CI for sugarcane does not include GHG emissions associated with ash that is trucked out to sugarcane fields and distributed on the ground to add nutrients back to the soil. (See *supra*, § II.A; see also Appendix D.)
- The CI for sugarcane is understated because the nitrogen content of biomass and fertilizer for sugarcane are far higher than estimated by CARB. (See *supra*, § II.A; see also Appendix E.)
- CA GREET 3.0 uses the same emission factor for truck transport in Brazil and California, even though Brazil should be higher. (See *supra*, § II.A; see also Appendix D.)
- CA GREET 3.0 uses simplified calculators for corn ethanol and sugarcane ethanol that contain several errors. Unless corrected, the CI for sugarcane ethanol will be understated, and the CI for corn will be overstated. (See *supra*, § II. A.; See also Appendix F.)
- The EER for electricity is far too high because the estimates were generated based on testing performed with accessory modes off. (See *supra*, § II.C; see also Appendix B.)
- The EER for electricity is also too high because it is based on optimal temperature (75°-80°) for battery efficiency, and not real world conditions. (See *supra*, § II.C; see also Appendix B.)
- The EERs for numerous vehicles are overstated. (See *supra*, § II.C; see also Appendix B at 13.)

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- The Proposed Amendments do not allow CI reduction for dedicated renewable electricity unless the generation facilities are co-located with the fuel production facility, removing incentives for fuel producers to develop renewable sources for process energy. Elsewhere, the ISOR states the goal of "incent[ing] the installation of additional low carbon electricity supply" would result in greater greenhouse gas benefits. (ISOR at EX-5.) As such, CARB should consider the impacts associated with not applying the same rules to process energy for fuel providers.

Each of the above issues has a material impact on the CI for the affected fuel. Cumulatively, correction of the above issues changes the CI dramatically. Thus, to avoid unnecessary increases in GHGs, CARB should resolve the above issues prior to certifying the EA and approving the Proposed Amendments.

6. The EA's Identification of Mitigation Measures

Attachment 2 to the EA includes a summary of environmental impacts and mitigation measures. (See EA, Attachment 2.) The document is structured in a manner similar to a Mitigation Monitoring and Reporting Program, although that is not what the attachment is entitled. Attachment 2, among other things, summarizes the mitigation measures identified in the EA. Each of the proposed mitigation measures should be augmented to ensure compliance with CEQA.

Legally Enforceable Mitigation Measures. As explained above, CEQA requires mitigation measures to be enforceable through means that are legally binding. (Pub. Resources Code, § 21081.6(b); CEQA Guidelines, § 15126.4.) This requirement is designed to ensure that mitigation measures will actually be implemented. (*Fed. of Hillside & Cyn. Ass'ns*, *supra*, 83

Cal.App.4th at 1261; *Anderson First*, *supra*, 130 Cal.App.4th at 1186.) The following mitigation measures do not represent binding commitments on the part of any person to do anything and therefore fail to ensure that mitigation measures will actually be implemented:

- Mitigation Measure B.1.a states that project proponents "would" take various actions in coordination with State or local land use agencies in seeking entitlements for development. There is nothing in Mitigation Measure B.1.a, however, that ensures the measures identified will actually be implemented. (EA, Attachment 2 at 1-2.)
- Mitigation Measure B.2.a merely states that "actions required to mitigate potentially significant . . . impacts ***may*** include the following actions." (*Id.* at 3.) Several actions are then stated in suggestive terms; however, none of the actions are required to be implemented. Nor are any mandatory performance standards articulated to assess the expected outcome of the measure. (*Id.* at 3-4.)
- Mitigation Measures B.4.a, B.5.a, C.6.b, B.7.a, B.9.a, B.10.a, C.12.b, 13.a, 17.a, B.18.a, merely state that "actions required to mitigate potentially significant . . . impacts ***may*** include the following; however, ***any mitigation specifically required*** for a new or modified facility ***would be determined by the local lead agency.***" (*Id.* at 10, 13 [emphasis added].) There is nothing in any of the above-referenced mitigation measures, however, that ensures the measures identified will actually be implemented.

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- Mitigation Measures B.7.b and C.12.b merely identify "[r]ecognized practices that are routinely required to avoid and/or minimize impacts." (*Id.* at 20, 35.) But they do not require that those practices actually be implemented.
- Mitigation Measures B.10.b and B.17.b merely identify various activities without requiring that the activities actually be performed. (*Id.* at 29-30, 43-44.)

Deferral of Mitigation. The formulation of specific mitigation measures may properly be deferred only if the mitigation measures specify performance standards for mitigating the impact. (See CEQA Guidelines, § 15126.4(a)(1)(B); see also *Sacramento Old City Ass'n v. City Council* (1991) 229 Cal.App.3d 1011; *Endangered Habitats League, Inc. v. County of Orange* (2005) 131 Cal.App.4th 777, 794 [upholding measures that included specific performance criteria and mitigation commitments and rejecting measure that lacked any criteria or standards].) A mitigation performance standard is sufficient if it identifies the criteria the agency will apply in determining that the impact will be mitigated. (See, e.g., *Citizens for a Sustainable Treasure Island v. City & County of San Francisco* (2014) 227 Cal.App.4th 1036, 1059.) Performance standards based on specific objectives that inform the agency "what it is to do and what it must accomplish" are adequate, (see *Center for Biological Diversity, supra*, 234 Cal.App.4th at 245), but "loose or open-ended performance criteria" are not. (*Rialto Citizens for Responsible Growth v. City of Rialto* (2012) 208 Cal.App.4th 899, 945.) The following mitigation measures appear to defer the formulation of specific mitigation measures because they do not include adequate performance criteria:

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- Mitigation Measures B.4.a, B.5.a, C.6.b, B.7.a, B.9.a, B.10.a, C.12.b, 13.a, 17.a, B.18.a, merely state that "actions required to mitigate potentially significant. . . impacts ***may*** include the following; however, ***any mitigation specifically required*** for a new or modified facility ***would be determined by the local lead agency.***" (EA, Attachment 2 at 10, 13 [emphasis added].) No performance standards are articulated to assess the expected outcome of these measures.

- Mitigation Measure B.3.a and B.3.b state that future project proponents "would" apply for and secure all necessary permits and comply with all applicable regulations. However, no performance standards are articulated to assess the expected outcome of these measures. (EA, Attachment 2 at 6-7.)

- Mitigation Measures 7.c, C.9.b, and 10.c.(1) merely identify various permits and agreements that "could" reduce environmental impacts, state that to obtain such permits, "the project proponent would be required to conduct various evaluations," and then identifies requirements such permits are "likely to include." (*Id.* at 21-22, 25-26.) However, no performance standards are articulated to assess the expected outcome of these measures. Curiously, the measures also state at the end that "this impact could be reduced," without providing any explanation as to how, or

if so, why additional measures are not being implemented. (*Id.* at 22, 26.)[19]

Several Mitigation Measures in Attachment 2 Are Inadequately Defined. Courts have held that mitigation measures that are so undefined that it is impossible to gauge their effectiveness are not adequate under CEQA. (See, e.g., *Preserve Wild Santee v. City of Santee* (2012) 210 Cal.App.4th 260, 281.) The mitigation measure for Impact B.11.a simply states "See Mitigation Measures: 2.a, 2.b, 4.a, 4.b, 8.b, and 10.a." It cannot be determined based on this statement to which mitigation measures the analysis is referring the reader. The same error is repeated in the discussion of Impacts C.11.a, B.11.b, and C.11.b. (See EA, Attachment 2 at 32-33.)

Further, despite the title of Attachment 2 to the EA ["Summary of Environmental Impacts and Mitigation Measures"], it is not clear whether these measures would be used to mitigate any environmental impacts. Instead, the information in Attachment 2 appears to be legal argument, as opposed to mitigation to lessen significant environmental impacts.

V. INCORPORATION OF PRIOR COMMENTS

Growth Energy notes that many of the comments that it submitted in connection with the 2015 rulemaking for the LCFS regulation and the ADF regulation remain relevant to this 2018 rulemaking. As such, Growth Energy is also enclosing its prior comments, and the supporting technical data, in electronic format.

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19 Unlike the other measures, Mitigation Measure 10.c.(1) states "this impact could be reduced to a less than significant level." (EA, Attachment 2 at 32.) In the next sentence, however, Attachment 2 states that "there is inherent uncertainty in the degree of mitigation ultimately implemented to reduce the potentially significant impacts." (*Id.*) These two statements do not appear to be consistent, and should be reconciled.

VI. CONCLUSION

Growth Energy appreciates the opportunity to participate in this rulemaking. Growth Energy, however, continues to have significant concerns regarding the LCFS regulation and the Proposed Amendments. As a result, Growth Energy requests that CARB staff augment the ISOR (and its appendices) to fully address and consider meaningful alternatives to the LCFS regulation (including the WSPA Alternative and the E15 Alternative). Growth Energy also requests that the ISOR also address each of the other issues raised in these comments in a revised ISOR. Following these revisions, CARB should recirculate the ISOR for public comment.

APPENDIX "A"

STATE OF CALIFORNIA

BEFORE THE AIR RESOURCES BOARD

Declaration of James M. Lyons

I, James Michael Lyons, declare as follows:

1. I make this Declaration based upon my own personal knowledge and my familiarity with the matters recited herein. It is based on my experience of nearly 30 years as a regulator, consultant, and professional in the field of emissions and air pollution control. A copy of my résumé can be found in **Attachment 1**.

2. I am a Principal Consultant of Trinity Consultants, an environmental consulting firm with offices located at 1801 J Street, Sacramento, California. Among other things, Trinity specializes in research and regulatory matters pertaining to air pollution control, and does work for both governmental and private industry clients. I have been employed at Trinity and its predecessors since 1991. I received a B.S. degree in Chemistry from the University of California, Irvine, and a M.S. Degree in Chemical Engineering from the University of California, Los Angeles. Before joining Sierra in 1991, I was employed by the State of California at the Mobile Source Division of the California Air Resources Board (CARB).

3. During my career, I have worked on many projects related to the following areas: 1) the assessment of emissions from on- and non-road mobile sources, 2) assessment of the impacts of changes in fuel composition and alternative fuels on engine emissions including emissions of green-house gases, 3) analyses of the unintended consequences of regulatory actions, and 4) the feasibility of compliance with air quality regulations.

4. I have testified as an expert under state and federal court rules in cases involving CARB regulations for gasoline, Stage II vapor recovery systems and their design, factors affecting emissions from diesel vehicles, evaporative emission control system design and function, as well as combustion chamber system design. While at Sierra I have acted as a consultant on automobile air pollution control matters for CARB and for the United States Environmental Protection Agency. I am a member of the American Chemical Society and the Society of Automotive Engineers and have co-authored nine peer-reviewed monographs concerned with automotive emissions, including greenhouse gases and their control. In addition, over the course of my career, I have conducted peer-reviews of numerous papers related to a wide variety of issues associated with pollutant emissions and air quality.

5. This Declaration summarizes the results of my review of the CARB's Staff Report: Initial Statement of Reasons, and related documents, concerning the Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels, which was released for

public review on March 6, 2018 (the "ISOR"). I have performed this review as an independent expert for Growth Energy. If called upon to do so, I would testify in accord with the facts and opinions presented here.

6. I have prepared several documents analyzing aspects ISOR, and the proposed amendments to the LCFS regulation and the ADF regulation (the "Proposed Amendments"), which are included as attachments to this declaration:

a. Attached hereto as **Attachment 2** is a true and correct copy of the document I prepared containing an analysis of cap & trade alternatives to the LCFS regulation, including the proposed alternative presented by Western States Petroleum Association.

b. Attached hereto as **Attachment 3** is a true and correct copy of the document I prepared containing the presentation of an alternative to the LCFS regulation for use in CARB's analysis of alternatives under the APA and CEQA. This alternative contemplates the continuation of the LCFS regulation, with the inclusion of the certification of E15. The inclusion of E15 into the LCFS regulation would lessen the significant and unavoidable effects associated with the construction of new or modified facilities, and would also achieve the greenhouse emissions reductions desired by CARB.

c. Attached hereto as **Attachment 4** is a true and correct copy of the document I prepared containing my review of issues relating to the analysis of biodiesel use in California under the LCFS program.

d. Attached hereto as **Attachment 5** is a true and correct copy of the document I prepared containing an analysis of potential impacts associated with new and modified facilities associated with the LCFS regulation, including potential mitigation.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed this 26th day of April, 2018 at Sacramento, California.

JAMES M. LYONS

Declaration of James M. Lyons

Attachment 1

James Lyons

Principal Consultant **– Sacramento Office**

Trinity Consultants

AREAS OF SPECIALIZATION

- New Vehicle and Engine Certification
- Development and Assessment of Mobile Source Emission Control Strategies
- Development and Assessment of Strategies for Reduction of Criteria Pollutant and GHG Emissions Related to Transportation Fuels – Including Alternative Fuels and Fuel Additives
- Design and Implementation of Vehicle Testing Programs and Data Analysis
- Enforcement and Litigation Support Related to Mobile Sources and Transportation Fuels
- Intellectual Property Disputes Involving Engine and Emission Control System Design, Function, and Novelty
- Tracking and Reporting of California Air Resources Board Activities Related to the Regulation of Mobile Source Emissions and Transportation Fuels
- Emission Inventories and Quantification

EDUCATION

M.S., Chemical Engineering, University of California, Los Angeles

B.S., Cum Laude, Chemistry, University of California, Irving

AFFILIATIONS

Society of Automotive Engineers

American Chemical Society

SUMMARY OF EXPERIENCE

A Principal Consultant and head of Trinity's Mobile Source and Fuels team, Mr. Lyons has extensive experience related to fuels issues and emissions, including the emission impacts of changes in gasoline and diesel fuel composition and substitution of alternative fuels for petroleum-based fuels. Specific projects have required work on issues related to the emissions impacts of changes in gasoline and diesel fuel as well as compliance with California Air Resources Board (CARB) and U.S. EPA regulations related to gasoline and diesel fuel properties and specifications, assessment of costs and benefits of alternative fuels and alternatively fueled vehicles, and direct involvement in analyses of issues related to CARB and EPA fuels regulations, including the Renewable Fuel Standards (RFS) and Low Carbon Fuel Standards. He has also provided expert services in fuels-related litigations.

Additional responsibilities include oversight and execution of complex analyses of the emission benefits, costs, and cost-effectiveness of mobile source air pollution control measures. Mr. Lyons has developed particular expertise with respect to the assessment of control measures involving accelerated vehicle/engine retirement programs; the deployment of advanced emission control systems, including electric fuel cell and hybrid technologies for on- and non-road gasoline- and diesel-powered vehicles and engines, as well as on-vehicle evaporative and refueling emission control systems. Other duties include assessments of the activities of federal, state, and local regulatory agencies with respect to motor vehicle emissions and reports to clients regarding those activities. Mr. Lyons has extensive litigation experience related to air quality and fuels including gasoline property and renewable fuels regulations, product liability, and intellectual property issues.

TECHNICAL EXPERTISE

Fuels Regulations. Managed numerous projects related to assessments of Low Carbon Fuel Standard (LCFS) regulations adopted or being prepared by California and a number of other jurisdictions. Has also been involved in the review of reformulated gasoline and diesel fuel regulations, including the federal RFS 1, RFS 2, and Tier 3 regulations.

Mobile Source Emissions Control. Participated in the design and evaluation of mobile source emission control measures and emission control systems; development of mobile source emissions modeling software; development of mobile source emission inventories; design and management of supporting field and laboratory studies; and the design and evaluation of vehicle emissions inspection and maintenance programs. Mobile source categories include on- and off-road vehicles, locomotives, marine vessels, and aircraft. Directly involved in assessing changes in vehicle technology required to comply

with federal, California, and Mexican new-vehicle greenhouse gas and fuel economy standards for light-duty vehicles.

New Vehicle and Engine Certification. Directly participated in and managed efforts related to obtaining U.S. EPA and California Air Resources Board certification for new engines and vehicles, including activities related to agency enforcement actions and on-going compliance requirements.

Air Quality Planning and Strategy Development. Has been involved in the development and critical assessment of mobile source and transportation fuels elements of State Implementation Plans.

Emission Control System Design and Evaluation. Provided support for the design and assessment of alternative emission control techniques, and for troubleshooting control system issues. Issues assessed have include VOC, CO, NOx, SOx, and PM control systems in various applications.

Expert Witness Services. Presented testimony and served as an expert or consulting expert on numerous cases in federal and state courts involving issues related to government regulations affecting mobile source certifications, in-use emissions issues, fuel regulations, intellectual property issues related to emission controls and fuels, and product liability.

EMPLOYMENT HISTORY

2014 – Present Trinity Consultants
1991 – 2014 Sierra Research
1985 – 1991 California Air Resources Board

SELECTED PUBLICATIONS (AUTHOR OR CO-AUTHOR)

"Follow-On Study of Transportation Fuel Life Cycle Analysis: Review of Current CARB and EPA Estimates of Land Use Change (LUC) Impacts," Sierra Research Report No. SR2016-08-01, prepared for the Coordinating Research Council, CRC Project No. E-88-3b, August 2016.

"Review of EPA's MOVES2014 Model," Sierra Research Report No. SR2016-07-01, prepared for the Coordinating Research Council, CRC Project No. E-101, July 2016.

"Development of Vehicle Attribute Forecasts for the '2015 Integrated Energy Policy Report,'" prepared for the California Energy Commission, February 5, 2016.

"Sensitivity Analysis of Key Assumptions on Energy and Environmental Economics (E3) 'California Pathways GHG Scenario Results' as They Pertain to the Light-Duty Vehicle Sector," prepared for the Alliance of Automobile Manufacturers, October 2015.

"Review of Energy and Environmental Economics (E3) "California Pathways GHG Scenario Results" as They Pertain to the Light-Duty Vehicle Sector," prepared for the Alliance of Automobile Manufacturers, October 2015.

"International Light-Duty Vehicle Fuel Economy and Greenhouse Gas Standards Analysis," prepared for the Alliance of Automobile Manufacturers, July 2015.

"Quantifying Aircraft Lead Emissions at Airports," prepared for the Transportation Research Board, Airport Cooperative Research Program, October 2014.

"Best Practices Guidebook for Preparing Lead (Pb) Emission Inventories from Piston-Powered Aircraft," prepared for the Transportation Research Board, Airport Cooperative Research Program, October 2014.

"Development of Vehicle Attribute Forecasts for 2013 IEPR," Sierra Research Report No. SR2014-01-01, prepared for the California Energy Commission, January 2014.

"Assessment of the Emission Benefits of U.S. EPA's Proposed Tier 3 Motor Vehicle Emission and Fuel Standards," Sierra Research Report No. SR2013-06-01, prepared for the American Petroleum Institute, June 2013.

"Development of Inventory and Speciation Inputs for Ethanol Blends," Sierra Research Report No. SR2012-05-01, prepared for the Coordinating Research Council, Inc. (CRC), May 2012.

"Review of CARB Staff Analysis of 'Illustrative' Low Carbon Fuel Standard (LCFS) Compliance Scenarios," Sierra Research Report No. SR2012-02-01, prepared for the Western States Petroleum Association, February 20, 2012.

"Review of CARB On-Road Heavy-Duty Diesel Emissions Inventory," Sierra Research Report No. SR2010-11-01, prepared for The Ad Hoc Working Group, November 2010.

"Identification and Review of State/Federal Legislative and Regulatory Changes Required for the Introduction of New Transportation Fuels," Sierra Research Report No. SR2010-08-01, prepared for the American Petroleum Institute, August 2010.

"Technical Review of EPA Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis for Non-GHG Pollutants," Sierra Research Report No. SR2010-05-01, prepared for the American Petroleum Institute, May 2010.

"Effects of Gas Composition on Emissions from Heavy-Duty Natural Gas Engines," Sierra Research Report No. SR2010-02-01, prepared for the Southern California Gas Company, February 2010.

"Effects of Gas Composition on Emissions from a Light-Duty Natural Gas Vehicle," Sierra Research Report No. SR2009-11-01, prepared for the Southern California Gas Company, November 2009.

"Technical Review of 2009 EPA Draft Regulatory Impact Analysis for Non-GHG Pollutants Due to Changes to the Renewable Fuel Standard," Sierra Research Report No. SR2009-09-01, prepared for the American Petroleum Institute, September 2009.

"Effects of Vapor Pressure, Oxygen Content, and Temperature on CO Exhaust Emissions," Sierra Research Report No. 2009-05-03, prepared for the Coordinating Research Council, May 2009.

"Technical Review of 2007 EPA Regulatory Impact Analysis Methodology for the Renewable Fuels Standard," Sierra Research Report No. 2008-09-02, prepared for the American Petroleum Institute, September 2008.

"Impacts of MMT Use in Unleaded Gasoline on Engines, Emission Control Systems, and Emissions," Sierra Research Report No. 2008-08-01, prepared for McMillan Binch Mendelsohn LLP, Canadian Vehicle Manufacturers' Association, and Association of International Automobile Manufacturers of Canada, August 2008.

"Attachment to Comments Regarding the NHTSA Proposal for Average Fuel Economy Standards Passenger Cars and Light Trucks Model Years 2011-2015, Docket No. NHTSA-2008-0089," Sierra Research Report No. SR2008-06-01, prepared for the Alliance of Automobile Manufacturers, June 2008.

"Evaluation of California Greenhouse Gas Standards and Federal Energy Independence and Security Act – Part 1: Impacts on New Vehicle Fuel Economy," SAE Paper No. 2008-01-1852, Society of Automotive Engineers, 2008.

"Basic Analysis of the Cost and Long-Term Impact of the Energy Independence and Security Act Fuel Economy Standards," Sierra Research Report No. SR 2008-04-01, April 2008.

"The Benefits of Reducing Fuel Consumption and Greenhouse Gas Emissions from Light-Duty Vehicles," SAE Paper No. 2008-01-0684, Society of Automotive Engineers, 2008.

"Assessment of the Need for Long-Term Reduction in Consumer Product Emissions in South Coast Air Basin," Sierra Research Report No. 2007-09-03, prepared for the Consumer Specialty Products Association, September 2007.

"Summary of Federal and California Subsidies for Alternative Fuels," Sierra Research Report No. SR2007-04-02, prepared for the Western States Petroleum Association, April 2007.

"Analysis of IRTA Report on Water-Based Automotive Products," Sierra Research Report No. SR2006-08-02, prepared for the Consumer Specialty Projects Association and Automotive Specialty Products Alliance, August 2006.

"Evaluation of Pennsylvania's Implementation of California's Greenhouse Gas Regulations on Criteria Pollutants and Precursor Emissions," Sierra Research Report No. SR2006-04-01, prepared for Alliance of Automobile Manufacturers, April 12, 2006.

"Evaluation of New Jersey's Adoption of California's Greenhouse Gas Regulations on Criteria Pollutants and Precursor Emissions," Sierra Research Report No. SR2005-09-03, prepared for the Alliance of Automobile Manufacturers, September 30, 2005.

"Evaluation of Vermont's Adoption of California's Greenhouse Gas Regulations on Criteria Pollutants and Precursor Emissions," Sierra Research Report No. SR2005-09-02, prepared for the Alliance of Automobile Manufacturers, September 19, 2005.

"Assessment of the Cost-Effectiveness of Compliance Strategies for Selected Eight-Hour Ozone NAAQS Nonattainment Areas," Sierra Research Report No. SR2005-08-04, prepared for the American Petroleum Institute, August 30, 2005.

"Evaluation of Connecticut's Adoption of California's Greenhouse Gas Regulations on Criteria Pollutants and Precursor Emissions," Sierra Research Report No. SR2005-08-03, prepared for the Alliance of Automobile Manufacturers, August 26, 2005.

"Evaluation of New York's Adoption of California's Greenhouse Gas Regulations On Criteria Pollutants and Precursor Emissions," Sierra Research Report No. SR2005-07-04, prepared for the Alliance of Automobile Manufacturers, July 14, 2005.

"Review of MOVES2004," Sierra Research Report No. SR2005-07-01, prepared for the Alliance of Automobile Manufacturers, July 11, 2005.

"Review of Mobile Source Air Toxics (MSAT) Emissions from On-Highway Vehicles: Literature Review, Database, Development, and Recommendations for Future Studies," Sierra Research Report No. SR2005-03-01, prepared for the American Petroleum Institute, March 4, 2005.

"The Contribution of Diesel Engines to Emissions of ROG, NOx, and PM2.5 in California: Past, Present, and Future," Sierra Research Report No. SR2005-02-01, prepared for Diesel Technology Forum, February 2005.

"Fuel Effects on Highway Mobile Source Air Toxics (MSAT) Emissions," Sierra Research Report No. SR2004-12-01, prepared for the American Petroleum Institute, December 23, 2004.

"Review of the August 2004 Proposed CARB Regulations to Control Greenhouse Gas Emissions from Motor Vehicles: Cost Effectiveness for the Vehicle Owner or Operator – Appendix C to the Comments of The Alliance of Automobile Manufacturers," Sierra Research Report No. SR2004-09-04, prepared for the Alliance of Automobile Manufacturers, September 2004.

"Emission and Economic Impacts of an Electric Forklift Mandate," Sierra Research Report No. SR2003-12-01, prepared for National Propane Gas Association,
December 12, 2003.

"Reducing California's Energy Dependence," Sierra Research Report No. SR2003-11-03, prepared for Alliance of Automobile Manufacturers, November 25, 2003.

"Evaluation of Fuel Effects on Nonroad Mobile Source Air Toxics (MSAT) Emissions: Literature Review, Database Development, and Recommendations for Future Studies," Sierra Research Report No. SR2003-10-01, prepared for American Petroleum Institute, October 3, 2003.

"Review of Current and Future CO Emissions from On-Road Vehicles in Selected Western Areas," Sierra Research Report No. SR03-01-01, prepared for the Western States Petroleum Association, January 2003.

"Review of CO Compliance Status in Selected Western Areas," Sierra Research Report No. SR02-09-04, prepared for the Western States Petroleum Association, September 2002.

"Impacts Associated With the Use of MMT as an Octane Enhancing Additive in Gasoline – A Critical Review", Sierra Research Report No. SR02-07-01, prepared for Canadian Vehicle Manufacturers Association and Association of International Automobile Manufacturers of Canada, July 24, 2002.

"Critical Review of 'Safety Oversight for Mexico-Domiciled Commercial Motor Carriers, Final Programmatic Environmental Assessment', Prepared by John A Volpe Transportation Systems Center, January 2002," Sierra Research Report No. SR02-04-01, April 16, 2002.

"Critical Review of the Method Used by the South Coast Air Quality Management District to Establish the Emissions Equivalency of Heavy-Duty Diesel- and Alternatively Fueled Engines", Sierra Research Report No. SR01-12-03, prepared for Western States Petroleum Association, December 21, 2001.

"Review of U.S. EPA's Diesel Fuel Impact Model", Sierra Research Report No. SR01-10-01, prepared for American Trucking Associations, Inc., October 25, 2001.

"Operation of a Pilot Program for Voluntary Accelerated Retirement of Light-Duty Vehicles in the South Coast Air Basin," Sierra Research Report No. SR01-05-02, prepared for California Air Resources Board, May 2001.

"Comparison of Emission Characteristics of Advanced Heavy-Duty Diesel and CNG Engines," Sierra Report No. SR01-05-01, prepared for Western States Petroleum Association, May 2001.

"Analysis of Southwest Research Institute Test Data on Inboard and Sterndrive Marine Engines," Sierra Report No. SR01-01-01, prepared for National Marine Manufacturers Association, January 2001.

"Institutional Support Programs for Alternative Fuels and Alternative Fuel Vehicles in Arizona: 2000 Update," Sierra Report No. SR00-12-04, prepared for Western States Petroleum Association, December 2000.

"Real-Time Evaporative Emissions Measurement: Mid-Morning Commute and Partial Diurnal Events," SAE Paper No. 2000-01-2959, October 2000.

"Evaporative Emissions from Late-Model In-Use Vehicles," SAE Paper No. 2000-01-2958, October 2000.

"A Comparative Analysis of the Feasibility and Cost of Compliance with Potential Future Emission Standards for Heavy-Duty Vehicles Using Diesel or Natural Gas," Sierra Research Report No. SR00-02-02, prepared for Californians For a Sound Fuel Strategy, February 2000.

"Critical Review of the Report Entitled 'Economic Impacts of On Board Diagnostic Regulations (OBD II)' Prepared by Spectrum Economics," Sierra Research Report No. SR00-01-02, prepared for the Alliance of Automobile Manufacturers, January 2000.

"Potential Evaporative Emission Impacts Associated with the Introduction of Ethanol-Gasoline Blends in California," Sierra Research Report No. SR00-01-01, prepared for the American Methanol Institute, January 2000.

"Evaporative Emissions from Late-Model In-Use Vehicles," Sierra Research Report No. SR99-10-03, prepared for the Coordinating Research Council, October 1999.

"Investigation of Sulfur Sensitivity and Reversibility in Late-Model Vehicles," SAE Paper No. 1999-01-3676, August 1999.

"Future Diesel-Fueled Engine Emission Control Technologies and Their Implications for Diesel Fuel Properties," Sierra Research Report No. SR99-08-01, prepared for the American Petroleum Institute, August 1999.

"Analysis of Compliance Feasibility under Proposed Tier 2 Emission Standards for Passenger Cars and Light Trucks," Sierra Research Report No. SR99-07-02, July 1999.

"Comparison of the Properties of Jet A and Diesel Fuel," Sierra Research Report No. SR99-02-01, prepared for Pillsbury Madison and Sutro, February 1999.

"Investigation of Sulfur Sensitivity and Reversibility in Late-Model Vehicles," Sierra Research Report No. SR98-12-02, prepared for the American Petroleum Institute, December 1998.

"Analysis of New Motor Vehicle Issues in the Canadian Government's Foundation Paper on Climate Change – Transportation Sector," Sierra Research Report No. SR98-12-01, prepared for the Canadian Vehicle Manufacturers Association, December 1998.

"Investigation of the Relative Emission Sensitivities of LEV Vehicles to Gasoline Sulfur Content - Emission Control System Design and Cost Differences," Sierra Research Report No. SR98-06-01, prepared for the American Petroleum Institute, June 1998.

"Costs, Benefits, and Cost-Effectiveness of CARB's Proposed Tier 2 Regulations for Handheld Equipment Engines and a PPEMA Alternative Regulatory Proposal," Sierra Research Report No. SR98-03-03, prepared for the Portable Power Equipment Manufacturers Association, March 1998.

"Analysis of Diesel Fuel Quality Issues in Maricopa County, Arizona," Sierra Research Report No. SR97-12-03, prepared for the Western States Petroleum Association, December 1997.

"Potential Impact of Sulfur in Gasoline on Motor Vehicle Pollution Control and Monitoring Technologies," prepared for Environment Canada, July 1997.

"Analysis of Mid- and Long-Term Ozone Control Measures for Maricopa County," Sierra Research Report No. SR96-09-02, prepared for the Western States Petroleum Association, September 9, 1996.

"Technical and Policy Issues Associated with the Evaluation of Selected Mobile Source Emission Control Measures in Nevada," Sierra Research Report No. SR96-03-01, prepared for the Western States Petroleum Association, March 1996.

"Cost-Effectiveness of Stage II Vapor Recovery Systems in the Lower Fraser Valley," Sierra Research Report No. SR95-10-05, prepared for the Province of British Columbia Ministry of Environment Lands and Parks and the Greater Vancouver Regional District, October 1995.

"Cost of Stage II Vapor Recovery Systems in the Lower Fraser Valley," Sierra Research Report No. SR95-10-04, prepared for the Province of British Columbia Ministry of Environment Lands and Parks and the Greater Vancouver Regional District, October 1995.

"A Comparative Characterization of Gasoline Dispensing Facilities With and Without Vapor Recovery Systems," Sierra Research Report No. SR95-10-01, prepared for the Province of British Columbia Ministry of Environment Lands and Parks, October 1995.

"Potential Air Quality Impacts from Changes in Gasoline Composition in Arizona," Sierra Research Report No. SR95-04-01, prepared for Mobil Corporation, April 1995.

"Vehicle Scrappage: An Alternative to More Stringent New Vehicle Standards in California," Sierra Research Report No. SR95-03-02, prepared for Texaco, Inc., March 1995.

"Evaluation of CARB SIP Mobile Source Measures," Sierra Research Report No. SR94-11-02, prepared for Western States Petroleum Association, November 1994.

"Reformulated Gasoline Study," prepared by Turner, Mason & Company, DRI/McGraw-Hill, Inc., and Sierra Research, Inc., for the New York State Energy Research and Development Authority, Energy Authority Report No. 94-18, October 1994.

"Phase II Feasibility Study: Heavy-Duty Vehicle Emissions Inspection Program in the Lower Fraser Valley," Sierra Research Report No. SR94-09-02, prepared for the Greater Vancouver Regional District, September 1994.

"Cost-Effectiveness of Mobile Source Emission Controls from Accelerated Scrappage to Zero Emission Vehicles," Paper No. 94-TP53.05, presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, OH, June 1994.

"Investigation of MOBILE5a Emission Factors, Assessment of I/M Program and LEV Program Emission Benefits," Sierra Research Report No. SR94-06-05, prepared for American Petroleum Institute, June 1994.

"Cost-Effectiveness of the California Low Emission Vehicle Standards," SAE Paper No. 940471, 1994.

"Meeting ZEV Emission Limits Without ZEVs," Sierra Research Report No. SR94-05-06, prepared for Western States Petroleum Association, May 1994.

"Evaluating the Benefits of Air Pollution Control - Method Development and Application to Refueling and Evaporative Emissions Control," Sierra Research Report No. SR94-03-01, prepared for the American Automobile Manufacturers Association, March 1994.

"The Cost-Effectiveness of Further Regulating Mobile Source Emissions," Sierra Research Report No. SR94-02-04, prepared for the American Automobile Manufacturers Association, February 1994.

"Searles Valley Air Quality Study (SVAQS) Final Report," Sierra Research Report No. SR94-02-01, prepared for North American Chemical Company, February 1994.

"A Comparative Study of the Effectiveness of Stage II Refueling Controls and Onboard Refueling Vapor Recovery," Sierra Research Report No. SR93-10-01, prepared for the American Automobile Manufacturers Association, October 1993.

"Evaluation of the Impact of the Proposed Pole Line Road Overcrossing on Ambient Levels of Selected Pollutants at the Calgene Facilities," Sierra Research Report No. SR93-09-01, prepared for the City of Davis, September 1993.

"Leveling the Playing Field for Hybrid Electric Vehicles: Proposed Modifications to CARB's LEV Regulations," Sierra Research Report No. SR93-06-01, prepared for the Hybrid Vehicle Coalition, June 1993.

"Size Distributions of Trace Metals in the Los Angeles Atmosphere," *Atmospheric Environment*, Vol. 27B, No. 2, pp. 237-249, 1993.

"Preliminary Feasibility Study for a Heavy-Duty Vehicle Emissions Inspection Program in the Lower Fraser Valley Area," Sierra Research Report No. 92-10-01, prepared for the Greater Vancouver Regional District, October 1992.

"Development of Mechanic Qualification Requirements for a Centralized I/M Program," SAE Paper No. 911670, 1991.

"Cost-Effectiveness Analysis of CARB's Proposed Phase 2 Gasoline Regulations," Sierra Research Report No. SR91-11-01, prepared for the Western States Petroleum Association, November 1991.

"Origins and Control of Particulate Air Toxics: Beyond Gas Cleaning," in Proceedings of the Twelfth Conference on Cooperative Advances in Chemical Science and Technology, Washington, D.C., October 1990.

"The Effect of Gasoline Aromatics on Exhaust Emissions: A Cooperative Test Program," SAE Paper No. 902073, 1990.

"Estimation of the Impact of Motor Vehicles on Ambient Asbestos Levels in the South Coast Air Basin," Paper No. 89-34B.7, presented at the 82nd Annual Meeting of the Air and Waste Management Association, Anaheim, CA, June 1989.

"Benzene/Aromatic Measurements and Exhaust Emissions from Gasoline Vehicles," Paper No. 89-34B.4, presented at the 82nd Annual Meeting of the Air and Waste Management Association, Anaheim, CA, June 1989.

"The Impact of Diesel Vehicles on Air Pollution," presented at the 12th North American Motor Vehicle Emissions Control Conference, Louisville, KY, April 1988.

"Exhaust Benzene Emissions from Three-Way Catalyst-Equipped Light-Duty Vehicles," Paper No. 87-1.3, presented at the 80th Annual Meeting of the Air Pollution Control Association, New York, NY, June 1987.

"Trends in Emissions Control Technologies for 1983-1987 Model-Year California-Certified Light-Duty Vehicles," SAE Paper No. 872164, 1987.

Declaration of James M. Lyons

Attachment 2

Attachment 2

CARB Staff's Analysis of Alternatives to the Proposed 2018 LCFS Regulation

The regulatory documents for the proposed 2018 LCFS amendments to the Low Carbon Fuel Standard (LCFS) regulation contain several alternatives that CARB staff purport to have analyzed, which are primarily iterations of the LCFS regulation. These include the following alternatives discussed in Sections VII and IX of the ISOR:[1]

1. Establishing a 25% CI reduction standard for 2030 instead of the proposed 20% using a linear decrease over time from the 2018 reduction requirement of 5% to establish CI reduction standards for interim years;

2. Establishing a 18% CI reduction standard for 2030 without changing the current CI reduction standards for 2018 to 2020 with a linear decrease overtime to establish CI reduction standards for interim years;

3. CARB also declined to include as an alternative a proposal from WSPA to eliminate the LCFS and rely instead on the Cap-and-Trade regulation to achieve the desired reductions in GHG emissions from the transportation sector while also providing financial incentives to encourage the production of low CI transportation fuels;

4. CARB also declined to include as formal alternatives proposals from Pacific Gas and Electric and Chevron that the 2030 CI reduction standard be set at 15%.

Only one of the above alternatives, the 25% CI reduction standard for 2030 (number 1 above) is included as a project alternative in the Draft Environmental Analysis (Appendix D to the ISOR)[2] which also adds the following alternatives that are not discussed in the ISOR:

5. A no project alternative where the current LCFS regulation is left in place without modification;

6. Exempting biodiesel from the LCFS regulation;

7. Excluding the proposed Carbon Capture and Sequestration Protocol from the LCFS regulation; and

8. Excluding the proposed opt-in Alternative Jet Fuels from the LCFS regulation;

In addition, the EA rejected the WSPA Alternative from inclusion as an alternative under CEQA. Alternatives analysis is also presented in the Draft Supplemental Disclosure Discussion of Oxides of Nitrogen Potentially Caused by the Low Carbon Fuel Standard Regulation (Appendix G to the ISOR).[3] This analysis provides a second assessment of the no project alternatives found in Appendix D to the ISOR (number 5 above) and exempting biodiesel from the LCFS

[1] https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf
[2] https://www.arb.ca.gov/regact/2018/lcfs18/appd.pdf
[3] https://www.arb.ca.gov/regact/2018/lcfs18/appg.pdf

regulation (number 6 above), but are not discussed in the ISOR itself and includes yet another alternative that appears only in Appendix G to the ISOR:

9. Requiring the mitigation of potential increases in NOx emissions associated with all biodiesel sold in California.

The ISOR does not consistently analyzed any of the above alternatives, in particular—the WSPA alternative that would eliminate the LCFS regulation and the alternative that would require mitigation of all potential increases in NOx emission from biodiesel sold in California.

The SIRO should be augmented to include a comprehensive and consistent analysis of all suggested alternatives analysis that quantifies the GHG reductions and economic impacts of those alternatives relative to the staff proposal. Further, the evaluation of alternatives across the various documents in the rulemaking should focus on the statutory requirements necessary to achieve reductions in GHG emissions in the most cost-effective manner possible and not reject alternatives because they do not meet subjective and arbitrary criteria that lack foundation in the underlying statutes, including, for example, achievement of "radical" decarbonization of transportation fuels.

CARB Should Consider Cap-and-Trade Alternatives to the LCFS

The WSPA Alternative submitted to CARB is attached at Appendix A and consists of two parts:

- Recognizing that the GHG emission reductions claimed by the LCFS program are already being achieved in large part in a more cost effective manner through the AB 32 Cap-and-Trade program, and

- Addressing the stated need for "innovation and fuel substituting" through the LCFS regulation through a financial incentive program tailored by CARB to satisfy that need.

The EA declines to consider the WSPA alternative, by stating that it was:

> *...not further analyzed because it is less likely to accomplish the innovation and fuel substituting benefits intended by the LCFS. Future emission reductions far beyond the near term reductions sought by the proposed LCFS or the Cap-and-Trade program will be necessary, and will be feasible only if transportation fuels are radically decarbonized through innovation in low carbon fuel production, distribution and use. The most effective way to achieve this is via programs that directly target transportation fuels. LCFS focuses on transportation fuels with a market approach that also minimizes the cost.*

It should be noted with respect to "minimized cost" that WSPA highlighted in its submission that GHG emission reduction credits under the Cap-and-Trade regulation cost as much as ten times less than GHG emission reduction credits under the LCFS regulation. As a consequence, California consumers are paying over $1.5 billion more per year for GHG reductions under the

LCFS program than they would have if the Cap-and-Trade regulation had been relied upon to generate the same GHG reductions.

It should also be noted that WSPA's proposal to use financial incentives to promote innovation in the California transportation fuel sector is the same strategy that CARB itself has and is continuing to pursue to accomplish the same goals.[4] Therefore, any criticism of the WSPA proposal in the EA or the ISOR lacks substantial evidence.

Growth Energy proposed a similar alternative that provided a pathway to eliminate the LCFS regulation which is redundant to the Cap-and-Trade regulation during CARB's consideration of the 2015 LCFS amendments. Growth Energy's proposal made as part of the 2015 LCFS rulemaking process, attached as Appendix B, outlined in detail the simple modifications that could be made to the Cap-and-Trade regulation that would assure that the targeted GHG reductions could be realized at a lower cost than with the LCFS regulation remaining in place. This proposed alternative, like the WSPA Alternative discussed above, was rejected , in the absence of any substantive analysis to support the assertions below:[5]

> *The proposed alternative assumes that the exclusive goal of the LCFS proposal is to achieve GHG emissions reductions without regard to source. If that were the case, this would be a viable alternative to the LCFS and would be assessed in this analysis. It is likely true that the estimated GHG emissions reductions appearing in the 2009 LCFS Initial Statement of Reasons ((California Air Resources Board, 2009)) could be achieved by the AB 32 Cap-and-Trade Program, along with the other programs cited by Sierra Research and Growth Energy. The LCFS proposal, however, was designed to address the carbon intensity of transportation fuels. Transportation in California was powered almost completely by petroleum fuels in 2010. Those fuels were extracted, refined, and distributed through an extensive and mature infrastructure. Transitioning California to alternative, lower-carbon fuels requires a very focused and sustained regulatory program tailored to that goal. The other regulatory schemes the alternative would rely on are comparatively "blunt instruments" less likely to yield the innovations fostered by the LCFS proposal.*

However, CARB staff did acknowledge that:

> *The proposed alternative assumes that the exclusive goal of the LCFS proposal is to achieve GHG emissions reductions without regard to source. If that were the case, this would be a viable alternative to the LCFS and would be assessed in this analysis. It is likely true that the estimated GHG emissions reductions appearing in the 2009 LCFS Initial Statement of Reasons ((California Air Resources Board, 2009)) could be achieved by the AB 32 Cap-and-Trade Program, along with the other programs cited by Sierra Research and Growth Energy.*

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[4] See for example https://www.arb.ca.gov/msprog/aqip/aqip.htm

[5] See pages E-36 and E-37 of Appendix E of the 2015 LCFS ISOR at https://www.arb.ca.gov/regact/2015/lcfs2015/lcfs15appe.pdf

Attachment 2

Although CARB did not specifically acknowledge the potential of the WSPA alternative to achieve the same GHG reductions as the proposed 2018 LCFS amendments, the extension of the Cap-and-Trade regulation through 2030 makes CARB's response to Growth Energy's 2015 proposal clear, that this is in fact the case.

As evidenced by the above and all of the regulatory documents prepared with respect to the 2015 and 2018 LCFS rulemakings, the alternatives analyses included in the ISOR and the EA should include a substantiated, quantitative analysis of the ability of a modified Cap-and-Trade regulation to replace the LCFS regulation while ensuring that the targeted GHG reductions are achieved at an equivalent or lower cost. Given that there is no statutory requirement for CARB to operate an LCFS program, both the EA and te ISOR should include such analyses to demonstrate the actual need for the LCFS program in light of the fact that its goals duplicate those of the Cap-and-Trade regulation with respect to reducing GHG emissions associated with transportation fuels and as noted by WSPA that required GHG emissions can be realized at much lower cost through the Cap-and-Trade regulation.

Declaration of James M. Lyons

Attachment 3

Attachment 3

CARB Staff Should Consider Alternative Fuel Specifications for E15 In Order to Facilitate Compliance with the LCFS Regulation

In 2010[1] and 2011[2], the U.S. EPA promulgated partial waivers allowing the use of E15 in 2001 and newer model-year vehicles. E15 is now available in 29 states.[3] However, at present, California has not adopted the alternative fuel specifications required to allow for the sale of E15 in the state despite the fact that CARB has long recognized that E15 can play an important part in reducing GHG emissions and ensuring that transportation fuel providers can comply with the LCFS regulation. This is the case, for example, in the ISOR for the 2009 LCFS regulation[4] where staff noted that E15, if approved by U.S. EPA, could provide additional volumes of ethanol needed for LCFS compliance. Similarly, in 2011, after U.S. EPA's approval of E15, the LCFS Advisory Panel's assessment of the potential for future compliance with the LCFS relied heavily on an assumption that E15 would be in widespread use in California by 2016.[5]

Further, as indicated in CARB's "Illustrative Compliance Scenario Calculator"[6], CARB staff currently estimates that the use of ethanol results in approximately 30% less GHG emissions than the use of a comparable amount of petroleum based gasoline feedstock based on equivalent energy content and forecasts that by 2030, GHG emissions from ethanol use will be 50% lower than from petroleum feedstocks. Given this, it is clear that allowing E15 in California will reduce GHG emissions, and result in greater volumes of LCFS credits which in turn will help to ensure and reduce the cost of LCFS compliance. E15 fuel specifications would also further diversify California's transportation fuel pool and reduce California's reliance on CARB staff's postulations regarding the availability of new supplies of renewable diesel, biodiesel, and electricity in order to achieve LCFS compliance.

While CARB has not yet moved forward to enact specifications for E15, it is clear from the U.S. EPA's action that there are no technical barriers to the use of E15 in California in 2001 and later model-year vehicles that constitute the bulk of the California vehicle fleet. It is also evident that widespread use of E15 would increase the already large of amount of LCFS being generated by ethanol[7] by another 50%.

Given the above, CARB should either move forward as quickly as possible to initiate the rulemaking process required to develop California fuel specifications for E15 or provide an analysis that shows the technical, environmental, and/or economic reasons why E15 should not be available in California to assist fuel providers in complying with the LCFS regulation.

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[1] https://www.gpo.gov/fdsys/pkg/FR-2010-11-04/pdf/2010-27432.pdf
[2] https://www.gpo.gov/fdsys/pkg/FR-2011-01-26/pdf/2011-1646.pdf
[3] https://www.afdc.energy.gov/fuels/ethanol_e15.html
[4] See pageVIII-13 of https://www.arb.ca.gov/regact/2009/lcfs09/lcfsisor1.pdf
[5] https://www.arb.ca.gov/fuels/lcfs/workgroups/advisorypanel/20111208_LCFS%20program%20review%20report_final.pdf
[6] https://www.arb.ca.gov/fuels/lcfs/rulemakingdocs.htm
[7] See for example, page I-6 of the 2018 LCFS ISOR.

Declaration of James M. Lyons

Attachment 4

Attachment 4

Review of CARB Staff Estimates of the Emissions Impacts Associated with Biodiesel use in California

During the course of the rulemaking process that lead to the adoption of the proposed Alternative Diesel Fuel (ADF) regulation and the readopted Low Carbon Fuel Standard (LCFS) regulation in 2015 by the California Air Resources Board (CARB), Growth Energy submitted extensive comments regarding issues with the analysis of the impact of the use of blends of biodiesel and conventional diesel fuel resulting from the ADF and LCFS regulation on emissions of oxides of nitrogen (NOx) from diesel vehicles operating in the state of California. Those Growth Energy comments, which demonstrated that the CARB staff analysis was insufficient and could not be relied upon are attached to this document as Appendix A. It should be noted that these comments have been passed over but never disaffirmed, and are still applicable to the staff's 2018 analysis of this issue.

As part of the 2018 LCFS rulemaking, the ISOR states that it presents a new analysis that utilizes a "conservative analytical approach that likely overestimates LCFS attributable impacts" of the impact of "biodiesel" and "biomass-based diesel" use in California on emissions of NOx and particulate matter (PM). Just as was the case with prior documents prepared to support the 2015 rulemaking, the new CARB analysis supporting the 2018 rulemaking is again insufficient and should be revised as explained below.

Summary CARB Staff's Conclusions

On March 6, 2018, CARB staff released the proposed LCFS regulation language, the accompanying Initial Statement of Reasons (ISOR), as well as supporting information.[1] Staff's analysis of the impact of the proposed ADF regulation on NOx and PM emissions and supporting information and assumptions are summarized in the ISOR Appendix G.

The conclusion[2] of the analysis in Appendix G regarding biodiesel impacts on NOx emissions is that:

> *...biodiesel use attributed to the LCFS would result in a potential increase in NOx emissions relative to use of conventional diesel in all years from 2019 through 2030. Even though the consumption of biodiesel in California is expected to increase over time, the NOx emissions impact is expected to decrease as the result of NOx mitigation of higher biodiesel blend levels required by the ADF regulation and the turnover to lower-NOx engines.*

This conclusion is based primarily on assumptions, and not substantial evidence in the record. Further, Appendix G considers but then dismisses a regulatory alternative that would ensure that biodiesel use in California creates no adverse environmental impacts based on economic factors alone without providing adequate data to justify that assumption.[3]

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[1] See https://www.arb.ca.gov/regact/2018/lcfs18/lcfs18.htm
[2] See https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf page V-12.
[3] See https://www.arb.ca.gov/regact/2018/lcfs18/appg.pdf

Attachment 4

CARB's Assumptions

CARB's analysis of the environmental impacts associated with biodiesel and the agency's conclusions rest on the following assumptions that are unsupported by the evidence. Key among these assumptions are:

1. The use of biodiesel in so called "new technology diesel engines" (NTDEs)[4] will not result in any increase in NOx emissions because those engines are equipped with selective catalytic reduction (SCR) systems that CARB staff claim, again without support, will mitigate biodiesel related increases in engine out NOx emissions;[5]

2. Increased emissions of NOx from the use of biodiesel can be claimed to be mitigated by reductions in NOx emissions resulting from the use of renewable diesel;[6] and that

3. A requirement that all biodiesel be subject to the NOx mitigation requirements of the Alternative Diesel Fuel regulation is not cost-effective and would reduce biodiesel use in California and therefore such a requirement should be rejected.[7]

Beginning with the first assumption regarding NOx increases resulting from the use of biodiesel in NTDEs, Appendix G does not identify or reference any new publications or data that supports this assumption beyond the data of Lammert upon which CARB staff misguidedly relied during the development of the 2015 LCFS regulations as indicated by Rincon Ranch Consulting.[8]

Biodiesel Increases NOx emissions from NTDEs

Although CARB preciously recognized that Lammert was an outlier, Appendix G does not recognize the need to modify its findings. I understand this is because of the assertion that, unlike Lammert, the other studies in the literature were based on testing performed on retrofit engines. Recently, however, CARB staff and its contractors have published data that directly questions CARB staff's assumption that the presence of SCR systems will mitigate increased engine out NOx emissions associated with biodiesel use and that it is reasonable to rely on

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[4] These engines are defined in 2293.2(a)(18) as:
"New Technology Diesel Engine" or "NTDE" means a diesel engine that meets at least one of the following criteria:

> *(A) Meets 2010 ARB emission standards for on-road heavy duty diesel engines under section 1956.8.*
> *(B) Meets Tier 4 emission standards for non-road compression ignition engines under sections 2421, 2423, 2424, 2425, 2425.1, 2426, and 2427.*
> *(C) Is equipped with or employs a Diesel Emissions Control Strategy (DECS), verified by ARB pursuant to CCR, title 13, chapter 14 (commencing with section 2700), which uses selective catalytic reduction to control Oxides of Nitrogen (NOx).*

[5] See Table 10 of https://www.arb.ca.gov/regact/2018/lcfs18/appg.pdf
[6] See Figure V-4 of https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf
[7] See pages G-8 and G-9 as well as G-88 to G-96 of https://www.arb.ca.gov/regact/2018/lcfs18/appg.pdf
[8] I understand a copy of this study is being submitted electronically concurrently with these comments.

Lammert to arrive at that conclusion. These studies[9,10,11,12] each involved testing on OEM production vehicles – not retrofits – and clearly demonstrate that the SCR systems that the ISOR claims will prevent increases in NOx emissions from biodiesel use in NTDEs are ineffective much of the time due to low exhaust temperatures. Table 5-10 of the reference listed in footnote 12 shows that the SCR systems of out-of-state line haul trucks are not-effective during 47% of vehicle operation and use of biodiesel in these vehicles would result in increased NOx emissions about 50% of the time despite the fact that they are equipped with NTDEs. The same table shows that SCR systems on drayage trucks used in port operations are ineffective 75% of the time and would therefore experience increases in NOx emissions due to biodiesel use during most of the time they are in operation. The references in footnotes 9 through 11 show that lack of SCR system efficiency results in actual in-use NOx emissions that are as much as 10 times higher than laboratory results because the SCR systems are ineffective and these high emissions would be further increased and exacerbated by the use of biodiesel. Again, it should be stressed that when SCR system efficiencies are low, NTDE NOx emissions will be affected by biodiesel use just like CARB staff acknowledges they are with older diesel engines.

In addition to the problems with NOx emissions being below the detection levels of the instrument making the measurement, Figures 12 and 13 of Lammert show very high SCR efficiencies throughout the course of testing. Therefore, the results presented in Lammert are not useful in assessing actual in-use NOx emissions from diesel vehicles as shown by CARB staff's own studies. Other factors that need to be considered when addressing in-use NOx emissions resulting from the use of biodiesel in addition to low exhaust temperatures that result in low SCR efficiency include performance deterioration, as well as tampering and mal-maintenance of SCR systems, which again, limit the SCR systems' effectiveness in reducing NOx emissions. These factors were overlooked by Lammert.

In assessing the impact of biodiesel use on NOx emissions, Appendix G should have relied on all of the data that it possess regarding the operation of SCR systems on NTDEs including information regarding low SCR efficiencies during actual in-use vehicle operation, as well as with respect to deterioration, tampering and maintenance issues with SCR systems. Although Appendix G does not address all of these issues with respect to its analysis of the NOx impacts of biodiesel under the LCFS regulation, those issues were addressed by CARB staff during the development of the agency's newly released EMFAC2017 emission inventory model.[13] CARB should explain why, in light of this knowledge, the ISOR does not include a proper assessment of the impacts of biodiesel use on NOx emissions from NTDEs as part of its LCFS analysis.

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[9] *In-Use NOx Emissions from Model-Year 2010 and 2011 Heavy-Duty Diesel Engines Equipped with Aftertreatment Devices, Environ. Sci. Technol., 2013, 47 (14), pp 7892–7898*

[10] *Real-World Emissions from Modern Heavy-Duty Diesel Natural Gas, and Hybrid Diesel Trucks Operating Along Major California Freight Corridors", Emiss. Control Sci. Technol. (2016) 2:156-172.*

[11] *Evaluating In-Use SCR Performance: Older vs. Late MY Engines, presented at the 26th CRC Real World Emissions Workshop, Newport Beach, CA, March 12-16, 2016.*

[12] *Collection of Activity Data from On-Road Heavy-Duty Diesel Vehicles, Final Report (ARB Agreement No. 13-301), Prepared for CARB by CEERT, May 2017.*

[13] See pages 18-20, 25, 142-143, 147, 153-157 of https://www.arb.ca.gov/msei/downloads/emfac2017-volume-iii-technical-documentation.pdf

Attachment 4

Although there does not appear to be any rigorous analysis of the type required to quantify the impacts of biodiesel use on NOx emissions from NTDEs, it is possible to use the above referenced data CARB staff has published in combination with EMFAC2017 to generate estimates of the potential magnitudes of the impacts assuming that NOx mitigated biodiesel is not used in on-road vehicles equipped with NTDEs. Actual in-use NOx impacts would be higher when non-road NTDEs are considered. The first step in this process is to estimate the magnitude of NOx emissions occurring when the SCR system is ineffective. Based on Figures 1b through 3b of the reference in footnote 9, this range is between 50 and 90 percent and the mid-point of this range, 70 percent has been assumed here. Given the fact that when functional SCR systems reduce engine out NOx emissions by 90% or more, the fact that overall NOx emissions from NTDEs will be dominated by emissions occurring when SCR systems are ineffective is apparent – as is demonstrated by the CARB publications referenced above.

The next step is to determine the amount of NOx emissions generated by vehicles equipped with NTDEs. This was done for the years 2018, 2025, and 2030 for the South Coast and San Joaquin Valley Air Basis using CARB's newly released EMFAC2017 model.

The final step is assessing the percentage NOx increase expected from the use of biodiesel when the SCR system is ineffective. This value depends on the average biodiesel blend level assumed by CARB staff in those calendar years which can be found in CARB staff's Illustrative Compliance Scenario Calculator[14] and the values determined by CARB staff for the percentage increase in NOx emissions for older engines as the result of biodiesel use shown in Table 10 of Appendix G to the 2018 LCFS ISOR.

The results of these calculations are shown in Tables 1 and 2 below for the South Coast and San Joaquin Air Basins, respectively, using CARB's assumption that all diesel fuel sold in California will be low-saturation. As shown, potential increases in NOx emissions dwarf those associated with the significance thresholds established by the South Coast Air Quality Management District[15] and the San Joaquin Valley Air Pollution Control District.[16]

Table 1
Potential Increases in NOx Emissions from Use of Unmitigated
Biodiesel in On-Road NTDEs Operating in the South Coast Air Basin

Year	NTDE NOx (tons/day)	BD in Diesel Pool (%)	Biodiesel Caused NOx Increase (%)	Biodiesel Caused NOx Increase (tons/day)
2018	36	5.3	1.2	0.3
2025	54	13.3	2.4	0.9
2030	59	13.5	2.4	1.0

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[14] Available at https://www.arb.ca.gov/fuels/lcfs/rulemakingdocs.htm .
[15] http://www.aqmd.gov/docs/default-source/ceqa/handbook/scaqmd-air-quality-significance-thresholds.pdf
[16] http://www.valleyair.org/transportation/0714-gamaqi-criteria-pollutant-thresholds-of-significance.pdf

Attachment 4

Table 2
Potential Increases in NOx Emissions from Use of Unmitigated
Biodiesel in NTDEs Operating in the San Joaquin Valley Air Basin

Year	NTDE NOx (tons/day)	BD in Diesel Pool (%)	Biodiesel Caused NOx Increase (%)	Biodiesel Caused NOx Increase (tons/day)
2018	35.0	5.3	1.2	0.3
2025	49.0	13.3	2.4	0.8
2030	51.0	13.5	2.4	0.9

Appendix G and the EA Should Not Rely upon the Claim that NOx Reductions from Use of Renewable Diesel Mitigate NOx Increases from Biodiesel

Appendix G and the EA rely upon the assumption that the use of renewable diesel will offset increased NOx emissions due to the use of biodiesel. First, there is nothing in the ADF regulation, the LCFS regulation, or the proposed amendments to both regulations that mandates the use of any volume of biodiesel in California, much less the use of the exact ratio of renewable diesel to biodiesel assumed in its emissions analysis. Similarly, nothing in the LCFS regulation mandates the use of alternative jet for the completion of solar steam projects, which are both claimed in Appendix G and the EA as other means of mitigating NOx increases associated with the use of biodiesel. Likewise, there is nothing in the regulation that would prevent or mitigate additional emissions of NOx if more biodiesel is used than if less renewable diesel is used.

Second, to the extent that there are reductions in NOx emissions from the use of renewable diesel, CARB has already formally committed to taking credit for those NOx reductions as part of a "Low-Emission Diesel" requirement of the agency's Mobile Source State Implementation Plan (SIP) Strategy.[17] As shown in Table 4 of the SIP Strategy document, CARB has claimed 8 tons per day or about 2,900 tons per year of NOx reductions for the Low-Emission Diesel requirement in 2031, with the regulatory program beginning in 2023. Comparison of this value to the NOx reductions claimed for the LCFS regulation as shown for example in Figure V-1 of the 2018 ISOR shows that the amount of NOx reductions claimed in the SIP for this measure is approximately the same as the NOx reductions CARB staff has claimed for renewable diesel use under the LCFS program. NOx reductions from renewable diesel fuel use cannot be both available to mitigate NOx increases from biodiesel use under the LCFS and the "real, quantifiable, surplus and enforceable" reductions in NOx emissions that CARB has already claimed will result from renewable diesel use as part of the already submitted SIP. Given that CARB has already made a federally enforceable commitment to use the NOx reductions from renewable diesel as part of the SIP, those reductions cannot be claimed to offset potential NOx increases from the use of biodiesel resulting from the LCFS.

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[17] See https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf

Attachment 4

CARB Could Eliminate Any Potential for Biodiesel to Increase NOx Emissions by Requiring NOx Mitigation for all Biodiesel

One of the alternatives considered by CARB to prevent the potential for increased NOx emissions is discussed only in Appendix G to the 2018 ISOR. Under this alternative, all biodiesel blends, regardless of biodiesel saturation level and season of the year, would require NOx mitigation by the LCFS to the level of conventional diesel. This is the only approach that would ensure that there are no increases in NOx emissions associated with biodiesel use in California. However, this alternative was rejected based on the following rationale:[18]

> *The future effects of requiring NOx mitigation of all biodiesel blends to the level of conventional diesel would be a likely increase in the use of additives, such as Di-tertbutyl peroxide or renewable diesel, to reduce NOx emissions associated with biodiesel use. This would increase the cost of biodiesel, which is currently one of the cheapest compliance options for the LCFS. The increased cost of biodiesel would likely reduce the incentive for its use, leading to a likely decrease in biodiesel consumption in California relative to projected levels for the project following the adoption of the Proposed Amendments. Because of this, greater quantities of other, more expensive fuels, including renewable diesel, would be necessary to replace credits that could otherwise be generated by biodiesel. Therefore, this alternative would make it more difficult and expensive to generate the average carbon intensity reductions and GHG benefits associated with the project following the adoption of the Proposed Amendments.*

Neither the ISOR nor any of its appendices present any quantification of any increased costs for biodiesel or any analysis that shows that biodiesel use would in fact be decreased. As such, the ISOR and Appendix G should be revised to present more than opinion to reject this regulatory alternative, particularly given that this conclusion is contrary to documents published by CARB.

First, with respect to the economic feasibility of mitigating NOx emissions increases associated with biodiesel use, CARB has already approved four alternative formulations for NOx mitigated biodiesel blends[19,20,21,22] a fact that demonstrates that they are economically viable. Second, although Appendix G and the EA provide no analysis on the cost-effectiveness of NOx mitigated biodiesel, CARB has recently published data regarding the expected cost-effectiveness[23] ratios of projects that will be funded using money from the Volkswagen Environmental Mitigation Trust it received as part of the settlement of the recent Volkswagen scandal, which are summarized in Table 3. As shown, with respect to these mitigation funds, it appears CARB contends mitigation of up to $350,000 per ton of NOx emissions eliminated is reasonable.

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[18] See page G95 of https://www.arb.ca.gov/regact/2018/lcfs18/appg.pdf
[19] https://www.arb.ca.gov/fuels/diesel/altdiesel/20170720_NBB_EO.pdf
[20] https://www.arb.ca.gov/fuels/diesel/altdiesel/20180118_REG_EO_ADF02.pdf
[21] https://www.arb.ca.gov/fuels/diesel/altdiesel/20180126_CF_EO.pdf
[22] https://www.arb.ca.gov/fuels/diesel/altdiesel/20180222_TTI_EO.pdf
[23] https://www.arb.ca.gov/msprog/vw_info/vsi/vw-mititrust/meetings/021618_discussiondoc.pdf

Attachment 4

The ISOR should also be augmented to include a quantitative analysis of the costs and benefits of requiring NOx mitigation for all biodiesel blends that demonstrates that the NOx reductions that would be achieved are not cost-effective relative to other emission control strategies CARB is pursuing in order to justify its rejection of this regulatory alternative.

Table 3
Expected Cost-Effectiveness Ratios for NOx Reductions Achieved by Projects Funded Through the Volkswagen Environmental Mitigation Trust

Project Type	Cost-Effectiveness ($/ton of NOx emissions eliminated)	
	Low	High
Transit, School, and Shuttle Buses	30,000	180,000
Class 8 Freight, Port and Drayage Trucks	80,000	95,000
Zero Emission Freight/Marine	130,000	350,000
Combustion Freight/Marine	5,000	30,000

CARB's Proposal to Mitigate Past NOx Emission Increases Associated with Biodiesel

In addition to rejecting requirements for NOx mitigation on all biodiesel blends, Appendix G to the 2018 ISOR[24] also proposes to attempt to mitigate past NOx emissions by providing funding to unspecified local air quality districts to implement NOx mitigation programs like those funded by the Carl Moyer program. However, this discussion does not specify the amount NOx emissions that will be mitigated, the source of the funding, specifics regarding the types of projects that will be funded, how the agency will ensure that funding is actually made available, or how the projects will actually be implemented.

[24] See pages G55-57.

Declaration of James M. Lyons

Attachment 5

CARB Can Formulate Mitigation Strategies to Address Adverse Impacts on California Air Quality from New or Modified Transportation Fuel Production Facilities Created by the LCFS

The draft Environmental Analysis ("EA") for the 2018 LCFS Amendments (Appendix D to the ISOR)[1] indicates that new or modified transportation fuel production facilities will be required in California to provide the low CI fuels needed to meet the demand caused by the LCFS. The EA states that those new or modified facilities in turn will create potentially significant and unavoidable impacts on air quality. However, the EA explains[2] that, despite the causal effect of the LCFS regulation in creating these impacts, CARB does not have the authority to require mitigation of such impacts:

CARB does not have the authority to require implementation of mitigation related to operation of new or modified facilities that would be approved by local jurisdictions. The ability to require such measures is within the purview of jurisdictions with local or State land use approval and/or permitting authority. New or modified facilities in California would likely qualify as a "project" under CEQA, because they would generally need a discretionary public agency approval and could affect the physical environment. The jurisdiction with primary approval authority over a proposed action is the Lead Agency, which is required to review the proposed action for compliance with CEQA. Project-specific impacts and mitigation would be identified during the environmental review by agencies with project-approval authority. ....

> *Because the authority to determine project-level impacts and required project-level mitigation lies with land use and/or permitting agencies for individual projects, and the programmatic level of analysis associated with this EA does not attempt to address project-specific details of mitigation, there is inherent uncertainty in the degree of mitigation that may ultimately be implemented to reduce potentially significant impacts. With mitigation, operational emissions could still exceed local air district threshold levels of significance, though this is not likely.*
>
> *Consequently, while CARB does not believe significant localized increases are likely and anticipates overall beneficial long-term operational impacts and if they were to exist impacts should be reduced to a less-than-significant level by land use and/or permitting agency conditions of approval, this EA takes the conservative approach in its postmitigation significance conclusion and discloses, for CEQA compliance purposes, that long-term operational-related air quality impacts resulting from the operation of new or modified facilities associated with the Proposed Amendments would be potentially significant and unavoidable.*

[1] https://www.arb.ca.gov/regact/2018/lcfs18/appd.pdf

[2] See pages 69, 70, 131 and others in https://www.arb.ca.gov/regact/2018/lcfs18/appd.pdf

Further, CARB's analysis of emission impacts of modified and new transportation fuel production facilities[3] is performed only on an aggregated basis[4] relative to the expected increases in the use of specific types of low CI fuels in California over time. It appears that the methodology in the EA for estimating emissions from modified and new transportation fuel production facilities for the 2018 LCFS amendments differs from that used for assessing the impacts of the 2015 LCFS amendments,[5] as does the presentation of emissions data from specific existing and potential California production facilities.

The importance of the fact that the EA does not assess environmental impacts from potential modified or new transportation fuel production facilities located in California in its assessment of the 2018 LCFS amendments can be seen in information included in the 2015 LCFS analysis. For example, in the 2015 LCFS analysis, the ISOR reported that one potential cellulosic ethanol facility considered for location in northern California could emit 3.9 tons of NOx per day or about 1,400 tons per year, which is well in excess of any local California air quality district's threshold for a significant impact and would require extensive mitigation. In addition, the NOx emission factor for this potential facility was derived directly from data for a biomass plant as shown in Table IV-15 of the 2015 ISOR and is over 120 times greater than the NOx emission factor that CARB staff used for the 2018 LCFS analysis which is presented in Table F-3 of Appendix F to the 2018 ISOR. There is no clarification presented by CARB staff explaining this discrepancy. Further, it does not appear that the EA includes the same kind of health risk assessment of potential California biofuel facilities that was presented in the 2015 LCFS ISOR as part of the 2018 LCFS analysis.

Overall, the EA's analysis of the potential impacts of modified and new transportation fuel production facilities in California driven by the LCFS regulation is incomplete, and a much more detailed analysis should be performed.

In addition, the EA does not identity, present, and analyze obvious mitigation requirements that could be incorporated into the LCFS regulation. For example, in approving the fuel production pathway CI values for modified and new California facilities, CARB could modify the LCFS regulation to withhold approval unless all significant environmental impacts of a facility were adequately mitigated. This could include requirements that project proponents and operators engage in Voluntary Emission Reduction Agreements (VERAs)[6] like those that are currently being required in the San Joaquin Valley.[7] Another example, of what CARB could do is, provided that it is adequately described and documented, expand the funding program described in Appendix G to the 2018 ISOR[8], intended to mitigate past NOx emissions associated with biodiesel use by providing funding to local air quality districts to implement programs like those funded by the Carl Moyer program.

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[3] https://www.arb.ca.gov/regact/2018/lcfs18/appf.pdf
[4] See page 69 of https://www.arb.ca.gov/regact/2018/lcfs18/appd.pdf
[5] See section IV of the 2015 LCFS ISOR at https://www.arb.ca.gov/regact/2015/lcfs2015/lcfs15isor.pdf
[6] http://www.valleyair.org/ceqaconnected/aqimeasures.aspx
[7] http://www.valleyair.org/isr/Documents/2017-ISR-Annual-Report.pdf
[8] See pages G55-57.

APPENDIX "B"

REVIEW OF THE ENERGY EFFICIENCY (EER) RATIO UTILIZED IN THE LCFS REGULATIONS

Prepared for:

Growth Energy

Prepared by:

H-D Systems
Washington, DC

April 23, 2018

1. INTRODUCTION

The California Low Carbon Fuels Standard (LCFS) incorporates the differences in the energy efficiency of alternative fuel vehicles relative to similar conventionally (gasoline and diesel) fueled vehicles by using an Energy Economy Ratio (EER) to determine the carbon intensity of alternative fuel vehicles for purposes of developing carbon credits. The EER is the ratio of energy use by the alternative fuel vehicle to the energy used by a conventional vehicle per unit travel distance. Since the performance characteristics of alternative fuel vehicles are sometimes quite different from those of conventional vehicles, the concept of EER incorporates a subjective element in the identification of "similar" vehicles to develop an EER. In addition, the response of alternative fuel vehicles to various duty cycles of operation and to changes in ambient temperature can differ from the response of conventional vehicles, and the EER is a function of both the duty cycle and ambient temperature under such conditions.

The ARB has documented the EER values for several alternative fuel vehicle types in Appendix H of the 2018 Initial Statement of Reasons for amendments to the LCFS. This report examines the EER values in Appendix H of the ISOR to assess its reasonableness using both an engineering analysis and an assessment of the similarity of vehicle types and tests used to generate the data underlying the EER. In addition, the EER values for cars and light trucks developed in the 2009 ISOR when the LCFS was first introduced are also reexamined in this report.

The report begins with an examination of fundamental engineering-based analysis of diesel and gasoline engine efficiency and their comparison to electric motor efficiency. It also examines vehicle power consumption especially for accessory drives which are often not utilized during tests of emissions or fuel economy. The discussion also covers the effects of driving cycles and varying ambient temperatures and how these factors affect energy efficiency. Following this general discussion, a critique of the EER values published in the ISOR for each vehicle type is provided.

2. ENGINEERING CONSIDERATIONS IN DEVELOPING THE EER

Our examination of the EER values developed in Appendix H showed that the methodology adopted by ARB to develop the EER ignored some aspects of engine efficiency trends with load and speed, and also did not consider the differences between dynamometer test procedure and real-world operation. In addition, the effects of ambient temperature were not discussed or included in the computation of EER. Chassis dynamometer ("dyno") tests are conducted with all accessories off and at an ambient temperature of 70 to 75 F, which are conditions where EER for electric vehicles may be the highest. Because these conditions may be experienced for only

short periods of time in much of California, EER values developed from dyno test data do not reflect real world conditions for much of the time such vehicles will be operating. The discussion below on engineering considerations provides a foundation for the critique of specific EER values in the following sections.

Conventional Gasoline and Diesel engines

Gasoline and diesel vehicles are the baseline for comparison for developing the EER values of alternative fuel vehicles. In modern vehicles the spark ignition (gasoline) engine has a peak efficiency of 35 to 36 percent but some more recent designs being introduced in cars and light trucks have efficiencies approaching 40%. Light duty diesels have a peak efficiency of about 41 to 42 percent but do not have near term prospects for improving significantly.

In a heavy-duty vehicle, diesel engines are more efficient with peak efficiency of 43 to 44%. However, the peak efficiencies are realized at high loads and the efficiency of both diesel and gasoline engines decline at low loads and is zero at idle by definition. The diesel's efficiency declines less than that of a s.i. engine with load reduction so that its relative efficiency over a gasoline engine improves at light load.

CNG and Propane Engines

Natural gas and propane are used primarily in spark ignition (s.i.) engines, but the type of s.i. engine differs between those used in light and light heavy vehicles up to about 14,000 lb. GVW. In these lighter vehicles, propane and natural gas engines are simple conversions of gasoline engines, with only the addition of a different fuel system. Efficiency is generally unaffected, implying a EER of 1.0. However, the tanks used for propane and CNG fuel are quite heavy and a CNG tank capable of providing over 200 miles range can weigh over 250 lbs. which is a significant weight increase. On a 4000 lb. gasoline vehicle, the addition of CNG tanks can cause fuel economy to decrease by 3 to 5 percent so that the EER will decline to 0.95 to 0.97. The lower power of the CNG engine further compromises the EER due to axle ratio and gear shift adjustments that must be made to restore performance and the net EER can decline to 0.9.

CNG spark ignition engines used in heavy trucks over 18,000 lb. GVW typically use a modified diesel engine so that they are highly turbocharged and offer better efficiency than a simple gasoline engine conversion but are still subject to the same trends with load and speed. While on a highly loaded duty cycle, the EER of a CNG can be as high as 0.9 relative to a diesel, this value declines due to the diesel's improved efficiency at lighter loads relative to an s.i. engine. In addition, the weight of the fuel tanks for the CNG fuel also reduces the vehicle efficiency at similar payload.

Electric Drivetrain and Battery Losses

Comparison of electric drivetrain efficiency to gasoline or diesel efficiency is more difficult due to the completely different efficiency characteristics of an electric motor relative to an internal combustion engine. Typically, an electric motor is most efficient at mid load/ low speed operation but becomes less efficient at high loads and very light loads. At "idle", and electric motor uses very little power (mostly in the controller). A typical electric motor/ controller's peak efficiency can be as high as 92 to 93% but the average efficiency in most light vehicular duty cycles is in the 80 to 85% range. In addition, the battery has internal energy loss during both charging and releasing energy so that the battery plus drivetrain efficiency is in the 75 to 80% range. Unlike the trend for internal combustion engines, system efficiency declines with higher loads so that on heavy trucks, the net efficiency on a highly loaded cycle can be significantly lower than the net efficiency for light vehicles.

The weight of the battery is also an important consideration in the determining the vehicle EER. In light vehicles with a range of 150 to 250 miles, the battery system weight ranges from 500 to 1000 lbs. while on a heavy truck, battery weight is 15% to 20% of the gross vehicle weight if the range is 150 to 200 miles. This has very significant impact on the EER of the vehicle and the EER can only be defined in the context of specific vehicle range and battery weight.

Impact of Accessory Loads

As noted, accessory loads are not switched on during dynamometer testing and their impact on the EER varies by vehicle type. Incorporation of accessory loads increases the load on the engine, or in the case of an EV, the battery. Increasing the load on an engine makes it more efficient while increased loads on the battery make it less efficient so that this affects the EER even if the accessory loads are identical. Accessory loads are particularly important in buses where the HVAC system accounts for as much as 40% of total fuel use in a transit bus in summer. These loads have a more modest effect on light duty vehicle fuel consumption.

In winter, diesel and gasoline engines use waste heat for providing passenger cabin heating but this is not possible in an EV where there is very little waste heat available. As a result, battery energy must be used and the resulting energy consumption substantially affects the EER. The reduction in EER can be very significant as many EVs use resistance heating for low cost, but this very inefficient.

Impact of Ambient Temperature

Ambient temperature affects the energy consumption in two ways – first by changing the energy consumption of the drivetrain and second, by requiring the use of air-conditioning or

heating. As noted, these factors are not reflected in the standard dyno tests which are conducted at ambient temperatures of 70° to 75° F without the HVAC system being on.

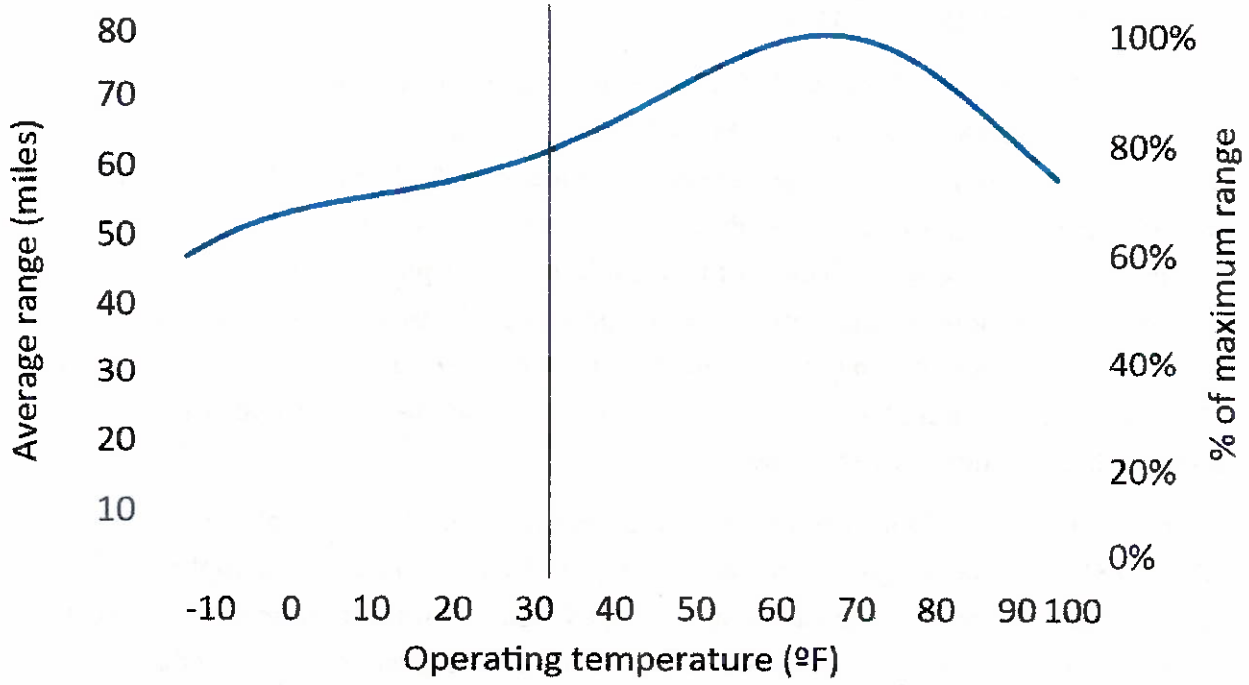

Figure 1: Average range of the Nissan Leaf as a function of Ambient Temperature[1]

At cold ambient temperatures below 10° F, fuel economy of internal combustion engines is decreased significantly due to the cold start and the energy needed to heat up the engine and transmission to operating temperature but the penalty is largely restricted to the warm-up period. Hence, the penalty averaged over a long trip becomes small. On an EV, battery internal losses and self-discharge increase with decreasing ambient temperatures and the energy loss is internal to the battery. In addition, the requirement for heating the cabin further deteriorates the vehicle EER. The combined loss results in loss of range, which is significant. An example of the loss of range with changes in ambient temperature for the Nissan Leaf EV is shown in Figure 1. As can be seen from the figure, battery range is maximum at 70° F (the typical dyno test temperature) and drops at both higher and lower temperature. At both 100° F and at 32° F, the range is 78% of the range at 70° F. Internal combustion engine powered cars have similar losses in fuel economy in summer but lower losses in winter, so that the reduction in EER of electric personal vehicles is potentially modest. However, in buses and commercial vehicles, the reduction in EER at colder temperatures may be quite large due to the high heating and ventilation load. We anticipate that the EER of electric vehicles could decline by 10 to 15% for

1 Data from Fleet Carma as reported on the Union of Concerned Scientists website

passenger cars and cargo trucks, and by 25 to 30% for buses in winter (50° F) and summer (>90° F) relative to the EER estimated from tests conducted at 70° F with the accessories shut off.

3. LIGHT DUTY CARS AND TRUCKS

In the 2009 LCFS, the EER of 1.0 for CNG vehicles relative to gasoline vehicles used in light-duty and medium duty applications and an EER of 3.0 for battery electric and plug-in hybrid electric light vehicles operating on electric power were developed by ARB. The LCFS accounted for the potential increases in gasoline engine efficiency by increasing the average fuel economy of light duty vehicles from 29 mpg by 30 percent to account for the impact of fuel economy standards. However, the LCFS does not account for the temperature effects which could potentially reduce the EER by 10 to 15% as noted in the previous section. The EPA tests are performed at 70° F without accessories, so that a more comprehensive EER estimate that includes winter and summer effects requires further study.

Currently, there are no EV light trucks in the market except the Tesla Model X, but we anticipate SUV and passenger van models are likely to have EER values close to those for cars. However, battery electric cargo vans and pickups will have significant reduction in payload capability compared to gasoline models of similar size and an adjustment methodology to account for the payload capability is required to develop EER values for such vehicles (several small electric cargo vans are expected to be introduced in 2019/2020).

The 2009 ISOR also estimates an EER of 2.3 for the hydrogen fuel cell vehicle. In 2018, there are three fuel cell vehicles in the market. Comparisons of the unadjusted EPA test fuel economy to their equivalent gasoline counterparts' fuel economy are shown in the table below

FCV Model	EPA FE (gasoline equivalent)	Gasoline model	EPA FE mpg	EER
Honda Clarity	98.0	Honda Civic 5-dr	47.29	2.07
Hyundai Tuscon	72.5	Tuscon FWD	36.10	2.01
Toyota Mirai	97.9	Toyota Camry	46.84	2.09

The data shows remarkably consistent values with an average EER of 2.06, which is lower than the 2.3 value estimated by ARB. It is not clear how the fuel economy of the fuel cell deteriorates in hot and cold weather and this may change the estimated EER value (at 70 F without accessory loads) of 2.06 further. A lower value of EER consistent with the data is recommended for use.

Finally, the ISOR estimates a CNG vehicle EER of 1.0 which does not account for the increased weight of the CNG fuel tanks and reduced engine power. The now discontinued Civic CNG model was rated 41.15 mpg for the unadjusted EPA test value in MY2015, while the gasoline Civic model with the same 1.8L engine was rated at 44.78 mpg. This shows an EER of 0.92 which may be better than the EER of light duty CNG aftermarket conversions, which are the only light duty CNG vehicles now available. We would suggest an EER value of 0.9 as appropriate for aftermarket conversions.

4. EER for LPG trucks and buses

The 2018 ISOR contains an extensive discussion of LPG bus fuel economy and the EER values relative to diesel and gasoline buses based on the testing done at the Altoona Bus Testing Center. The tests include dynamometer tests using the Manhattan cycle (6.8 mph average speed), the Orange county cycle (12.0 mph) and the Urban Dynamometer Driving Schedule (18.9 mph). Tests were also conducted on the test track using cycles labelled CBD (12.8 mph) Arterial (27 mph) and Commuter (38 mph) test cycles. In both the dyno and track tests, the HVAC system was turned off. In addition, the test cycles used for the track tests do not resemble normal driving in that the cycles consist of a simple pattern of steady accelerations cruise at constant speed, and steady deceleration to idle.

Hence, the loads on the test track cycle do not resemble those for the dyno tests, and there is significant reason to doubt test track results between different engine types (spark ignition vs. diesel) would yield EER values consistent with real world values. This is particularly true given that the track data also appeared to contain more errors than the dyno data. For example, the fuel economy measured on the Commuter cycle (which is essentially a constant speed cycle at 40 mph with 2 stops) was worse than the fuel economy measured on the UDDS cycles (with numerous stop-and-go events and a speed of 18.9 mph) on the dyno for many of the vehicles in the ARB database. These data would contradict the fact that fuel economy of conventional vehicles is typically highest at 40 to 50 mph constant speed conditions.

Figure 2 taken from the ISOR shows the EER values computed for three different LPG vs. diesel vehicle pairs labelled as "trolley", "upfit" and "school bus". The EER trend for the trolley with increased cycle average speed shows a different trend than those for the other two types, where the propane vehicle EER decreases with increasing speed.

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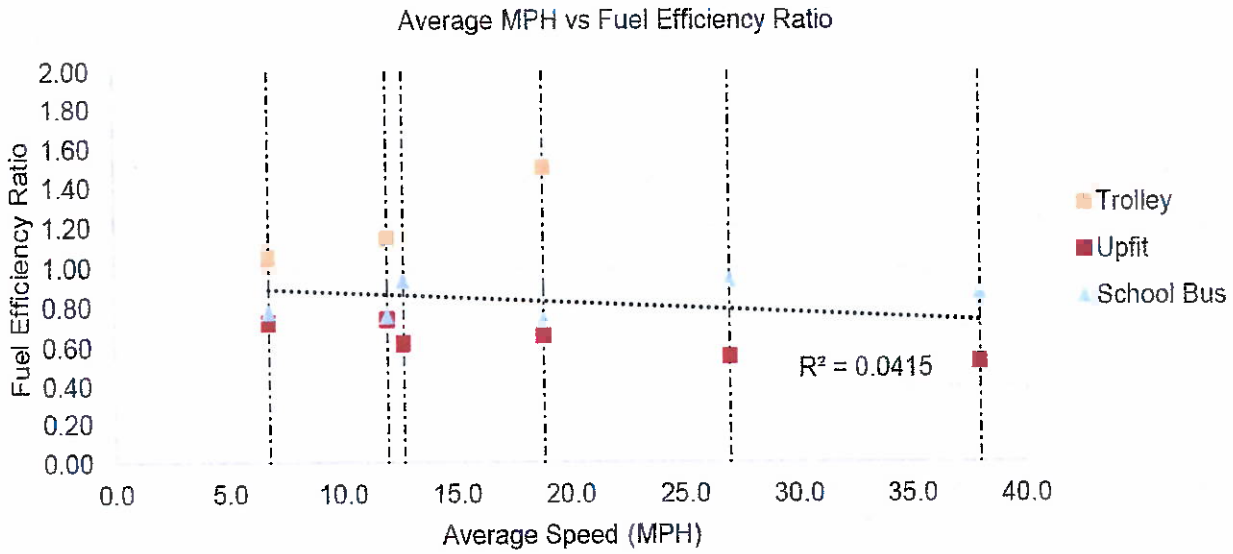

Figure 2: EER of Propane Buses relative to Diesel Buses

An examination of the data showed that mixing the track and dyno results could mask the real trends in the EER, and that the diesel trolley bus chosen for comparison had unusual fuel economy trends on the dyno compared to the trends for other vehicles. If the other trolley excluded by ARB in its analysis (for its test weight being about 20% heavier) is chosen for reference and the EER discounted by 20% (as a 1% increase in weight decreases fuel economy by approximately 1% in slow speed stop and go cycles), a more comparable set of figures emerge as shown below:

Test Type	Cycle	Trolley	Upfit	Bus
Dyno	Manhattan	0.83	0.72	0.78
	Orange	0.79	0.74	0.76
	UDDS	0.70	0.66	0.74
Track	CBD	0.90	0.62	0.93
	Arterial	0.93	0.55	0.93
	Commuter	1.02	0.52	0.87

While the data still shows some scatter, the low speed cycle data on the dyno suggest a propane bus EER of 0.74 for urban cycles. The high-speed arterial and commuter cycle data from the test track show a significant discrepancy for the "upfit" vehicles and the data on the

diesel upfit vehicles on the test track was difficult to reconcile against their performance on the dyno tests. One upfit diesel vehicle showed higher mpg on the dyno UDDS cycle than on the 38 mph commuter cycle which has only two stops and extensive cruise at 40 mph, and this appears unlikely in real world driving. Ignoring the upfit EER results would suggest an EER of 0.9 to 0.95 for higher speeds. The higher EER at higher speeds is also consistent with the narrowing efficiency differential between s.i. engines and diesel engines at higher speeds and loads.

The ARB has also estimated an EER of 1.0 for a propane bus relative a gasoline bus at urban speeds. Note that this is quite consistent with an EER of 0.74 for a propane to diesel bus comparison as the diesel is known to be 25 to 30 percent more efficient relative a gasoline engine at urban speeds.

5. EER for Transport Refrigeration Units

ARB acknowledges that the data from Transport Refrigeration units (TRU) is sparse and has estimated the EER from a single fleet using a sample of 4 diesel TRU units. Appendix H mentions that electricity use was obtained from one of the units but it is unclear if diesel and electricity use were obtained from the same unit. The EER developed uses the four diesel unit data and the single data point for electricity consumption. However, the diesel data showed vary large variance in the TRU diesel fuel consumption with one unit at 0.40 gal/hr, the second at 0.81 gal/hr, the third at 1.31 gal/hr and the fourth at 1.57 gal/hr, which is a 392% variance between units ostensibly of the same size. This would suggest that the refrigeration loads were very different between the units, and if electricity consumption was measured with diesel consumption on the same unit, it would be important to use a consistent set of data to derive the EER value. It is also unclear why the median electricity consumption value rather than the mean was selected to derive the EER.

The computed EER value of 3.4 may be a reasonable or somewhat optimistic value, as the efficiency of a diesel engine in cyclic operation is typically 25 to 30 percent, while the efficiency of an electric motor/ controller driving the compressor of the TRU can be in the 80% to 85% range which would suggest EER values in the 2.7 to 3.4 range.

6. EER for Electric Motorcycles

ARB has derived the EER for electric motorcycles based on a sample of electric motorcycles tested by the EPA on the UDDS cycle on the dyno, and comparing the energy use to gasoline motorcycles with similar rated power. However, the UDDS is a very slow speed cycle with gentle accelerations and multiple stops. Motorcycles have very high power-to-weight ratios relative to cars and trucks, and the UDDS is not likely to represent the driving cycle for most motorcycle owners. (ARB should also distinguish between on-road motorcycles versus

children's electric motorcycles which do not provide any energy benefit) In addition, gasoline motorcycle engines are designed for high specific output and are quite inefficient at the low speeds in the UDDS. The EER values of 8 to 10 found in the sample comparison are not applicable, and ARB has recognized this and suggested an EER of 4.4. However, no basis is provided for the staff multiplying the UDDS value of EER by 0.5 to obtain the 4.4 value. One option may be to use the US06 cycle for testing both electric and gasoline motorcycles as this would represent a more aggressive and well-developed cycle but not derived from motorcycle specific driving patterns. Otherwise, driving cycle data from instrumented motorcycles will need to be collected and a test procedure developed to characterize motorcycle EER.

Electric motorcycle efficiency can also be deduced from the battery capacity and claimed range from the motorcycle manufacturer websites. As an example, Zero motorcycles claims a city/highway combined range of 108 miles with a 13 kWh battery and a range of 138 miles with a 16.6 kWh battery for its Zero S model. Assuming that 90% of battery capacity is available for use, the energy consumption is 0.11 kWh/mi at the battery and 0.13 kWh/mi at the plug assuming battery charger efficiency and battery storage loss combined of 85%. The motorcycle has a motor rated at 60HP, which is comparable to gasoline motorcycles with a 650cc to 750cc engine. Data from the motorcycle fuel economy guide[2] shows ratings of about 60 to 70 mpg for many such vehicles (although there is a lot of variability) which indicates a potential EER of about 3.5. A more comprehensive analysis is required to establish a more accurate EER but we anticipate that EER values of about 3.5 may be more realistic than the 4.4 value suggested by ARB as we expect similar EER values to those derived for electric cars.

7. EER for Electric trucks and buses

ARB has derived data for electric bus EER values from tests conducted at the Altoona bus center, and the data suffers from many of the same issues raised for the propane bus EER analysis. As noted, the HVAC system is turned off during the tests. The Altoona bus tests showed a 5.4 EER for an electric bus relative to a diesel bus over the CBD cycle which has an average speed of 12.7 mph. As noted in Section 4, the track tests do not use "realistic" cycles and even comparisons between similar vehicles of different fuel types can be erroneous if the powertrain efficiency responds differentially to load.

A more valid comparison is obtained from the NREL study[3] comparing electric buses to CNG buses in the San Gabriel and Pomona Valley region where data was collected from in-service buses where the HVAC was functioning. This study is referenced by ARB but oddly, it shows

[2] www.totalmotorcycle.com/MotorcycleFuelEconomyGuide/2016b

[3] NREL, Foothill Transit Battery Electric Bus Demonstration Results, Technical Report NREL/TP-5400-65274, January 2016

data attributed to the NREL study that differ in fuel consumption by a factor of 2 for CNG buses to what is shown in the NREL study.

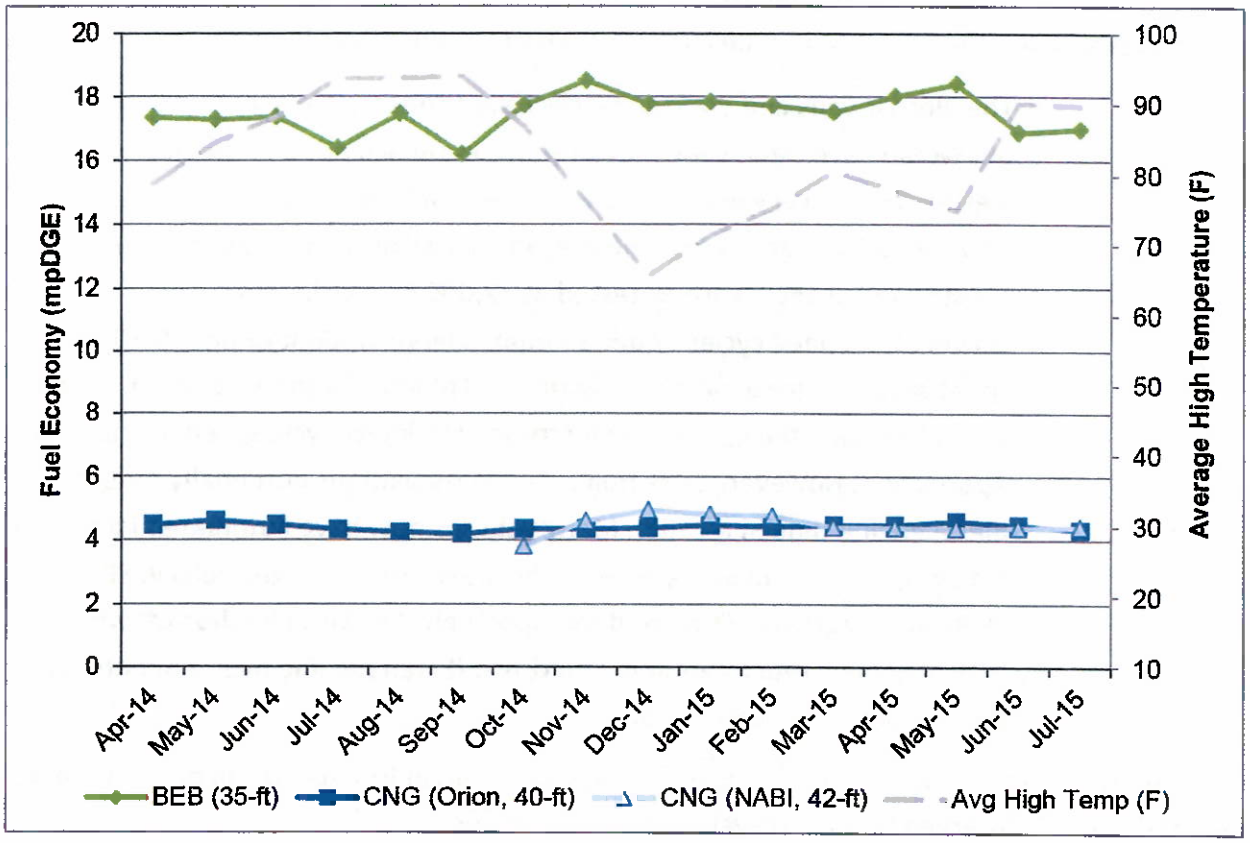

Figure 3: Fuel economy of Electric buses and CNG buses operated by Foothills Transit

The CNG bus fuel economy is shown as 2.1 mpg (diesel equivalent) in Appendix H but the NREL report lists the CNG bus fuel economy as 4.51 mpg diesel equivalent. The electric bus fuel economy is reported in both studies as 17.5 mpg so that the computed EER differs by more than a factor of 2. Our computation of EER for the electric bus from NREL data shows an EER of 3.29 relative to a diesel bus assuming that the diesel is 15% more efficient than a CNG bus. The NREL report indicates that average speed was 8.42 mph with over 50% of time at idle as evidenced by the average speed excluding idle time of 17.66 mph. Figure 3 shows the seasonal variations in fuel economy which are small as the valley has a mild climate but the dip in electric bus efficiency is significant during the warmer months and the electric bus efficiency dips as low as 16 mpg while the CNG bus efficiency declines to 4.1 mpg The EER also does not account for the fact that the CNG buses are larger than the electric buses (40 to 42 ft. long vs. 35 ft for the electric bus). At more extreme climates and especially at colder temperatures, we anticipate that the EER should be close to 3.

Results for the Drayage truck and the parcel delivery van are based on comparisons of more similar vehicles EV and diesel tested on the dynamometer. The issue of HVAC use is till pertinent but the energy consumption by the system on a truck is a smaller factor than on a bus. However, two other significant issues not considered by ARB affect the EER

- The electric vans and drayage trucks have the same GVW as the diesel trucks but would have significantly lower payload capacity due to the battery weight. The parcel vans may be volume constrained rather than load constrained in many cases. The drayage trucks however were obviously load constrained as they were all tested at 72,000 lb. GVW.
- On very low speed cycles under 15 mph, a large amount of time (>50%) is spent at idle. Since a diesel consumes fuel at idle but the EV consumes very little electricity, the EER should increase with lower cycle speed as shown in Appendix H. However, California anti-idle regulations potentially reduce diesel engine time in real life. Many vehicles now have automated idle shut-off after 1 minute of idling. Hence, the steep rise in electric vehicle EER is likely inaccurate for more modern diesel vehicles with idle shut-off which may become a requirement in California. (Extended idle over 5 minutes is already banned in California).

Based on these factors, we expect that Electric truck EER even at low speed will be in the same range of 3 to 3.5 observed for electric vehicles of other types.

8. Summary and Conclusions

A review of the energy efficiency ratios for alternative fuel vehicles show the following results

- The EER value of 3.0 for electric light duty vehicles relative to gasoline vehicles may be appropriate for mild weather but is likely to be lower at more extreme ambient temperature
- The EER for Fuel cell light duty vehicles appears to be overstated based on the actual measured fuel economy data for the three fuel cell vehicles available commercially in 2018
- The EER values for propane buses derived from Altoona Bus Testing Center data rely on tests that do not resemble real world use. An EER of 0.74 may be appropriate for propane buses but this needs confirmation on tests with the bus HVAC system operating normally.
- The EER for Transport Refrigeration Units is derived from a small and excessively variable set of data. It is unclear if the comparison between

electricity consumption and diesel consumption is based on the same duty cycle.

- The EER for electric motorcycles appears to have been derived arbitrarily. Data from motorcycle websites suggest lower values than those developed by ARB but more research is required.
- The EER for electric buses operating at urban speeds appears to be significantly overstated and appears to partly based on a misreading of NREL data.
- The EER for commercial electric trucks compares energy efficiency at the same gross weight which ignores the loss of payload due to the weight of the battery (which can be very significant). In addition, diesel engines operating at very low speed cycles which involve extensive idle will have significant efficiency improvement with idle shutoff, a feature that will have significant market penetration due to EPA GHG regulations on trucks.

EER Summary

Vehicle Type	EER recommended by ARB	Suggested Correction
Battery Electric Cars (LDV)	3.0	Could be reduced by 10 to 15% in summer and winter
Battery Electric Light Duty Trucks (LDT)	3.0	As above, plus payload reduction in cargo trucks
Hydrogen Fuel Cell LDV	2.3	About 2.0, weather effects unknown
CNG LDV/LDT	1.0	0.9 for aftermarket conversions
LPG Bus	0.9	0.74 at urban speeds (<20 mph)
Electric TRU	3.4	ARB data too variable for conclusion
Electric Motorcycles	4.4	Probably closer to 3.5, need data
Electric Bus	4.8 at urban speed	About 3 as an all-season average
Parcel and Drayage Trucks	4 to 5.5	Payload loss, seasonal effects and diesel idle shutoff not accounted for.

Curriculum Vitae

For

K.G. Duleep

K.G. Duleep

President, H-D Systems

EDUCATION

M.B.A., Finance, Wharton School, University of Pennsylvania, Philadelphia, PA, 1989

Doctoral Candidate, Aerospace Engineering – Combustion, University of Michigan, Ann Arbor, MI, 1976

M.S., Aerospace Engineering/Computer Information and Control Engineering, University of Michigan, Ann Arbor, MI, 1975

Bachelor of Technology, Aerospace Engineering, Indian Institute of Technology, Madras, India 1972

EXPERIENCE OVERVIEW

K.G. Duleep is President of H-D Systems, a new consulting firm which is a spin-off of the EEA automotive technology group, in the Washington, DC metropolitan area. His extensive work on vehicle energy use, cost and performance of fuels and engine technology and manufacturing costs have been widely cited around the world. Through his work, he meets periodically with the technical staffs of most of the world's largest auto-manufacturers to discuss new technology and has obtained key insights on vehicle development through this process. He is well known for his work on vehicle fuel economy technology and his CAFE forecasts under alternative scenarios have been the basis for many regulatory and policy discussions in Congress. In 2008/9, he directed analyses as a support contractor to the National Academy of Sciences Committee on Fuel Economy Standards, and he is currently involved in the new CAFE standards for the post-2016 time frame. He has also performed studies on life cycle energy use and the energy use in vehicle manufacturing. He was the developer of the fuel economy forecasting algorithm embedded in NEMS, which he and his group has updated periodically.

PROJECT EXPERIENCE

Fuel Economy Modeling and Forecasting, EIA and CEC, 1990 –Present. Developed detailed forecasting models of light and heavy vehicle fuel economy that are modules within the NEMS model and the CALCARS models. Models were periodically updated by Mr. Duleep over the last 20 years.

Automotive Technology Cost Analysis, Department of Energy, ongoing. Direct multi-year task order contract with DOE'S Policy Office to evaluate costs and benefits of new automotive technologies. Also serve as technical lead on advanced engine technology analysis. Coordinate efforts of two major subcontractors. Most recent project in 2014-15 covered engine technology potential from use of 98 octane E25 (25% ethanol) blends.

Technology Planning, U.S. Oil Refiners, Japanese Auto manufacturers, 1996–Present. Provides technology planning and emissions compliance support to oil refiners and import auto manufacturers. The work involves detailed assessment of new technology for vehicles and estimation of their impact on vehicle fuel economy, cost, drivability and reliability. Forecast of technology penetration in different markets and segments of the fleet are also part of the services provided.

Alternative Fuels Outlook, Califoria Energy Commission, Led the study of alternative fuel vehicles as a means of reaching California's GHG reduction goals. Reported on the current state of vehicles and forecasted the economic viability of alternative fuels in the state considering potential roadblocks such as higher costs and increased weight. Estimated the required capital requirements for any incremental infrastructure that may be necessary. Provided strategic recommendations on investment priorities and mechanisms to accelerate commercialization of alternative fuels and technologies.

Analaysis of Fuel Cell/ Hydrogen Power in Non-Automotive Markets, US DOE, 2009-2010. Examined the potential for PEM fuel cells in diverse markets like stand-by power, fork lift trucks, and combined residential heat and power for the US. Work was a follow-on to a market penetration analysis for fuel cells in automotive markets.

An overview of Electric Vehicles and Plug-in Hybrid Electric Vehicles, European Commission Directorate-General Environment. Provided consultation to the EU concerning the impacts of an attributes-based standard such as weight-based standards on fuel economy and GHG emissions. Created a simple model that could verify the results of a very complex model with hundreds of inputs.

Analysis of Light Duty Vehicle Weight Reduction Potential, Department of Energy, Directed a large scope of study focusing on weight reduction technologies as capable of significant fuel economy improvement at potentially low costs. Utilized the staff capabilities developed in this area as a result of weight reduction analysis for the US EPA, California Air Resources Board (ARB) and other clients. Conducted high level meetings with weight reduction experts through his extensive contacts in the auto-industry and the Tier I supplier base.

PUBLICATIONS AND REPORTS

Mr. Duleep has over 50 publications in technical society and peer reviewed journals and has authored over 200 reports to clients. He also has authored two encyclopedia articles on Internal Combustion engine efficiency.

AWARDS/HONORS

SAE Award for Contribution to Public Policy Analysis, 2011

Directors List (First Rank), Wharton School, 1989

Merit Scholarship, University of Michigan, 1974

First Prize Winner, University Science Fair, India, 1971

PROFESSIONAL AFFILIATIONS

Tau Beta Pi (Engineering Honor Society)

Society of Automotive Engineers

LANGUAGES

English, Hindi and Tamil

EMPLOYMENT HISTORY

ICF International	Managing Director	2007-2011
Energy and Environmental Analysis, Inc.	Managing Director	1997-2007
Energy and Environmental Analysis, Inc.	Director	1988-1997
Energy and Environmental Analysis, Inc.	Senior Consultant	1979-1988
Bendix Electronics and Engine Control Systems Group	Senior Engineer	1976-1978
Aeronautical Development Establishment (India)	Junior Scientific Officer	1972-1973

APPENDIX "C"

APPENDIX "C"

Appendix C

Domestic Ethanol "Shuffling" in Response to the LCFS

Prepared by Edgeworth Economics

April 26, 2018

Since even before the LCFS was initially implemented, it has been noted that one potential mode of compliance could be fuel "shuffling," or rationalization of existing supplies, whereby fuels with different CI scores would be shifted between markets, with no beneficial impact on overall carbon emissions.[1] As described in a 2012 paper by researchers at U.C. Davis:[2]

> Shuffling will reduce the effectiveness of low-carbon fuel policies by appearing to achieve GHG emission reductions on paper even though no net GHG emission reduction takes place in reality. In the worst case, net emissions could actually increase due to the extra transport distance required to shuffle fuels and/or feedstock.

Most of the focus on the potential for fuel shuffling has been directed towards the markets for crude oil and the bilateral ethanol trade between the U.S. and Brazil.[3] However, given the numerous pathways with widely varying CI scores among domestic ethanol refineries, shuffling has been predicted as a likely compliance response for refined fuels within the U.S., as well.[4]

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[1] See, for example, Alexander Farrell, Daniel Sperling, et al., "A Low-Carbon Fuel Standard for California Part 1: Technical Analysis," Institute of Transportation Studies, U.C. Berkeley, May 29, 2007, p. 14.

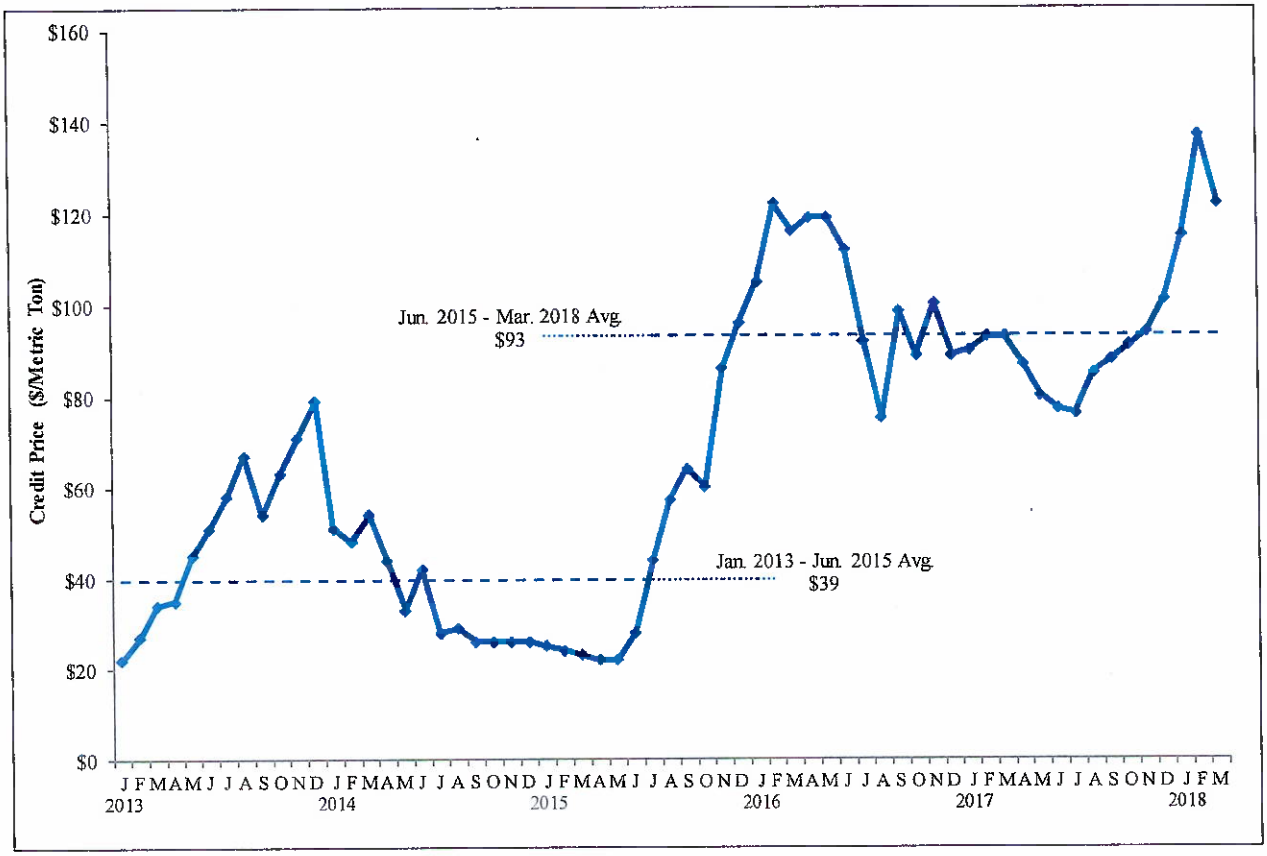
[2] Sonia Yeh, Daniel Sperling, et al., "National Low Carbon Fuel Standard: Policy Design Recommendations," Institute of Transportation Studies, U.C. Davis, July 2012, p. 72.

[3] See, for example, Sonia Yeh, Julie Witcover, and Jeff Kessler, "Status Review of California's Low Carbon Fuel Standard," Institute of Transportation Studies, U.C. Davis, Spring 2013, p. 6; and Sonia Yeh, Daniel Sperling, et al., "National Low Carbon Fuel Standard: Policy Design Recommendations," Institute of Transportation Studies, U.C. Davis, July 2012, p. 12.

[4] See, for example, "Response by Growth Energy to the Request for Comment on Proposals to Establish a Washington Clean Fuel Standard Program," comments submitted to the Washington Department of Ecology, March 4, 2015, pp. 8-9.

Prior to 2016, credit prices generally had remained low, averaging about $44 from 2013 through 2015. (See Figure 1.) The incentive for shuffling therefore had been muted. In late-2015, however, credit prices rapidly escalated, from $28 in June 2015 to as high as $122 in February 2016. A recent spike caused prices to reach a new monthly high of $137 in February 2018. Since July 2015, credit prices have averaged $93, compared to $39 prior to that date. Other factors equal, this shift would be expected to increase the incentives for fuel shuffling.

Figure 1
CARB Average Monthly Credit Price

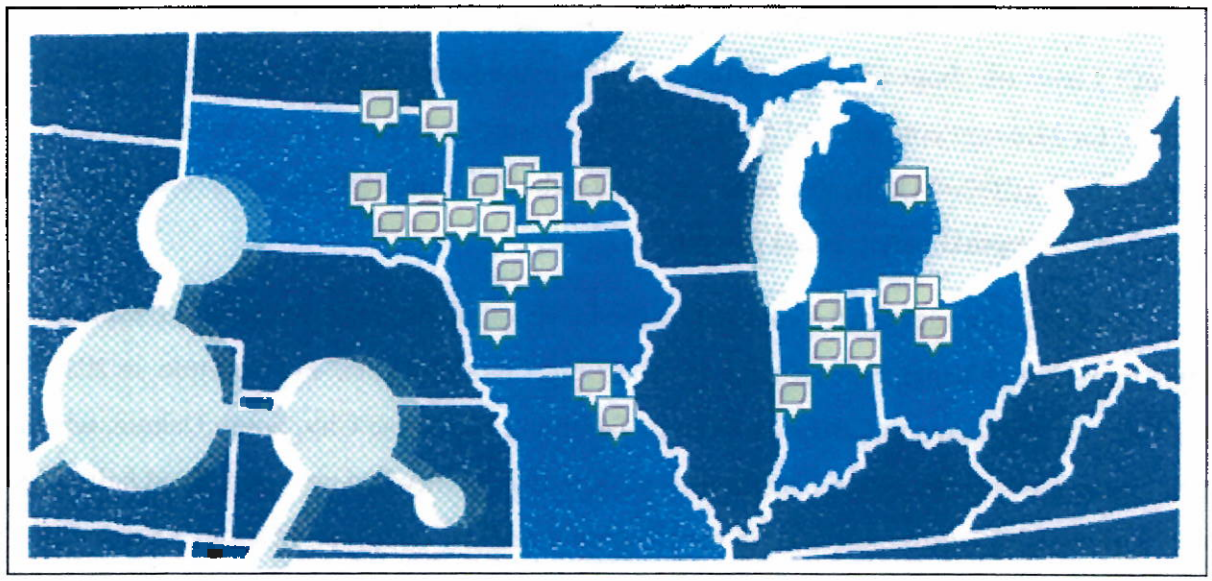


Source: CARB website, www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm.

Edgeworth Economics has been asked by Growth Energy to evaluate production and shipment data from POET, one of the largest U.S. ethanol refiners, to determine the extent to which refiners are shuffling domestic ethanol production and to identify potential consequences for emissions reductions and transportation costs. POET's operations provide a useful cross-section of U.S.-based refineries for this purpose, since the company manages 27 separate

facilities across a broad region of the Midwest (see Figure 2) which have been assigned a wide range of CI scores.[5]

Figure 2
POET Ethanol Refineries



Source: POET website, poet.com/plants.

Prior to implementation of the LCFS in 2011, ethanol from all production facilities was essentially a fungible commodity. POET matched production facilities and customer locations based primarily on logistics costs and therefore organized deliveries to account for rail access, schedule, tariffs, and other factors. For example, POET never delivered ethanol to California from its plants located in the eastern part of its territory—Indiana, Ohio, and Michigan—but rather has used plants in South Dakota, Iowa, and Minnesota for this purpose, particularly those with favorable rail access. In 2010, POET delivered ethanol to California from 15 different facilities located in those three states.

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[5] Since 2005, POET has delivered ethanol to California from 17 different facilities, each producing and shipping at various times ethanol produced in combination with both "wet" and "dry" distillers grains with solubles ("WDGS" and "DDGS"). Production of DDGS requires additional energy, relative to WDGS, and therefore ethanol refined during a process that creates DDGS is assigned higher CI scores than ethanol refined during a WDGS process. Since implementation of the LCFS in 2011, POET has shipped ethanol to California from plants assigned CI scores in the range of 63.9 to 98.4 gCO2e/MJ.

Since the implementation of the LCFS in 2011, however, demand for ethanol by customers in California has been influenced by the CI score granted to the particular refineries and the contemporaneous price of credits, which together determines the financial impact of purchasing and blending ethanol from the various sources. The range of values of the credits generated by ethanol with different CI scores can be significant. At a credit price of $100, each point of CI is worth about $0.01 per gallon gasoline-equivalent ("gge"). Based on the pathways available for Midwest corn ethanol as of 2011, which were granted CI scores in the range of about 80 to 98 gCO2e/MJ, the difference in credit value for ethanol from POET's various plants was as high as approximately $0.20 per gge.

As a result of the penalty imposed by the LCFS on high-CI ethanol from the Midwest, POET immediately began rationalizing, or "shuffling," its shipments. For example, in 2011 POET ceased shipments to California from its facility in Big Stone City, South Dakota, which has a higher CI than other POET facilities. In 2010, that facility had provided about half of its total output—37.5 million gallons—to the California market, representing about 3 percent of California's requirement for fuel ethanol. Big Stone City, however, did not reduce its production of ethanol in 2011. Instead, the entire output of the facility was redirected to other markets in the U.S. Thus, higher CI fuel was simply sold to markets outside of California. Moreover, it is likely that overall emissions associated with the output of that facility increased, as the re-orientation of POET's logistics to other states likely involved greater transportation distances.

Another set of major adjustments for POET occurred in 2016, following the sharp increase in credit prices in late-2015. POET began to concentrate its California deliveries from a limited number of low-CI plants. In 2016, POET reduced the number of facilities delivering to California from 13 in 2015 to eight in 2016. By 2017, POET was delivering product to California from only three facilities, although the total quantity of ethanol delivered into California was essentially unchanged relative to 2010. Most of POET's California volumes now come from a single plant, Chancellor, which has received a favorable CI score due to its capability to use landfill gas and biomass as an energy source.

While the adjustment may help reduce the CI of California's fuel portfolio, the LCFS regulation does not maximize GHG benefits system-wide. The 12 POET facilities that delivered

ethanol to California prior to the LCFS, but that no longer do so due to higher CI scores, are now simply shipping the same fuels outside California. Moreover, the increase in logistical costs associated with the reorganization of POET's deliveries likely has been associated with additional emissions from transport to less convenient locations.

In summary, the incentives created by the LCFS credit mechanism have caused POET to reorganize its delivery pattern, with little, if any, change in the output from both its high-CI facilities and its low-CI facilities. The primary difference is that this reorganization has caused the company to incur greater logistics costs and likely has generated additional carbon emissions (relative to pre-LCFS) due to greater transportation distances.

Curriculum Vitae

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Jesse David heads the Los Angeles office for Edgeworth Economics. Dr. David is an expert on the valuation of intangible assets, market definition, and the assessment of economic impacts in complex commercial disputes and regulatory proceedings. His experience spans intellectual property, antitrust, labor, regulatory, and class certification matters, among other economic issues related to the intersection of business and government.

Dr. David has provided economic consulting and expert testimony for many industries, including pharmaceuticals, telecommunications, agricultural products, finance, petroleum products, chemicals, software, and consumer products. He frequently submits expert reports to and testifies before decision-making bodies, including U.S. federal and state courts, the Federal Energy Regulatory Commission, the National Energy Board of Canada, and various arbitration venues.

Dr. David's consulting practice also includes developing cost-benefit analyses of government regulations and assessing the economic impacts of government policies and other changes in industry structure. Dr. David has prepared studies for entities such as the American Trucking Association, the National Football League Players Association, the San Diego County Water Authority, the New York Power Authority, and the Ocean Conservancy.

Education

Stanford University
Ph.D., Economics, 2000

Brandeis University
B.A., *magna cum laude*, Economics and Physics, 1991

Employment

Edgeworth Economics, LLC, Washington, D.C.
2012 - present, Partner
2009 - 2012, Senior Vice President

Criterion Economics, LLC, Washington, D.C.
2009, Senior Vice President

National Economic Research Associates, Inc., White Plains, NY
2004 - 2009 Vice President
2000 - 2004 Senior Consultant
1997 - 1999 Senior Analyst

Stanford University, Palo Alto, CA
1993 - 1995 Research Assistant/Teaching Assistant

Testimony and Expert Reports

XY, LLC, Beckman Coulter, Inc. and Inguran, LLC d/b/a STgenetics v. Trans Ova Genetics, LC, U.S. District Court for the District of Colorado. Expert report, April 13, 2018.

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Dow Corning Corporation and Hemlock Semiconductor Corporation v. Jie (George) Xiao, LXEng LLC, and LXE Solar, Inc., U.S. District Court for the Eastern District of Michigan, Northern Division. Declaration, January 9, 2012; expert report, March 1, 2012.

Riverplace Development, LLC v. Charles Cranford, Esquire and Rogers Towers, P.A., Circuit Court, Fourth Judicial Circuit, in and for Duval County, Florida. Depositions, October 12, 2011 and December 21, 2011.

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Student Lifeline, Inc. v. The Senate of the State of New York, et al., U.S. District Court for the Eastern District of New York. Expert report, January 29, 2007; deposition, July 26, 2007.

Pediatrix Screening, Inc. et al v. Telechem International, Inc., U.S. District Court for the Western District of Pennsylvania. Expert reports, December 15, 2006, February 16, 2007, and July 6, 2007; deposition, March 28, 2007; trial testimony, July 18-19, 2007.

Green Mountain Chrysler-Plymouth-Dodge-Jeep, et al. v. Torti, U.S. District Court for the District of Vermont. Expert reports, October 9, 2006 and January 17, 2007.

The Procter & Gamble Company v. Teva Pharmaceuticals USA, Inc., U.S. District Court for the District of Delaware. Expert report, August 31, 2006; deposition, October 13, 2006; trial testimony, November 6, 2006.

Central Valley Chrysler Jeep, Inc. et al. v. Witherspoon, U.S. District Court for the Eastern District of California. Expert reports, June 12, 2006, October 9, 2006, and January 16, 2007; deposition, October 27, 2006.

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Merck & Co., Inc. v. Teva Pharmaceuticals USA, Inc., U.S. District Court for the District of Delaware. Expert report, April 6, 2006; deposition, August 8, 2006.

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Re Colonial Pipeline Company, Federal Energy Regulatory Commission. Declaration, February 28, 2006.

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Touch-n-Buy, Inc. v. Radiant Telecom, Inc., et al., U.S. District Court for the Southern District of Florida. Expert report, November 9, 2005; deposition, February 8, 2006.

Jamaica Recycling Corp., et al. v. The City of New York, et al., Supreme Court of the State of New York, County of New York. Affidavit, August 18, 2005.

Amerisource Corporation v. RX USA International, Inc., et al., U.S. District Court for the Eastern District of New York. Expert report, August 15, 2005; deposition, June 5, 2006.

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Forrest W. Garvin and E-Netec, Corp. v. McGuireWoods, LLP, et al., General Court of Justice, Superior Court Division for the State of North Carolina, Mecklenburg County. Deposition, July 27, 2004.

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Allocco Recycling, Ltd. v. John Doherty, U.S. District Court for the Southern District of New York. Expert report, February 4, 2004; deposition, December 9, 2004; declaration, December 2, 2005.

Pinnacle Systems, Inc. v. XOS Technologies, Inc., et al., U.S. District Court for the Northern District of California. Expert report, November 7, 2003; deposition, January 15, 2004; trial testimony, February 11, 2004.

Sinclair Oil Corporation v. BP Pipelines (North America), Inc., Federal Energy Regulatory Commission. Direct testimony, September 18, 2003; rebuttal testimony, March 16, 2004.

SELECTED CONSULTING PROJECTS AND REPORTS

Economic Issues Associated with a Change in the RFS Point of Obligation. Analysis of proposals put forward by various petitioners to change the point of obligation for the RFS regulation from refiners/importers to blenders.

Calculation of potential exposure related class action claims for false labeling of retail food product. Analysis of retail scanner data and wholesale transaction databases to determine potential price premiums associated with label claims and calculate potential damages related to allegedly false claims.

Calculation of potential exposure related class action claims for unpaid wages. Analysis of card-swipe, payroll, and scheduling data for a public utility to assess potential damages in a class action claim.

Analysis of EPA's Proposal for a Reduction in the RFS Volume Requirements for 2014. Analysis of EPA's proposal to adjust the volumetric requirements under the RFS.

Economic Impacts of the RFS Program: An Analysis of the NERA Report Submitted to the EPA. Analysis of the findings of NERA and CRA regarding economic impacts of waiving the Clean Air Act requirement for ethanol blending in gasoline.

Calculation of potential exposure related class action claims for payroll violations. Analysis of login, payroll, and expense report data for financial services firm to assess potential damages in a class action claim.

The Impact of a Waiver of the RFS Mandate on Food/Feed Prices and the Ethanol Industry. Analysis of the impacts of waiving the Clean Air Act requirement for ethanol blending in gasoline on animal feed prices, household expenditures on food, and the ethanol industry.

Analysis of generic pharmaceutical company's exposure for a potential at-risk launch. Financial analysis of the potential damages against a pharmaceutical company for launching a generic product before patent expiration.

Analysis of coal supply contract escalator. Report on the expected escalation in various cost indices used to determine the pricing of coal in a contract between a mining company and an electric utility.

Review of PHMSA's Regulatory Analysis for the External Piping Requirement. Analysis of cost-benefit for a proposed regulation on external loading pipes for hazardous materials tankers. Testified before Congressional Sub-Committee.

The Economic Impact of a Potential NFL Lockout in 2011. Analysis for the National Football Players Association of the impact of a loss of professional football games to the local economies of host cities.

Review of FMCSA's Regulatory Impact Analysis for the 2010-2011 Hours of Service Rule. Cost-benefit study for the American Trucking Associations on the proposed change in regulations of hours of service for long-haul truckers.

Consulting for an electric power cooperative on class certification in a claim for trespass damages. Analyzed factors involved in hypothetical negotiations between landowners and a transmission line operator related to value of an easement for telecommunications use.

A Cost-Benefit Analysis of Gear Replacement for Gulf Shrimp Fishermen. Analysis prepared for the Ocean Conservancy on the costs and benefits associated with industry-wide changes in equipment used by shrimp fisherman in the Gulf of Mexico.

Analysis of the impacts on competition of a merger in the solid-waste collection industry. Prepared databases for turnover to the U.S. Department of Justice in response to a Second Request. Prepared economic and statistical analyses of transaction data to address questions of competitive impact of consolidation.

A Review of FMCSA's Regulatory Evaluation for the Proposed Minimum Training Requirements for Entry-Level Commercial Motor Vehicle Operators. Analysis of the U.S. Department of Transportation's proposed regulation regarding the minimum training requirements for truck and bus drivers.

Separable Costs–Remaining Benefits calculation for a dam reconstruction project. Report on cost allocation for a municipal water district which assessed the relative benefits and costs of recreational and water-supply uses of a reservoir.

Peer review for U.S. EPA STAR Grant program. Peer review of grant applications to the EPA's National Center for Environmental Research. Provided expertise in the areas of environmental economics, statistics, and policy analysis.

Evaluation of potential Natural Resource Damage liabilities at current and former aerospace manufacturing sites. Estimated the potential costs associated with NRD liabilities at contaminated sites for an aerospace manufacturer, for use in negotiations with insurance carriers.

Non-compete valuation for real estate executives. Assessment of the value of non-compete agreements for two senior executives at a real estate management firm.

Evaluation of Natural Resource Damage liabilities at an operational mining site. Report on the potential litigation and regulatory risk associated with environmental damages at an operational mining site, including estimates of cost, probability, and timing.

Economic impact report for entertainment-related industry. Analysis of the economic impact of an entertainment-related industry on the economies of four states, including the impact of content-generation, distribution, and retail sales on employment, output, and tax revenue.

The Past, Present, and Future Socioeconomic Effects of the Niagara Power Project. Analysis of the economic impact of a hydro-electric facility on the local and regional economies, demographics, industry, and real estate as part of a supplemental environmental impact statement for re-licensing.

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Research Associates 2005); also in Economic Damages in Intellectual Property (Daniel Slottje ed., John Wiley & Sons 2006); co-authored with Marion B. Stewart.

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"The Welfare Implications of Recycled Newsprint Regulation," doctoral dissertation, Stanford University (2000).

PRESENTATIONS

"Classwide Damage Models in Misleading and False Advertising Consumer Class Actions," Strafford CLE webinar, November 2017.

"Hedonic Price Regressions in False Advertising Class Actions," webinar for The Knowledge Group: *Expert Testimony and Survey Methodology in False Advertising Cases: A 2017 Perspective*, January 2017.

"Food & Beverage Class Actions: National Trends, Best Practices, and Emerging Claims," at Perrin Conference: *Challenges Facing the Food and Beverage Industries in Complex Consumer Litigations*, Chicago, IL, April 2014.

"Clone Wars: *Abraham & Veneklasen Joint Venture v. American Quarter Horse Association*," webinar for the ABA Section of Antitrust Law, Agriculture and Food Committee, March 2014.

"Expert Data Analysis in Wage & Hours Class Actions after *Dukes*, *Comcast*, and *Brinker*," at American Conference Institute's 19th National Forum on Wage & Hour Claims and Class Actions, San Francisco, CA, September 2013.

"Food Labeling Class Actions: Economic and Legal Perspectives on the Rule 23 Predominance Requirement," Edgeworth Economics Webinar, June 2013.

"Economic Issues in Pharmaceutical Patent Litigation," at Edgeworth Economics CLE Seminar, Washington, DC, September 2010.

"The Evolution of a Complex Damages Report," at Edgeworth Economics CLE Seminar, Philadelphia, PA, April 2010.

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"Comparables: The Use and Misuse of Benchmark Royalty Rates for Patent Damages," at NERA CLE Seminar, San Francisco, CA, January 2007.

"When You Get to the Fork in the Road, Take It! Alternative Approaches to Defending your Transaction before the Agencies," at *NERA Antitrust Trade and Regulation Conference*, Santa Fe, NM, July 2006.

"The Role of Economic Analysis in Intellectual Property Litigation," at Sonnenschein Nath & Rosenthal CLE Program, Chicago, IL, January 2006; also at *NERA Intellectual Property Roundtable*, Tokyo, Japan, July 2004.

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"The Role of Economics in Complex Business Litigation," at Columbus Bar Association CLE Program, Columbus, OH, December 13, 2004.

"Is Bankruptcy the Answer?" at *Asbestos Litigation Conference* sponsored by Glasser LegalWorks, New York, NY, April 2003.

The Secondary Impact of Asbestos Liabilities, at U.S. Chamber of Commerce conference: *Understanding Asbestos Litigation: The Genesis, Scope, and Impact*, Washington, D.C., January 2003.

"Trends in Intellectual Property Litigation," at Licensing Executives Society conference, San Jose, CA, April 2002.

"Environmental Risk and the Bottom Line," at 2001 NAEM *Environmental Management Forum*, San Antonio, TX, October 2001; also at *Financial Executives Summit*, Scottsdale, AZ, May 2001.

"Competitive Analysis in the Refined Petroleum Products Pipeline Industry," at *Advanced Workshop in Regulation and Competition*; Competitive Change in Network Industries 14th Annual Western Conference, San Diego, CA, June 2001.

APPENDIX "D"

APPENDIX "D"

Comments on the CaGREET3.0 Model and Corn and Sugarcane Calculators

April 23, 2018

By Thomas Darlington, Air Improvement Resource Inc.
Donald O'Connor, (S&T)^2 Consultants Inc.

In connection with its consideration of the amendments to the LCFS regulation, ARB has developed a new model, CaGREET3.0, to determine the carbon intensity ("CI") of various regulated fuels. To develop the new model, CARB adapted most of the Argonne GREET2016 model. We support this method in general; that is, that the California GREET model should be consistent with the latest Argonne GREET model and data for corn farming and other factors. We are concerned, however, that CARB did not incorporate some important components of the Argonne GREET2016 model, and that certain aspects of the CaGREET3.0 model are not supported by the evidence.

Corn Ethanol

ARB made the corn ethanol emissions in CaGREET3.0 to be mostly consistent with the GREET2016 model. We have two comments on this update: (1) staff did not include the distillers' grains methane credit in GREET2016, and (2) the emissions for medium and heavy-duty trucks appear to be out-of-date.

Distillers Grains Methane Avoidance Credit

In addition to ethanol, all dry mill ethanol plants produce distillers' grains, which are fed to livestock. The distillers' grains can either be wet (used immediately), or it can be dried and used later. Beef cattle that are fed distillers grains (either wet or dry) have reduced enteric fermentation as compared to cattle that are not fed this product, and the result is lower methane emissions overall from cattle. Methane is a greenhouse gas. The emission credit from reduced methane emissions from cattle is called the DDG methane avoidance credit.

GREET2016 contains distillers' grains (DDG) methane avoidance credit. The credit is 2.1 g/MJ, which is sufficient to have a material effect on the CI of an applicant's pathway. ARB's rationale for not including this credit is stated in its report on CaGREET2.0.

> There is no credit for reduced enteric fermentation emissions due to the inclusion of DGS in livestock ratios in LCFS ethanol pathways. The animals consuming the DGS are not currently in the LCFS LCA ethanol system boundary. [1]

[1] *CA-GREET 2.0 Supplemental Document and Tables of Changes*, ARB Staff Update, June 4, 2015, page 49.

This stated reason for not including the DGS methane avoidance credit is inconsistent with ARB's granting of a LCFS pathway for methane produced from livestock manure, in which case the pathway was allowed a substantial credit for methane avoidance similar to the methane avoidance credit for DGS. [2] If ARB allows a methane avoidance credit for methane produced from manure, ARB should allow a methane avoidance credit for corn ethanol from DGS use as well.

CARB staff's decision to not provide a DDG methane avoidance credit is also inconsistent with ISO life cycle assessment (LCA) standards. The LCA concept emerged in the late 1980's from competition among manufacturers attempting to persuade users about the superiority of one product choice over another. As more comparative studies were released with conflicting claims, it became evident that different approaches were being taken related to the key elements in the LCA analysis:

- Boundary conditions (the "reach" or "extent" of the product system);
- Data sources (actual vs. modeled); and
- Definition of the functional unit.

In order to address these issues and to standardize LCA methodologies and streamline the international marketplace, the International Standards Organization (ISO) developed a series of international LCA standards, specifications, and technical reports under its ISO 14000 Environmental Management series. The main contribution of these ISO standards was the establishment of the LCA framework that addressed the inconsistencies and allowed for proper comparisons between products or systems.

CARB staff's decision to not provide a DDG methane avoidance credit is also inconsistent with ISO LCA standards. In CARB's approach, the lifecycle system boundary includes the production and use of corn ethanol but only the production of the DDG. This approach is inconsistent with the ISO LCA standard 14044, which states:

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[2] Pathway T2R-1062, Fuel Producer: California Bioenergy LLC (B194) Facility Name: Kern County Dairy Biogas Cluster (B2139). Dairy Biogas from Kern County from dairy manure covered aneaerobic lagoons to CNG in California (accounting for avoided methane per ARB Livestock Offset Protocol), https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm. Pathway CI is -272.97 for the LCFS.

> LCA addresses the environmental aspects and potential environmental impacts (e.g. use of resources and environmental consequences of releases) throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling, and final disposal (i.e. cradle-to-grave).[3]

CARB have deviated from international norms by effectively truncating the system boundary so as to exclude the emission benefits of the use of DDG compared to other animal feeds.

Trucking Transport Emissions

Table 1 shows the fuel economy and energy consumption of medium-heavy and heavy-heavy duty diesel trucks in CaGREET3.0.

Table 1. Energy Consumption of MHDT and HHDT Trucks in CaGREET3.0

Truck Type	Fuel economy (mpg)	Energy Consumption (Btu/mile)	BTU/ton
HHDT	5.3	24,236	1,616
MHDT	10.4	12,351	1,544

As shown in Table 1, the energy use for HHDTs is higher than for MHDTs. In CaGREET3.0, it is not logical that the energy use per ton-mile is lower for a medium duty truck than it is for a heavy-duty truck. CaGREET3.0 overestimates the fuel use for a heavy-duty truck and underestimated the fuel use for a medium duty truck compared to the most recent values in the Oakridge National Laboratories Transportation Energy Use Data Book (see Table 2).[4]

Table 2. Trucking Fuel Economies in CaGREET3.0

Vehicle Type	CA GREET (mpg)	Transportation Energy Use Data Book (mpg)
MDT	10.4	7.4
HDT	5.3	5.9

In addition to the energy use being questionable, the load size is too small for the heavy-duty truck at only 15 tons. While the maximum load size will vary by state a typical value is 20 tons for a heavy-duty truck.

Table 3 shows the impact of making changes in the fuel economies for MHDTs and HHDTs, and also a change in load size for HHDTs from 15 to 20 tons.

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[3] https://www.iso.org/obp/ui/#iso:std:iso:14044:ed-1:v1:en

[4] Transportation Energy Data Book. https://cta.ornl.gov/data/index.shtml

Table 3. Impacts of Fuel Economy Change and Load Size Change on Corn Feedstock Production	
Case	Feedstock Production CI (g/MJ)
CaGREET3.0 Default	17.33
Updated fuel economies (see Table 2)	17.31
Updated fuel economy and load change	17.04

Furthermore using the same energy per ton-mile for the delivery as the return trip (backhaul) is not appropriate as the load is on the order of 50%. The impact of all of the transportation issues is that the transport emissions are overstated.

Sugarcane Ethanol

We have several comments on the sugarcane ethanol emissions: (1) the quantity of nitrogen in sugarcane in aboveground residues has been set to the lowest value found in literature; also the nitrogen in the root biomass is not included in GHG calculations, (2) the amount of fertilizer applied to sugarcane is 40% lower than the Brazilians use their emissions model, and (3) N_2O emissions from nitrogen in fertilizer are too low and not consistent with N_2O emissions from fertilizer in other countries. These issues are discussed further below.
Estimated nitrogen amounts in sugarcane, and fertilizer amounts

Estimated nitrogen amounts in the biomass and fertilizer of sugarcane in CaGREET3.0 are shown in Table 4.

Table 4. Nitrogen Input Comparison		
Component	Ca GREET2.0	Ca GREET3.0
Fertilizer	800	1,025**
Crop Residue*	1,036	705
Filtercake	36	36
Vinasse	205	205
Roots	0	0
Total	2,077	2,302

*Referred to as "above and below biomass" in GREET. But it does not include the biomass of the roots.
** Includes 225 g "supplemental N"

The CaGREET3.0 value for the nitrogen content of the aboveground biomass emanates from GREET 2012 rev 2. The data sources and the values are shown in the following table.

Table 5. GREET Sugarcane Biomass N Content	
Source	Value
Macedo [5]	0.37%
Seabra et al. [6]	0.60%
Lisboa[7]	0.50%
Gava et al. [8]	0.64%
Adopted in GREET 2012	0.37%

GREET adopted the lowest value in the literature for sugarcane. There is no explanation for the selection of this value in the ISOR or related materials. Nor is there any evidence to suggest this value is realistic. In fact, the studies adopted after 2012 show the value should be much higher. The Leite paper, for example, recently measured the nitrogen content.[9] They reported a value of 0.54% for nitrogen. Looking at the reported N content of biomass per tonne of sugar cane, they found a value of 864 g N/tonne of cane. This does not include the nitrogen in the roots.

The nitrogen inputs values in CaGREET3.0 are also understated because they do not include nitrogen in the roots. The importance of including nitrogen in the roots was demonstrated in a discussion of the Canasoft model that is part of the Virtual Sugarcane Biorefinery (VSB) modeling system (Bonomi et al, 2016). That study found that the sugarcane root system is renewed each year by re-growth of ratoon. Emissions of root system are estimated using the root's nitrogen content and the amount of root system, calculated with a root-stalks ratio of 0.2. The root nitrogen content considered is 0.514 %. This reveals there is an additional 304 g N/tonne of cane from the roots. The total biomass N is therefore 1,168 g N/tonne of cane, 23.5% higher than the value in CaGREET3.0.

The VSB also reports the other inputs that are summarized and compared to the CaGREET3.0 values in the following table.

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[5] *Sugar Cane's Energy: Twelve studies on Brazilian sugar cane agribusiness and its sustainability,* Macedo, I.C., 20072nd ed. UNICA.

[6] *Life cycle assessment of Brazilian sugarcane products: GHG emissions and energy use,* Seabra, J., Macedo, I., Chum, H., Faroni, C., Sarto, C. A Biofuels, Bioproducts and Biorefining, 2011, V5, 519–532

[7] *Bioethanol production from sugarcane and emissions of greenhouse gases – known and unknowns.* Lisboa, C.C., Butterbach-Bahl, K., Mauder, M., Kiese, R., 2011GCB Bioenergy 3, 277–292.

[8] *Urea and sugarcane straw nitrogen balance in a soil-sugarcane crop system,* Gava, G.J. de C., Trivelin, P.C.O., Vitti, A.C., Oliveira, M.W. de, 2005. Pesquisa Agropecuária Brasileira 40, 689–695.

[9] *Nutrient Partitioning and Stoichiometry in Unburnt Sugarcane Ratoon at Varying Yield Levels,* Leite, J.M., Ciampitti, I.A., Mariano, E., Vieira-Megda, M.X., Trivelin, P.C.O., Frontiers in Plant Science, 20 April 2016.

Table 6. VSB Inputs vs. CaGREET3.0 (Sugarcane)		
	CaGREET3.0	VSB
Nitrogen, g/tonne cane	800	1,342
Phosphorus, g/tonne cane	300	203
Potassium, g/tonne cane	1,000	1,420

Not only is the biomass N underestimated in GREET but the synthetic fertilizer is also underestimated. The following table compares the nitrogen inputs from GREET 2013, CA GREET 2.0, and the best available data.

Table 7. Nitrogen Input Comparison for Sugarcane (Kg N/tonne cane)			
	CaGREET 2.0	CaGREET3.0	Best Available Data
Fertilizer	800	1,025	1,342
Crop Residue	1,036	705	864
Filtercake	36	36	36
Vinasse	205	205	205
Roots	0	0	305
Total	2,077	2,302	2,752

The carbon intensity of sugarcane ethanol is shown with CaGREET3.0 and the best available data in Table 8. Emissions using best available nitrogen data are 4.78 g/MJ higher than CaGREET3.0. Clearly, at least the 305 g root nitrogen should be added to CaGREET3.0 since it is currently not counted.

Table 8. CI of Sugarcane Ethanol		
Scenario	g CO2e/MJ	
	Feedstock Production CI	Total CI
CaGREET3.0	21.17	51.11
Best Available Data	26.13	55.89

N as N_2O Emissions from Sugarcane.

The N_2O emission factors in CaGREET3.0 are shown in Table 8. The N_2O fractions are shown for the nitrogen from biomass and nitrogen from fertilizer. All of the biomass nitrogen is at 1.225%, which is the IPCC default level for biomass. The nitrogen from fertilizer is given an extra 0.1% to account for volatilization of nitrogen from fertilizer, which does not occur for the biomass. But the value being used for fertilizer in Brazil is 1.220%. This value comes from the GREET model. This value for fertilizer in Brazil should be changed to 1.325% to be consistent with the IPCC default value, and to be consistent with N_2O from fertilizer in the US.

Table 9. N_2O Emissions: N in N_2O as % of N in N Fertilizer and Biomass

Biomass						Fertilizer	
Corn Farming	Switchgrass	Miscanthus	Corn Stover	Sorghum	Sugarcane	Nitrogen fertilizer in the US	Nitrogen fertilizer in Brazil
1.225%	1.225%	1.225%	1.225%	1.225%	1.225%	1.325%	1.220%

When the N in N_2O in fertilizer is increased to 1.325% from 1.220%, the CI increases by 0.43 gCO2e/MJ (56.32 instead of the 55.89 in Table 8)

Curriculum Vitae

For

Thomas Darlington

And

Donald O'Connor

Thomas L. Darlington
President, Air Improvement Resource Inc.

Profile

Thomas L. Darlington is President of Air Improvement Resource, a company formed in 1994 specializing in mobile source emission modeling. He is an internationally recognized expert in mobile source emissions modeling, lifecycle analysis, and land use modeling.

Professional Experience

1994-Present	President, Air Improvement Resource
1993-1994	Director, Mobile Source Programs, Systems Application International
1989-1994	Senior Engineer, General Motors Corporation, Environmental Activities
1988-1989	Senior Project Engineer, Detroit Diesel Corporation
1979-1988	Project Manager, U.S. EPA, Ann Arbor, Michigan

Recent Major Projects

- Provided numerous OMEGA outputs to The Alliance for their review of the 2022-2025 GHG standards
- Participating on behalf of Growth Energy in EPA's MOVES model development stakeholder meetings
- Creating a new California emissions model for offroad equipment
- Published a Society of Automotive Engineers paper at SAE World Congress in 2017 (April 2017) on modeling GHG emission reductions with a high octane, low carbon biofuel (Minnesota Corn Growers and others)
- Published an SAE paper at the 2016 World Congress on our review of EPA's EPAct fuels testing and modeling (Growth Energy)
- Developed Life Cycle reports and complete applications for 8 plants for the California Low Carbon Fuel Standard
- Participated in and provided written comments on California's three 2014 Indirect Land Use (iLUC) workshops (Growth Energy)
- With Purdue University, conducted study of iLUC emissions of rapeseed and other oilseeds in 2013 utilizing an updated version of GTAP (European Biodiesel Board)
- Reviewed EPA's palm oil iLUC emissions in 2013 (NESTE)
- Submitted comments on ARB's new GREET2.0 model
- Reviewed CARB's land use emissions for soybean biodiesel
- Reviewed the land use impacts of the RFS2 from EPA, including the notice of Proposed Rule, Regulatory Impact Analysis, and approximately one hundred documents in the rulemaking docket.

- Completed a land use study for Renewable Fuels Association and reviewed California Air Resource Board's Initial Statement of Reasons for the Low Carbon Fuel Standard
- Represented three stakeholders in the recent development of the ARB Predictive Model for reformulated gasoline in California (Alliance of Automobile Manufacturers, Renewable Fuels Association and Western States Petroleum Association)
- Represented two stakeholders in EPA's development of the MOVES on-highway emissions model (Alliance of Automobile Manufacturers and Engine Manufacturers Association)
- Developed the effects of ethanol permeation on on-highway and off-highway mobile sources in California and other states for the American Petroleum Institute
- Studied gasoline and diesel fuel options for Southeast Michigan (for SEMCOG, API and Alliance of Automobile Manufacturers)

Recent Publications

Darlington, T., Herwick, G., Kahlbaum, D., and Drake, D., "Modeling the Impact of Reducing Vehicle Greenhouse Gas Emissions with High Compression Engines and High Octane Low Carbon Fuels," SAE 2017-01-0906, 2017, doi: 10.4271/2017-01-0906.

Darlington, T., Kahlbaum, D., Van Hulzen, S., and Furey, R., "Analysis of EPAct Emission Data Using T70 as an Additional Predictor of PM Emissions from Tier 2 Gasoline Vehicles", SAE Technical Paper 2016-01-0996, 2016, doi: 10.4271/2016-01-0996.

"Study of Transportation Fuel Life Cycle Analysis: Review of Economic Models Used to Assess Land Use Effects", CRC-E-88-3, July 2014.

"Land Use Change Greenhouse Gas Emissions of European Biofuel Policies Utilizing the Global Trade Analysis Project Model", Darlington, Kahlbaum, O'Connor, and Mueller, August 30, 2013.

"A Comparison of Corn Ethanol Lifecycle Analyses: California Low Carbon Fuels Standard (LCFS) Versus Renewable Fuels Standard (RFS2)", June 14, 2010. Renewable Fuels Association and Nebraska Corn Board. This study compared and contrasted the corn ethanol lifecycle analyses performed by both CARB (as a part of the LCFS) and the EPA (as a part of RFS2).

"Review of EPA's RFS2 Lifecycle Emissions Analysis for Corn Ethanol", September 25, 2009. Conducted for Renewable Fuels Association. This study reviewed EPA's land use GHG emissions assessment for corn ethanol, including the FASOM and FAPRI models and Winrock land-use types converted and emission factors by ecosystem type. The study made many recommendations for improving the land-use and emissions modeling.

"Review of CARB's Low Carbon Fuel Standard Proposal", April 15, 2009. Conducted for Renewable Fuels Association. This study reviewed CARB's analysis of land use emissions using GTAP6 and CARB's overall lifecycle emissions for corn ethanol. This study made many recommendations for improving the land use and lifecycle emissions of corn ethanol.

"Emission Benefits of a National Clean Gasoline", August 2008. Conducted for the Alliance of Automobile Manufacturers. This study evaluated the nationwide criteria pollutant emission reductions of a national clean gasoline standard.

"Land Use Effects of Corn-Based Ethanol", February 25, 2009. Conducted for Renewable Fuels Association. This study evaluates possible land use changes and GHG emissions associated with these land use changes as a result of the renewable fuel standard mandated 15 billion gallons of corn ethanol required by calendar year 2015. The study utilized projections of land use in the US and rest of world performed by Informa Economics, LLC, as well as newer estimates of the land use credits of co-products produced by ethanol plants to evaluate possible land use changes.

"On-Road NOx Emission Rates From 1994-2003 Heavy-Duty Trucks", SAE2008-01-1299, conducted for the Engine Manufacturers Association. This study examined manufacturers consent decree emissions data to determine on-road NOx emission rates, and deterioration in emissions from heavy-duty vehicles. (Peer reviewed publication)

"Evaluation of California Greenhouse Gas Standards and Federal Energy Independence and Security Act - Part 2: CO2 and GHG Impacts", SAE2008-01-1853, conducted for the Alliance of Automobile Manufacturers. This paper evaluated the comparison of greenhouse gases from cars and light trucks in the US under both the Federal and California GHG policies. (Peer reviewed publication)

"Effectiveness of the California Light Duty Vehicle Regulations as Compared to Federal Regulations", June 15, 2007. Conducted with NERA Economic Consulting and Sierra Research for The Alliance of Automobile Manufacturers. This study compares the emission benefits of the California and Federal light duty vehicle regulations for HC, CO, NOx, PM, SOx, and Toxics taking into account the difference in emission standards, new vehicle costs and its effect on fleet turnover, new vehicle fuel economy and its effect on vehicle miles traveled, and other factors. Both the EPA MOBILE6 and ARB EMFAC on-road emissions models were used to estimate changes in emissions inventories.

"The Case for a Dual Tech 4 Model Within the California Predictive Model", May 20, 2007. Conducted with ICF International and Transportation Fuels Consulting for the Renewable Fuels Association (RFA). This study developed separate emissions vs fuel property models for lower and higher Tech 4 (1986-1995) vehicles, and showed that utilizing this alternative Predictive Model would result in a higher compliance margin for fuels containing higher volumes of ethanol. It was thought that this could lead to higher ethanol concentrations in the state, but even if the dual model is not used, it is a better representation of the 2015 inventory than the ARB single model.

"Updated Final Report, Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory From On-Road and Off-Road Sources, Inclusion of E-65 Phase 3 Data and Other Updates", June 20, 2007. Conducted for the American Petroleum Institute. This report updates the earlier March 3, 2005 report for API utilizing data collected by CRC and others since of the time of the earlier report.

Final Report, Development of Technical Information for a Regional Fuels Strategy, February 28, 2006. Conducted for the Lake Air Directors Consortium (LADCO). This report provided guidance to the LADCO states (Midwestern states) concerning how to model different types of fuel control programs (in particular) using EPA mobile source models, and how to set up the baseline input files so that results are consistent between the different states.

"Emission Reductions from Changes to Gasoline and Diesel Specifications and Diesel Engine Retrofits in the Southeast Michigan Area", February 23, 2005. Conducted for the Southeast Michigan Council of Governments (SEMCOG), the Alliance of Automobile Manufacturers, and the American Petroleum Institute. This study examined the on-road and off-road emission benefits of many different possible gasoline and diesel fuel specifications that the state could adopt to help meet the 8-hour ozone standards. This study formed the basis for the state's move to lower RVP summer gasoline.

"Examination of Temperature and RVP Effects on CO Emissions in EPA's Certification Database, Final Report", CRC Project No. E-74a, April 11, 2005. Conducted for the Coordinating Research Council. This study compared CO vs temperature results from the MOBILE6 model to the certification data, and recommended further testing, which is being conducted by the CRC at this time.

"Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory From On-Road and Off-Road Sources" March 3, 2005. Conducted for the American Petroleum Institute (API). Using data from the CRC-E-65 program, and data collected by the California EPA and Federal EPA, this study estimated the impacts of ethanol use on increasing permeation VOC emissions from on-road vehicles, off-road equipment and vehicles, and from portable containers. Emission inventory estimates were made for a number of geographical areas including the state of California, and results showed that the permeation effect increases anthropogenic VOC inventories by 2-4%.

Review of EPA Report "A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions", February 11, 2003. Conducted for the American Petroleum Institute. This study critically examined the methods that EPA used to develop the impacts of biodiesel fuels on HC, CO, NOx, and PM emissions.

"Well-To Wheels Analysis of Advanced Fuel/Vehicle Systems – A North American Study of Energy Use, Greenhouse Gas Emissions, and Criteria Pollutant Emissions", May 2005. Conducted for General Motors Corporation, with Argonne National Labs. This study examined many different well to wheels pathways for various fuels, and their impacts on GHG and criteria pollutant emissions.

"Potential Delaware Air Emission Impacts of Switching From MTBE to Ethanol in the Reformulated Gasoline Program", May 26, 2005. Conducted for Lyondell Chemical Company. This study examined the HC, CO, and NOx impacts of switching from MTBE to ethanol.

"Potential Massachusetts Air Emission Impacts of Switching From MTBE to Ethanol in the Reformulated Gasoline Program" June 17, 2005. Conducted for Lyondell Chemical Company. This study is similar to the Delaware study above.

"Potential Maryland Air Emission Impacts of a Ban on MTBE in the Reformulated Gasoline Program", October 18, 2005. Conducted for Lyondell Chemical Company. This study is similar to the Delaware study above.

"MOBILE6.2C with Ethanol Permeation and Ethanol NOx Effects", February 8, 2005. Conducted for Health Canada. This study modified the MOBILE6.2C model for ethanol permeation VOC and ethanol NOx effects.

Education

B. Sc., (Materials and Metallurgical Engineering), University of Michigan, Ann Arbor, 1979
Post Graduate Courses (Business Administration), University of Michigan, Ann Arbor, 1982

Donald Victor O'Connor, P. Eng.

Summary

An innovative, achievement oriented business leader with over 40 years experience with energy and environmental issues in Canada. Successfully developed and commercialized environmentally sound energy alternatives.
Background includes:

- Development of the GHGenius life cycle assessment model for energy systems.
- Developing Canada's largest alternative fuel retailing program.
- Establishment of the ethanol industry in Western Canada, from manufacturing to retailing. Extensive experience with production of biofuels.
- Detailed knowledge of fuels and the fuels industry. Technical expertise regarding the utilization of methanol, ethanol, natural gas, propane, hydrogen, gasoline and diesel fuels.
- Developing objectives, strategy and tactics in highly competitive manufacturing and retail industries.

Professional Experience

$(S\&T)^2$ Consultants Inc. (1998-2018)

President

The firm specializes in energy and environment issues. $(S\&T)^2$ helps corporations with business development strategies concerning new energy markets and products and it helps governments understand the business, energy and environmental issues of new energy pathways.
Mr. O'Connor has recently provided strategic advice on fuels, transportation issues, and greenhouse gas emissions to a number of Provincial governments, several Canadian Federal Government departments, and international agencies and governments. Mr. O'Connor has also consulted for a number of companies developing new technologies for alternative fuelled vehicles and companies developing new transportation fuel processes and facilities.

Projects have included:

- Development of the GHGenius life cycle assessment model
- Development of the Ontario Ethanol Growth Fund. Led to the establishment of 50% of the Canadian ethanol production capacity.
- Analysis of the US EPA RFS program for the National Biodiesel Board. Resulted in soybean biodiesel passing the GHG emission threshold established by the US Congress.
- Establishment of the qualifying criteria for biofuels under the Alberta RFS program.
- Proposed and participated in the development of a novel, patented process for the production of ethanol from woody lignocellulosic feedstock. Five patents granted.
- Provided guidance and recommendations for the establishment of a biofuels program for the Government of Peru.
- Provided project development services for the development and construction of western Canada's largest fuel ethanol plant.

Mohawk Canada Limited (1981 – 1998)

Mohawk was Western Canada's largest independent automotive fuel retailer offering environmentally responsible fuels and lubricants through 300 retail and bulk facilities. Mohawk also manufactures re-refined lubricants from used oil, and ethanol, distillers' grains and Fibrotein from grain.

President, COO, and Director, Mohawk Products Ltd. (1997 – 1998)
President, COO, and Director, Mohawk Lubricants Ltd. (1992 – 1998)
Vice President, Supply and Manufacturing (1989 – 1998)
Various positions in R&D, manufacturing and supply (1981-1989)

Donald Victor O'Connor, P. Eng.

Responsibilities:

- Led and managed three business units simultaneously. These units manufactured lubricants from used oil, processed grain into ethanol and human and animal foods, and the corporate supply function covering all aspects of fuels' development, supply and distribution, and core supplier relationships for convenience goods and corporate services. Recommended objectives, strategy and tactics consistent with the organization's values to achieve corporate vision.

Accomplishments:

- Contributed to the development of a vision and unique corporate positioning that allowed the company to increase its market share by 50% over five years;
- Initiated and led the successful introduction of several new or differentiated alternative fuels to the market (Natural Gas, M85, Ethanol blends (Regular Plus and Premium Plus), and premium diesel fuels (Diesel with ECA and Diesel Max);
- Led the turnaround of used oil re-refining business by doubling production and sales over a four-year period. Increased bottom line by 500% and made the operation the most profitable of its kind in the world.
- Introduced a strategic sourcing program throughout the organization.

Additional Professional Activities

- Advisory Committee. ILUC Quantification Study of EU Biofuels. GLOBIOM Model ILUC project.
- Canadian expert on GHG emissions and indirect effects to ISO TC 248 developing ISO 13065.
- Expert Working Group on Indirect Effects. California Air Resources Board. 2010
- Canadian Biomass Innovation Network. External Advisory Panel. 2005-2010.
- Director, B.C. Buildings Corporation. 2000-2002
- Co-Chair 1999-2001. Member, Executive Committee on Cleaner Technology Vehicles (Minister's Committee, B.C. Environment) (1995 - 2001)
- Director, Pound-Maker Adventures (1990 - 1998) An integrated ethanol plant cattle feeding operation in Saskatchewan.
- Director, Canadian Renewable Fuels Association (1990 – 1998, 2000-2002)
- Member, Environment Advisory Committee, Vancouver Foundation (2001-2003)
- Member, Ethanol BC Board (2000-2010)
- Member, Bio-based Products R&D Advisory Council, BIOCAP Canada, (2002-2003)
- Member, National Advisory Committee on Bioenergy (1984 - 1990)
- Member, Efficiency and Alternative Energy Committee, Minister's National Advisory Council to CANMET (1990 - 1994)
- Chair, Ethanol Program Advisory Committee, Agriculture and Agrifood Canada (1992 - 1997)
- Canadian Petroleum Products Institute, Western Division Management Committee (1996 - 1998)
- Numerous presentations on alternative fuels at National and International conferences.

Employment

- Manager, Energy and Environmental Technology, B.H. Levelton & Associates Ltd. Consulting Engineers (1974 - 1981)
- Air Engineer, Province of British Columbia, Pollution Control Branch (1973 - 1974)

Patents

- Mazza; Giuseppe, Gao; Lei, Oomah; B. Dave, O'Connor; Donald, Crowe; Brian. "Functional, water-soluble protein-fibre products from grains". 07/19/2001. U.S. Patent No. 6,261,629.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennestad; Gordon, Berlin; Alex, MacLachlan; John Ross. "Continuous counter-current organosolv processing of lignocellulosic feedstocks," 12/16/08, U.S. Patent No. 7,465,791.
- Berlin; Alex, Pye; Edward Kendall, O'Connor; Donald, "Concurrent saccharification and fermentation of fibrous biomass," 11/15/11, U.S. Patent No. 8,058,041.

- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma; Raymond. Continuous counter-current organosolv processing of lignocellulosic feedstocks. 6/05/12, U.S. Patent No. 8,193,324.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Continuous counter-current organosolv processing of lignocellulosic feedstocks. 7/24/12, U.S. Patent No. 8,227,004.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Modular system for organosolv fractionation of lignocellulosic feedstock. 10/09/2013. U.S. Patent 8,528,463.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Continuous counter-current organosolv processing of lignocellulosic feedstocks. US Patent 8,772,427.

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- Vuksan, V., Jenkins, D. J., Vidgen, E., Ransom, T. P., Ng, M. K., Culhane, C. T., & O'Connor, D. 1999. A novel source of wheat fiber and protein: effects on fecal bulk and serum lipids–. The American journal of clinical nutrition, 69(2), 226-230.
- O'Connor, D., Esteghlalian, A.R., Gregg, D.J. and Saddler, J.N. 2003. Carbon Balance of Ethanol from Wood: The effect of Feedstock Source in Canada. The Role of Boreal Forests and Forestry in the Global Carbon Budget. pp. 289-296 (Proceedings of the International Science Conference, Edm. Alta. May 2000).
- Hünerberg, M., Little, S.M., Beauchemin, K.A., McGinn, S.M., O'Connor, D., Okine, E.K., Harstad, O.M., Kröbel, R. and McAllister, T.A., 2014. Feeding high concentrations of corn dried distillers' grains decreases methane, but increases nitrous oxide emissions from beef cattle production. *Agricultural Systems*, *127*, pp.19-27.
- Chen, R., Qin, Z., Han, J., Wang, M., Taheripour, F., Tyner, W., O'Connor, D. and Duffield, J., 2018. Life cycle energy and greenhouse gas emission effects of biodiesel in the United States with induced land use change impacts. *Bioresource technology*, *251*, pp.249-258.

Education

- Bachelor of Applied Science, Mechanical Engineering, University of British Columbia (1973)

Professional Memberships

- Association of Professional Engineers and Geoscientists of British Columbia
- Association of Professional Engineers of Ontario
- Society of Automotive Engineers

Awards

- Canadian Renewable Fuels Association. Outstanding Dedication to the Advancement of Renewable Fuels in Canada. 2007.

APPENDIX "E"

Indirect Land Use Comments

April 23, 2018

By Thomas Darlington, Air Improvement Resource Inc.
Donald O'Connor, (S&T)² Consultants Inc.

ARB Failed to Update Indirect Land Use Emissions in the LCFS

The carbon intensities of biofuels include estimated emissions for indirect land use changes, generally referred to as "ILUC." Including estimates of these emissions in the carbon intensities of biofuels by ARB has been controversial, because the ILUC estimates for biofuels are very uncertain, and require a myriad of input information and different models to estimate. In prior efforts to determine ILUC, the input information needed to make these estimates was not available, and the models used to make these estimates were in their infancy.

ILUC emissions should not have been included in the LCFS by ARB in the first place, as the science has not matured to the point where it included most of the significant input drivers. For example, the ILUC estimates for biofuels used by ARB in the current and previous LCFS regulation do not include any effects for multi-cropping or the use of idle cropland. These and other factors have been pointed out to ARB since the advent the LCFS regulations. Economists have been developing methods of including these factors in ILUC estimates, and their inclusion into ILUC estimates has had a dramatic effect at reducing initial biofuel ILUC estimates.

Indeed, it is now widely recognized that early efforts to calculate ILUC were significantly overstated. As the methods for estimating these emissions have started to mature somewhat, the ILUC estimates for various biofuels have fallen significantly. For example, an early estimate of ILUC for corn ethanol was 106 g/MJ.[1] ARB's first estimate of the ILUC of corn ethanol was 30 g/MJ.[2] The ILUC of corn ethanol in the current regulation is 19.8 g/MJ.[3]

Substantial evidence no longer supports an ILUC of 19.8 g/MJ for corn ethanol. The consensus among technical experts is that these ILUC values remain overstated, and should be further reduced. Specifically, current estimates for the ILUC of corn ethanol in the U.S. range from 7.8-12 g/MJ.[4,5]

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[1] *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change*, Searchinger, T., Heimlich, R., Houghton, R.A., Dong, F., Elobeid, A., Fabiosa, J., Tokgoz, S., hayes, D., Yu, T., Science, 29 Feb 2008: Vol. 319, Issue 5867, pp. 1238-1240DOI: 10.1126/science.1151861

[2] Final Regulation Order for Low Carbon Fuel Standard, January 12, 2010, Table 6, page 47, https://www.arb.ca.gov/regact/2009/lcfs09/finalfro.pdf

[3] Final Regulation Order for Low Carbon Fuel Standard, Table 5, page 60, https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf

[4] Argonne GREET2016 Model, https://greet.es.anl.gov/

Despite this new data, in the proposed LCFS amendments, ARB has updated the direct emission estimates such as the farming and fertilizer emissions, but failed to update the indirect estimates. The ILUC estimates are a very significant proportion of total emissions for biofuels. For example, the total carbon intensity for corn ethanol is now around 68 g/MJ, depending on various inputs from the corn ethanol plant and the distance of that plant from California. The ILUC estimate for corn ethanol is 19.8 g/MJ, which is 30% of the total carbon intensity. ARB has therefore taken a "piecemeal" approach to updating the carbon intensities to the various biofuels. With respect to updating the ILUC estimates, the ISOR states:

> Staff has not observed sufficient evidence in the literature to justify modifying the LUC CI values for the proposed regulation.[6]

This statement is simply not true. Growth Energy, in its comments on the existing regulation, referenced significant work by the Babcock and Iqbal at the University of Iowa that showed significantly less global land conversions due to biofuel policies than previous thought and estimated by the ARB staff. [7,8] Their analysis showed that land "intensification", that is, the use of existing cropland through multi-cropping and the use of idle land, was much more prevalent than land "extensification", where land such as forest is converted to cropland. ARB's ILUC estimates were primarily based on land extensification. Growth Energy also recommended methods of incorporating UI's analysis into ARB's estimates, and developed preliminary estimates of ILUC using the Babcock/Iqbal work.

The work by Babcock/Iqbal was also reviewed extensively by Global Trade Analysis Project (GTAP) researchers at the University of Purdue. The GTAP economic general equilibrium model is used by ARB to estimate ILUC values for biofuels for the LCFS. Purdue researchers used the Babcock/Iqbal methods and data to update the GTAP model, and the Purdue researchers also updated many other significant factors in the GTAP model, including updating the GTAP model database from calendar year 2004 to calendar year 2011.[9] Their work was published in a peer-reviewed journal publication in July of 2017.[10] Their work showed that, using ARB's AEZ-EF model in conjunction with GTAP to estimate emissions associated with the various land use changes, corn ethanol ILUC dropped from 23.3 g/MJ to 12 g/MJ, with the

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[5] *The impact of considering land intensifications and updated data on biofuels land use change and emissions estimates,* Figure 4, F. Taheripour, X. Zhao, and W. Tyner, Biotechnology for Biofuels, DOI.1186/s13068-017-0877-y, July 2017

[6] Initial Statement of Reasons for LCFS, Page III-86.

[7] Growth Energy's Response to the Notices of Public Hearings Dated December 16, 2014 2015 Cal. Reg. Notice Reg. 13, 45 (January 2, 2015), February 17, 2015, Appendix A.

[8] Using Recent Land Use Changes to Validate Land use Change Models", Babcock and Iqbal, Staff Report 14-SR- 109, Center for Agriculture and Rural Development, Iowa State University, www.card.iastate.edu.

[9] The current ARB ILUC estimates are based on the 2004 calendar year database.

[10] *The impact of considering land intensifications and updated data on biofuels land use change and emissions estimates,* F. Taheripour, X. Zhao, and W. Tyner, Biotechnology for Biofuels, DOI.1186/s13068-017-0877-y, July 2017.

incorporation of (1) land intensification effects, and (2) the change to the 2011 database. [11] The reduction in corn ethanol ILUC associated with these model updates is 48%. Assuming that this percent reduction in ILUC obtained by Purdue with the two major model modifications can be applied to ARB's current ILUC value for corn ethanol of 19.8, gives a value of 10.3 g/MJ. Therefore, if Staff had used the available updated GTAP model to estimate new ILUC values for biofuels using its 30 sensitivity scenarios, it is likely ARB would have developed an estimate of around 10g/MJ for corn ethanol. There would have been significant changes in the ILUC values for other biofuels as well, since land intensification and the change in database would likely have affected all biofuel feedstocks.

The technical documents supporting the ISOR and the EA also do not recognize ongoing efforts by technical experts to resolve known issues relating to the overstatement of the ILUC value for corn ethanol, and to incorporate more recent facts into these analysis. For example, the current ILUC for corn ethanol does not reflect accurate facts because it is based on year 2011 conditions, which correspond to a drought year in the US which negatively impacted crop yields. This is important because higher yields mean that less land use change is required to satisfy the new demand resulting in lower ILUC values. The 2011 corn yield was 146.8 bu/acre, which was actually lower than the 2004 yield of 160.3 bu/acre and one of the reasons why the ILUC emissions went up when the 2011 database was used. The 2017 corn yield was 176.6 bu/acre.

The GTAP team is also investigating the response of the livestock sector to increased biofuel production in the model to ensure that the model is consistent with the observed recent changes in that sector. In particular, there has been a major shift in livestock production in the last 40 years in the US from beef to poultry. Because of the much lower land requirements of poultry than beef, much agricultural land has been freed up for other agricultural uses, and this has led to lower land use transformation than previously thought. [12]

Therefore, our conclusion is that (1) the existing ILUC value for corn ethanol of 19.8 g/MJ is no longer supported by substantial evidence, (2) the literature demonstrates the ILUC values should be updated in time for the proposed amendments to the LCFS regulation, and (3) if the values had been updated by ARB, they would have been much lower than the values from the previous regulation.

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[11] Purdue ran a single scenario to estimate these values. For the current regulation, ARB ran 30 scenarios with varying inputs and averaged the 30 results to obtain the 19.8 g/MJ for corn ethanol.

[12] *Technological progress in US agriculture: Implications for biofuel production*, Taheripour, F., Department of Agricultural Economics, Purdue University, presented at National Biodiesel Board Webinar, March 15, 2018.

Curriculum Vitae

For

Thomas Darlington

And

Donald O'Connor

Thomas L. Darlington
President, Air Improvement Resource Inc.

Profile

Thomas L. Darlington is President of Air Improvement Resource, a company formed in 1994 specializing in mobile source emission modeling. He is an internationally recognized expert in mobile source emissions modeling, lifecycle analysis, and land use modeling.

Professional Experience

1994-Present	President, Air Improvement Resource
1993-1994	Director, Mobile Source Programs, Systems Application International
1989-1994	Senior Engineer, General Motors Corporation, Environmental Activities
1988-1989	Senior Project Engineer, Detroit Diesel Corporation
1979-1988	Project Manager, U.S. EPA, Ann Arbor, Michigan

Recent Major Projects

- Provided numerous OMEGA outputs to The Alliance for their review of the 2022-2025 GHG standards
- Participating on behalf of Growth Energy in EPA's MOVES model development stakeholder meetings
- Creating a new California emissions model for offroad equipment
- Published a Society of Automotive Engineers paper at SAE World Congress in 2017 (April 2017) on modeling GHG emission reductions with a high octane, low carbon biofuel (Minnesota Corn Growers and others)
- Published an SAE paper at the 2016 World Congress on our review of EPA's EPAct fuels testing and modeling (Growth Energy)
- Developed Life Cycle reports and complete applications for 8 plants for the California Low Carbon Fuel Standard
- Participated in and provided written comments on California's three 2014 Indirect Land Use (iLUC) workshops (Growth Energy)
- With Purdue University, conducted study of iLUC emissions of rapeseed and other oilseeds in 2013 utilizing an updated version of GTAP (European Biodiesel Board)
- Reviewed EPA's palm oil iLUC emissions in 2013 (NESTE)
- Submitted comments on ARB's new GREET2.0 model
- Reviewed CARB's land use emissions for soybean biodiesel
- Reviewed the land use impacts of the RFS2 from EPA, including the notice of Proposed Rule, Regulatory Impact Analysis, and approximately one hundred documents in the rulemaking docket.

Air Improvement Resource, Inc. 10820 Boyce Rd, Chelsea, Michigan 48118
Phone: 248-921-5096

- Completed a land use study for Renewable Fuels Association and reviewed California Air Resource Board's Initial Statement of Reasons for the Low Carbon Fuel Standard
- Represented three stakeholders in the recent development of the ARB Predictive Model for reformulated gasoline in California (Alliance of Automobile Manufacturers, Renewable Fuels Association and Western States Petroleum Association)
- Represented two stakeholders in EPA's development of the MOVES on-highway emissions model (Alliance of Automobile Manufacturers and Engine Manufacturers Association)
- Developed the effects of ethanol permeation on on-highway and off-highway mobile sources in California and other states for the American Petroleum Institute
- Studied gasoline and diesel fuel options for Southeast Michigan (for SEMCOG, API and Alliance of Automobile Manufacturers)

Recent Publications

Darlington, T., Herwick, G., Kahlbaum, D., and Drake, D., "Modeling the Impact of Reducing Vehicle Greenhouse Gas Emissions with High Compression Engines and High Octane Low Carbon Fuels," SAE 2017-01-0906, 2017, doi: 10.4271/2017-01-0906.

Darlington, T., Kahlbaum, D., Van Hulzen, S., and Furey, R., "Analysis of EPAct Emission Data Using T70 as an Additional Predictor of PM Emissions from Tier 2 Gasoline Vehicles", SAE Technical Paper 2016-01-0996, 2016, doi: 10.4271/2016-01-0996.

"Study of Transportation Fuel Life Cycle Analysis: Review of Economic Models Used to Assess Land Use Effects", CRC-E-88-3, July 2014.

"Land Use Change Greenhouse Gas Emissions of European Biofuel Policies Utilizing the Global Trade Analysis Project Model", Darlington, Kahlbaum, O'Connor, and Mueller, August 30, 2013.

"A Comparison of Corn Ethanol Lifecycle Analyses: California Low Carbon Fuels Standard (LCFS) Versus Renewable Fuels Standard (RFS2)", June 14, 2010. Renewable Fuels Association and Nebraska Corn Board. This study compared and contrasted the corn ethanol lifecycle analyses performed by both CARB (as a part of the LCFS) and the EPA (as a part of RFS2).

"Review of EPA's RFS2 Lifecycle Emissions Analysis for Corn Ethanol", September 25, 2009. Conducted for Renewable Fuels Association. This study reviewed EPA's land use GHG emissions assessment for corn ethanol, including the FASOM and FAPRI models and Winrock land-use types converted and emission factors by ecosystem type. The study made many recommendations for improving the land-use and emissions modeling.

"Review of CARB's Low Carbon Fuel Standard Proposal", April 15, 2009. Conducted for Renewable Fuels Association. This study reviewed CARB's analysis of land use emissions using GTAP6 and CARB's overall lifecycle emissions for corn ethanol. This study made many recommendations for improving the land use and lifecycle emissions of corn ethanol.

"Emission Benefits of a National Clean Gasoline", August 2008. Conducted for the Alliance of Automobile Manufacturers. This study evaluated the nationwide criteria pollutant emission reductions of a national clean gasoline standard.

"Land Use Effects of Corn-Based Ethanol", February 25, 2009. Conducted for Renewable Fuels Association. This study evaluates possible land use changes and GHG emissions associated with these land use changes as a result of the renewable fuel standard mandated 15 billion gallons of corn ethanol required by calendar year 2015. The study utilized projections of land use in the US and rest of world performed by Informa Economics, LLC, as well as newer estimates of the land use credits of co-products produced by ethanol plants to evaluate possible land use changes.

"On-Road NOx Emission Rates From 1994-2003 Heavy-Duty Trucks", SAE2008-01-1299, conducted for the Engine Manufacturers Association. This study examined manufacturers consent decree emissions data to determine on-road NOx emission rates, and deterioration in emissions from heavy-duty vehicles. (Peer reviewed publication)

"Evaluation of California Greenhouse Gas Standards and Federal Energy Independence and Security Act - Part 2: CO2 and GHG Impacts", SAE2008-01-1853, conducted for the Alliance of Automobile Manufacturers. This paper evaluated the comparison of greenhouse gases from cars and light trucks in the US under both the Federal and California GHG policies. (Peer reviewed publication)

"Effectiveness of the California Light Duty Vehicle Regulations as Compared to Federal Regulations", June 15, 2007. Conducted with NERA Economic Consulting and Sierra Research for The Alliance of Automobile Manufacturers. This study compares the emission benefits of the California and Federal light duty vehicle regulations for HC, CO, NOx, PM, SOx, and Toxics taking into account the difference in emission standards, new vehicle costs and its effect on fleet turnover, new vehicle fuel economy and its effect on vehicle miles traveled, and other factors. Both the EPA MOBILE6 and ARB EMFAC on-road emissions models were used to estimate changes in emissions inventories.

"The Case for a Dual Tech 4 Model Within the California Predictive Model", May 20, 2007. Conducted with ICF International and Transportation Fuels Consulting for the Renewable Fuels Association (RFA). This study developed separate emissions vs fuel property models for lower and higher Tech 4 (1986-1995) vehicles, and showed that utilizing this alternative Predictive Model would result in a higher compliance margin for fuels containing higher volumes of ethanol. It was thought that this could lead to higher ethanol concentrations in the state, but even if the dual model is not used, it is a better representation of the 2015 inventory than the ARB single model.

"Updated Final Report, Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory From On-Road and Off-Road Sources, Inclusion of E-65 Phase 3 Data and Other Updates", June 20, 2007. Conducted for the American Petroleum Institute. This report updates the earlier March 3, 2005 report for API utilizing data collected by CRC and others since of the time of the earlier report.

Final Report, Development of Technical Information for a Regional Fuels Strategy, February 28, 2006. Conducted for the Lake Air Directors Consortium (LADCO). This report provided guidance to the LADCO states (Midwestern states) concerning how to model different types of fuel control programs (in particular) using EPA mobile source models, and how to set up the baseline input files so that results are consistent between the different states.

"Emission Reductions from Changes to Gasoline and Diesel Specifications and Diesel Engine Retrofits in the Southeast Michigan Area", February 23, 2005. Conducted for the Southeast Michigan Council of Governments (SEMCOG), the Alliance of Automobile Manufacturers, and the American Petroleum Institute. This study examined the on-road and off-road emission benefits of many different possible gasoline and diesel fuel specifications that the state could adopt to help meet the 8-hour ozone standards. This study formed the basis for the state's move to lower RVP summer gasoline.

"Examination of Temperature and RVP Effects on CO Emissions in EPA's Certification Database, Final Report", CRC Project No. E-74a, April 11, 2005. Conducted for the Coordinating Research Council. This study compared CO vs temperature results from the MOBILE6 model to the certification data, and recommended further testing, which is being conducted by the CRC at this time.

"Effects of Gasoline Ethanol Blends on Permeation Emissions Contribution to VOC Inventory From On-Road and Off-Road Sources" March 3, 2005. Conducted for the American Petroleum Institute (API). Using data from the CRC-E-65 program, and data collected by the California EPA and Federal EPA, this study estimated the impacts of ethanol use on increasing permeation VOC emissions from on-road vehicles, off-road equipment and vehicles, and from portable containers. Emission inventory estimates were made for a number of geographical areas including the state of California, and results showed that the permeation effect increases anthropogenic VOC inventories by 2-4%.

Review of EPA Report "A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions", February 11, 2003. Conducted for the American Petroleum Institute. This study critically examined the methods that EPA used to develop the impacts of biodiesel fuels on HC, CO, NOx, and PM emissions.

"Well-To Wheels Analysis of Advanced Fuel/Vehicle Systems – A North American Study of Energy Use, Greenhouse Gas Emissions, and Criteria Pollutant Emissions", May 2005. Conducted for General Motors Corporation, with Argonne National Labs. This study examined many different well to wheels pathways for various fuels, and their impacts on GHG and criteria pollutant emissions.

"Potential Delaware Air Emission Impacts of Switching From MTBE to Ethanol in the Reformulated Gasoline Program", May 26, 2005. Conducted for Lyondell Chemical Company. This study examined the HC, CO, and NOx impacts of switching from MTBE to ethanol.

"Potential Massachusetts Air Emission Impacts of Switching From MTBE to Ethanol in the Reformulated Gasoline Program" June 17, 2005. Conducted for Lyondell Chemical Company. This study is similar to the Delaware study above.

"Potential Maryland Air Emission Impacts of a Ban on MTBE in the Reformulated Gasoline Program", October 18, 2005. Conducted for Lyondell Chemical Company. This study is similar to the Delaware study above.

"MOBILE6.2C with Ethanol Permeation and Ethanol NOx Effects", February 8, 2005. Conducted for Health Canada. This study modified the MOBILE6.2C model for ethanol permeation VOC and ethanol NOx effects.

Education

B. Sc., (Materials and Metallurgical Engineering), University of Michigan, Ann Arbor, 1979
Post Graduate Courses (Business Administration), University of Michigan, Ann Arbor, 1982

Donald Victor O'Connor, P. Eng.

Summary

An innovative, achievement oriented business leader with over 40 years experience with energy and environmental issues in Canada. Successfully developed and commercialized environmentally sound energy alternatives.
Background includes:

- Development of the GHGenius life cycle assessment model for energy systems.
- Developing Canada's largest alternative fuel retailing program.
- Establishment of the ethanol industry in Western Canada, from manufacturing to retailing. Extensive experience with production of biofuels.
- Detailed knowledge of fuels and the fuels industry. Technical expertise regarding the utilization of methanol, ethanol, natural gas, propane, hydrogen, gasoline and diesel fuels.
- Developing objectives, strategy and tactics in highly competitive manufacturing and retail industries.

Professional Experience

$(S\&T)^2$ Consultants Inc. (1998-2018)

President

The firm specializes in energy and environment issues. $(S\&T)^2$ helps corporations with business development strategies concerning new energy markets and products and it helps governments understand the business, energy and environmental issues of new energy pathways.
Mr. O'Connor has recently provided strategic advice on fuels, transportation issues, and greenhouse gas emissions to a number of Provincial governments, several Canadian Federal Government departments, and international agencies and governments. Mr. O'Connor has also consulted for a number of companies developing new technologies for alternative fuelled vehicles and companies developing new transportation fuel processes and facilities.

Projects have included:

- Development of the GHGenius life cycle assessment model
- Development of the Ontario Ethanol Growth Fund. Led to the establishment of 50% of the Canadian ethanol production capacity.
- Analysis of the US EPA RFS program for the National Biodiesel Board. Resulted in soybean biodiesel passing the GHG emission threshold established by the US Congress.
- Establishment of the qualifying criteria for biofuels under the Alberta RFS program.
- Proposed and participated in the development of a novel, patented process for the production of ethanol from woody lignocellulosic feedstock. Five patents granted.
- Provided guidance and recommendations for the establishment of a biofuels program for the Government of Peru.
- Provided project development services for the development and construction of western Canada's largest fuel ethanol plant.

Mohawk Canada Limited (1981 – 1998)

Mohawk was Western Canada's largest independent automotive fuel retailer offering environmentally responsible fuels and lubricants through 300 retail and bulk facilities. Mohawk also manufactures re-refined lubricants from used oil, and ethanol, distillers' grains and Fibrotein from grain.

President, COO, and Director, Mohawk Products Ltd. (1997 – 1998)
President, COO, and Director, Mohawk Lubricants Ltd. (1992 – 1998)
Vice President, Supply and Manufacturing (1989 – 1998)
Various positions in R&D, manufacturing and supply (1981-1989)

Donald Victor O'Connor, P. Eng.

Responsibilities:

- Led and managed three business units simultaneously. These units manufactured lubricants from used oil, processed grain into ethanol and human and animal foods, and the corporate supply function covering all aspects of fuels' development, supply and distribution, and core supplier relationships for convenience goods and corporate services. Recommended objectives, strategy and tactics consistent with the organization's values to achieve corporate vision.

Accomplishments:

- Contributed to the development of a vision and unique corporate positioning that allowed the company to increase its market share by 50% over five years;
- Initiated and led the successful introduction of several new or differentiated alternative fuels to the market (Natural Gas, M85, Ethanol blends (Regular Plus and Premium Plus), and premium diesel fuels (Diesel with ECA and Diesel Max);
- Led the turnaround of used oil re-refining business by doubling production and sales over a four-year period. Increased bottom line by 500% and made the operation the most profitable of its kind in the world.
- Introduced a strategic sourcing program throughout the organization.

Additional Professional Activities

- Advisory Committee. ILUC Quantification Study of EU Biofuels. GLOBIOM Model ILUC project.
- Canadian expert on GHG emissions and indirect effects to ISO TC 248 developing ISO 13065.
- Expert Working Group on Indirect Effects. California Air Resources Board. 2010
- Canadian Biomass Innovation Network. External Advisory Panel. 2005-2010.
- Director, B.C. Buildings Corporation. 2000-2002
- Co-Chair 1999-2001. Member, Executive Committee on Cleaner Technology Vehicles (Minister's Committee, B.C. Environment) (1995 - 2001)
- Director, Pound-Maker Adventures (1990 - 1998) An integrated ethanol plant cattle feeding operation in Saskatchewan.
- Director, Canadian Renewable Fuels Association (1990 – 1998, 2000-2002)
- Member, Environment Advisory Committee, Vancouver Foundation (2001-2003)
- Member, Ethanol BC Board (2000-2010)
- Member, Bio-based Products R&D Advisory Council, BIOCAP Canada, (2002-2003)
- Member, National Advisory Committee on Bioenergy (1984 - 1990)
- Member, Efficiency and Alternative Energy Committee, Minister's National Advisory Council to CANMET (1990 - 1994)
- Chair, Ethanol Program Advisory Committee, Agriculture and Agrifood Canada (1992 - 1997)
- Canadian Petroleum Products Institute, Western Division Management Committee (1996 - 1998)
- Numerous presentations on alternative fuels at National and International conferences.

Employment

- Manager, Energy and Environmental Technology, B.H. Levelton & Associates Ltd. Consulting Engineers (1974 - 1981)
- Air Engineer, Province of British Columbia, Pollution Control Branch (1973 - 1974)

Patents

- Mazza; Giuseppe, Gao; Lei, Oomah; B. Dave, O'Connor; Donald, Crowe; Brian. "Functional, water-soluble protein-fibre products from grains". 07/19/2001. U.S. Patent No. 6,261,629.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennestad; Gordon, Berlin; Alex, MacLachlan; John Ross. "Continuous counter-current organosolv processing of lignocellulosic feedstocks," 12/16/08, U.S. Patent No. 7,465,791.
- Berlin; Alex, Pye; Edward Kendall, O'Connor; Donald, "Concurrent saccharification and fermentation of fibrous biomass," 11/15/11, U.S. Patent No. 8,058,041.

- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma; Raymond. Continuous counter-current organosolv processing of lignocellulosic feedstocks. 6/05/12, U.S. Patent No. 8,193,324.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Continuous counter-current organosolv processing of lignocellulosic feedstocks. 7/24/12, U.S. Patent No. 8,227,004.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Modular system for organosolv fractionation of lignocellulosic feedstock. 10/09/2013. U.S. Patent 8,528,463.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Continuous counter-current organosolv processing of lignocellulosic feedstocks. US Patent 8,772,427.

Peer Reviewed Papers

- Vuksan, V., Jenkins, D. J., Vidgen, E., Ransom, T. P., Ng, M. K., Culhane, C. T., & O'Connor, D. 1999. A novel source of wheat fiber and protein: effects on fecal bulk and serum lipids–. The American journal of clinical nutrition, 69(2), 226-230.
- O'Connor, D., Esteghlalian, A.R., Gregg, D.J. and Saddler, J.N. 2003. Carbon Balance of Ethanol from Wood: The effect of Feedstock Source in Canada. The Role of Boreal Forests and Forestry in the Global Carbon Budget. pp. 289-296 (Proceedings of the International Science Conference, Edm. Alta. May 2000).
- Hünerberg, M., Little, S.M., Beauchemin, K.A., McGinn, S.M., O'Connor, D., Okine, E.K., Harstad, O.M., Kröbel, R. and McAllister, T.A., 2014. Feeding high concentrations of corn dried distillers' grains decreases methane, but increases nitrous oxide emissions from beef cattle production. *Agricultural Systems*, *127*, pp.19-27.
- Chen, R., Qin, Z., Han, J., Wang, M., Taheripour, F., Tyner, W., O'Connor, D. and Duffield, J., 2018. Life cycle energy and greenhouse gas emission effects of biodiesel in the United States with induced land use change impacts. *Bioresource technology*, *251*, pp.249-258.

Education

- Bachelor of Applied Science, Mechanical Engineering, University of British Columbia (1973)

Professional Memberships

- Association of Professional Engineers and Geoscientists of British Columbia
- Association of Professional Engineers of Ontario
- Society of Automotive Engineers

Awards

- Canadian Renewable Fuels Association. Outstanding Dedication to the Advancement of Renewable Fuels in Canada. 2007.

APPENDIX "F"

APPENDIX "F"

Comments on the Simplified Corn and Sugarcane Calculators

April 23, 2018

By Donald O'Connor, (S&T)^2 Consultants Inc.

Starch Calculator

The simplified starch calculator that CARB released as part of the rule making process on March 6, 2018 appears to be functioning properly. The incorrect N_2O emission factor for corn that was presented in the version released in November has been corrected.

We were able to confirm that all of the emission factors used in the calculator came from the CA GREET 3.0 model. There is one small issue with the emission factors for ethanol transportation. In GREET there is a small amount of electricity that is used in the transportation and distribution calculations that is independent of the mode of transport. This is essentially the power to load the truck or rail car. The emissions for the power are determined by the region used for the electric power mix. For starch ethanol most of the trucking emissions are likely to be in California but the emission factor is developed using US average power. The value used is 0.6366 g CO_2eq/gal-mile. The California value is 0.6287 g CO_2eq/gal-mile. The difference is small but as shown below the lower value is being used for sugarcane ethanol.

The GHG emissions for corn ethanol are about 49 g/MJ without ILUC and 68 with ILUC. Individual plants with vary. This is significantly lower than the existing Tier 1 calculator that has values of about 83 g/MJ with ILUC.

The emission calculations of the sorghum ethanol are 4 g/MJ higher than corn ethanol and the difference is all in the feedstock emission area.

There are 25 hidden sheets in the model. There does not appear to be any information transferred in from the hidden sheets which suggests that these sheets could and should be removed.

Also rows 85 to 87 on the EF Tables sheet are not used and should be deleted.

Sugarcane Ethanol Calculator

The sugarcane ethanol calculator needs to be cleaned up. There are a lot of calculations on sheets EF Tables and EF General that take emissions in g/MJ from CA GREET and then convert the emissions to g/tonne, when the g/tonne emission factor can be taken directly from CA GREET. For many of the calculations the conversion of VOC and CO emissions to CO_2eq is done with rounded emission factors rather than the actual values used in CA GREET. This leads to small differences in the emission factors and the potential for errors since the GWP conversion factors are hard coded in the calculator. We found at least one error in coding where the wrong conversion factor was used.

There is one sheet, Feasibility Report 1, that is hidden and it should be visible for full transparency.

The critical parameters are in rows 131 and 142 on the Calculator sheet. These emission factors should all be the same as the values in CA GREET 3.0. When CA GREET 3.0 is used it needs to be set up on the Region Selection sheet. Setting the electricity to the Brazilian mix in cells B8 and E8 is obvious but the appropriate setting for the crude oil and natural gas setting is not obvious. The natural gas selection does not have an impact on the emission factor. The crude oil selector has a very small impact of the emission factors. We have set the regions to Brazil for the electricity and the US parameters for natural gas and crude oil. This appears to be what CARB did.

As noted above, in the calculator the conversion of CO and VOC to GHG emissions is generally hard code and the factors used have been rounded to two decimal points. The calculator underestimates the CO emissions and overestimates the VOC emissions as shown below.

	CA GREET	Calculator
	GWP Conversion	
VOC	3.1167	3.12
CO	1.5714	1.57

Each of the emission factors in row 131 is discussed below.

Sugarcane Agriculture & Farming Impacts

The emission factors from the calculator and from CA GREET are compared in the following table.

	CA GREET	Calculator
	g CO_2eq/tonne cane	
Farming	8,377	7,819
Fertilizer	8,394	8,393
N_2O	11,279	11,279
Total	28,049	27,491

The farming emissions in the calculator appear to include VOC emissions from bulk terminal that is not used in CA GREET and have applied a GWP factor of 1.57 instead of 25 to the methane emissions (AP 39 on the EF Tables Sheet). It is not clear what the bulk terminal emissions would be for sugarcane farming but the impact is only 24 g/tonne but the methane GWP has an impact of about 580 g/tonne (2%) and accounts for most of the understatement of emissions.

Cane & Filtercake Transport

The emission factor for the cane and filtercake emissions is a dynamic calculation. It uses emission data on tonne-mile basis from CA GREET and then multiplies it by the miles, adds the filtercake transport emissions calculated in a similar factor and then applies it to the tonnes of cane transported. The emission factor therefore changes when the miles transported changes.

The model uses incorrect emission factors from CA GREET. On the EF Tables sheet the composite emission factor is calculated in rows 9 to 13, columns C to H. The emission factors in column C for the HDD truck are not the same as they are in CA GREET as shown in the following table.

	CA GREET	Calculator
	HDD (grams/ton-mile cane transported)	
VOC	0.083	0.038
CO	0.275	0.131
CH_4	0.673	0.180
N_2O	0.001	0.002
CO_2	289	136.45
GHG	307	141

The calculator again understates the emission factor for sugarcane ethanol, in this case by more than a factor of two.

Straw Burning Emissions

The straw burning emissions are close and the difference is caused by the GWP conversion factors for VOC and CO.

	CA GREET	Calculator
	Emissions per tonne of cane	
VOC	1,499.4	1,499.4
CO	19,706.4	19,706.4
CH_4	578.3	578.3
N_2O	15.0	15.0
CO_2	-37,230.8	-37,230.8
GHG	17,336.3	17,313.1

Net Surplus Cogenerated Electricity Credit

The emission credit provided for the net (after T&D losses) excess power is the same value as is used for power generation in Brazil.

Ethanol Production Emissions

The ethanol production emission factor in the simplified calculator is much lower than it is in CA GREET. In the simplified calculator it is the sum of emissions from residual oil, lime use, and the non-biogenic emissions of bagasse combustion.

CA GREET included emissions from burning straw as well as burning bagasse. When the straw burning emissions are removed from CA GREET we get the values in the following table. It is not clear where the errors in fuel oil and lime are in the calculator as they are fixed values. The fuel oil emissions are from an assumption that 10% of the lubricants

are combusted. It is much more likely that 100% of the spent lubricants are either burned or used for dust suppression where they are eventually oxidized.

	CA GREET	Calculator
	Emissions per gallon of ethanol	
Fuel oil	2.99	9.9
Lime	37.35	48.8
Bagasse combustion	175.16	168.3
Total	222.5	227.0

The simplified calculator asks for the amount of externally acquired bagasse in column I of the Calculator tab but this value does not go anywhere. However the power that is produced from imported bagasse is excluded from the electricity credit calculation.

Truck Transport Emissions

The same emission factor is used for truck transport in Brazil and in California. This should not be the case as there is a different power mix in the two regions. The Brazilian results are shown in the following table.

	CA GREET	Calculator
	Emissions per mmBTU-mile	
VOC	0.0022	0.0022
CO	0.0073	0.0073
CH_4	0.0179	0.0180
N_2O	0.0000	0.0000
CO_2	7.6835	7.6757
GHG	8.1616	8.1532
GHG, g CO_2/gallon	0.623	0.622

The difference is due to the rounding of the GWP for VOC and CO. The larger issue is that these are not the same emission factors used for the corn ethanol calculator even for the California portion of the transport.

Anhydrous Ethanol Ocean Transport Emissions

The comparison of the ocean transport emission factors is presented below. The differences are again due to the GWP rounding in the calculator.

	CA GREET	Calculator
	Emissions per mmBTU-mile	
VOC	0.0010	0.0010
CO	0.0022	0.0022
CH_4	0.0020	0.0020
N_2O	0.0000	0.0000
CO_2	1.0833	1.0831

GHG	1.1408	1.1472
GHG, g CO_2/gallon	0.0871	0.0876

Summary

The development of the emission factors used in the sugarcane calculator is much more complicated than it needs to be. There are two significant errors in the calculator.

1. The farming emission factor is too low due to the use of 1.57 instead of 25 for the methane GWP.

2. The sugarcane transportation emissions are about half of what they should be due to the use of incorrect emission factors.

There are a number of other small errors due to the hard coding of truncated GWPs for CO and VOC. There are some inconsistencies between the emission factors used for this calculator and the starch ethanol calculator for exactly the same activity.

Curriculum Vitae

For

Donald Victor O'Conner, P. Eng

Donald Victor O'Connor, P. Eng.

Summary

An innovative, achievement oriented business leader with over 40 years experience with energy and environmental issues in Canada. Successfully developed and commercialized environmentally sound energy alternatives.
Background includes:

- Development of the GHGenius life cycle assessment model for energy systems.
- Developing Canada's largest alternative fuel retailing program.
- Establishment of the ethanol industry in Western Canada, from manufacturing to retailing. Extensive experience with production of biofuels.
- Detailed knowledge of fuels and the fuels industry. Technical expertise regarding the utilization of methanol, ethanol, natural gas, propane, hydrogen, gasoline and diesel fuels.
- Developing objectives, strategy and tactics in highly competitive manufacturing and retail industries.

Professional Experience

$(S\&T)^2$ Consultants Inc. (1998-2018)

President

The firm specializes in energy and environment issues. $(S\&T)^2$ helps corporations with business development strategies concerning new energy markets and products and it helps governments understand the business, energy and environmental issues of new energy pathways.
Mr. O'Connor has recently provided strategic advice on fuels, transportation issues, and greenhouse gas emissions to a number of Provincial governments, several Canadian Federal Government departments, and international agencies and governments. Mr. O'Connor has also consulted for a number of companies developing new technologies for alternative fuelled vehicles and companies developing new transportation fuel processes and facilities.

Projects have included:

- Development of the GHGenius life cycle assessment model
- Development of the Ontario Ethanol Growth Fund. Led to the establishment of 50% of the Canadian ethanol production capacity.
- Analysis of the US EPA RFS program for the National Biodiesel Board. Resulted in soybean biodiesel passing the GHG emission threshold established by the US Congress.
- Establishment of the qualifying criteria for biofuels under the Alberta RFS program.
- Proposed and participated in the development of a novel, patented process for the production of ethanol from woody lignocellulosic feedstock. Five patents granted.
- Provided guidance and recommendations for the establishment of a biofuels program for the Government of Peru.
- Provided project development services for the development and construction of western Canada's largest fuel ethanol plant.

Mohawk Canada Limited (1981 – 1998)

Mohawk was Western Canada's largest independent automotive fuel retailer offering environmentally responsible fuels and lubricants through 300 retail and bulk facilities. Mohawk also manufactures re-refined lubricants from used oil, and ethanol, distillers' grains and Fibrotein from grain.

President, COO, and Director, Mohawk Products Ltd. (1997 – 1998)
President, COO, and Director, Mohawk Lubricants Ltd. (1992 – 1998)
Vice President, Supply and Manufacturing (1989 – 1998)
Various positions in R&D, manufacturing and supply (1981-1989)

Donald Victor O'Connor, P. Eng.

Responsibilities:

- Led and managed three business units simultaneously. These units manufactured lubricants from used oil, processed grain into ethanol and human and animal foods, and the corporate supply function covering all aspects of fuels' development, supply and distribution, and core supplier relationships for convenience goods and corporate services. Recommended objectives, strategy and tactics consistent with the organization's values to achieve corporate vision.

Accomplishments:

- Contributed to the development of a vision and unique corporate positioning that allowed the company to increase its market share by 50% over five years;
- Initiated and led the successful introduction of several new or differentiated alternative fuels to the market (Natural Gas, M85, Ethanol blends (Regular Plus and Premium Plus), and premium diesel fuels (Diesel with ECA and Diesel Max);
- Led the turnaround of used oil re-refining business by doubling production and sales over a four-year period. Increased bottom line by 500% and made the operation the most profitable of its kind in the world.
- Introduced a strategic sourcing program throughout the organization.

Additional Professional Activities

- Advisory Committee. ILUC Quantification Study of EU Biofuels. GLOBIOM Model ILUC project.
- Canadian expert on GHG emissions and indirect effects to ISO TC 248 developing ISO 13065.
- Expert Working Group on Indirect Effects. California Air Resources Board. 2010
- Canadian Biomass Innovation Network. External Advisory Panel. 2005-2010.
- Director, B.C. Buildings Corporation. 2000-2002
- Co-Chair 1999-2001. Member, Executive Committee on Cleaner Technology Vehicles (Minister's Committee, B.C. Environment) (1995 - 2001)
- Director, Pound-Maker Adventures (1990 - 1998) An integrated ethanol plant cattle feeding operation in Saskatchewan.
- Director, Canadian Renewable Fuels Association (1990 – 1998, 2000-2002)
- Member, Environment Advisory Committee, Vancouver Foundation (2001-2003)
- Member, Ethanol BC Board (2000-2010)
- Member, Bio-based Products R&D Advisory Council, BIOCAP Canada, (2002-2003)
- Member, National Advisory Committee on Bioenergy (1984 - 1990)
- Member, Efficiency and Alternative Energy Committee, Minister's National Advisory Council to CANMET (1990 - 1994)
- Chair, Ethanol Program Advisory Committee, Agriculture and Agrifood Canada (1992 - 1997)
- Canadian Petroleum Products Institute, Western Division Management Committee (1996 - 1998)
- Numerous presentations on alternative fuels at National and International conferences.

Employment

- Manager, Energy and Environmental Technology, B.H. Levelton & Associates Ltd. Consulting Engineers (1974 - 1981)
- Air Engineer, Province of British Columbia, Pollution Control Branch (1973 - 1974)

Patents

- Mazza; Giuseppe, Gao; Lei, Oomah; B. Dave, O'Connor; Donald, Crowe; Brian. "Functional, water-soluble protein-fibre products from grains". 07/19/2001. U.S. Patent No. 6,261,629.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennestad; Gordon, Berlin; Alex, MacLachlan; John Ross. "Continuous counter-current organosolv processing of lignocellulosic feedstocks," 12/16/08, U.S. Patent No. 7,465,791.
- Berlin; Alex, Pye; Edward Kendall, O'Connor; Donald, "Concurrent saccharification and fermentation of fibrous biomass," 11/15/11, U.S. Patent No. 8,058,041.

- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma; Raymond. Continuous counter-current organosolv processing of lignocellulosic feedstocks. 6/05/12, U.S. Patent No. 8,193,324.
- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Continuous counter-current organosolv processing of lignocellulosic feedstocks. 7/24/12, U.S. Patent No. 8,227,004.
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- Hallberg; Christer, O'Connor; Donald, Rushton; Michael, Pye; Edward Kendall, Gjennstad; Gordon, Berlin; Alex, MacLachlan; John Ross, Ma. Continuous counter-current organosolv processing of lignocellulosic feedstocks. US Patent 8,772,427.

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- Vuksan, V., Jenkins, D. J., Vidgen, E., Ransom, T. P., Ng, M. K., Culhane, C. T., & O'Connor, D. 1999. A novel source of wheat fiber and protein: effects on fecal bulk and serum lipids–. The American journal of clinical nutrition, 69(2), 226-230.
- O'Connor, D., Esteghlalian, A.R., Gregg, D.J. and Saddler, J.N. 2003. Carbon Balance of Ethanol from Wood: The effect of Feedstock Source in Canada. The Role of Boreal Forests and Forestry in the Global Carbon Budget. pp. 289-296 (Proceedings of the International Science Conference, Edm. Alta. May 2000).
- Hünerberg, M., Little, S.M., Beauchemin, K.A., McGinn, S.M., O'Connor, D., Okine, E.K., Harstad, O.M., Kröbel, R. and McAllister, T.A., 2014. Feeding high concentrations of corn dried distillers' grains decreases methane, but increases nitrous oxide emissions from beef cattle production. *Agricultural Systems*, *127*, pp.19-27.
- Chen, R., Qin, Z., Han, J., Wang, M., Taheripour, F., Tyner, W., O'Connor, D. and Duffield, J., 2018. Life cycle energy and greenhouse gas emission effects of biodiesel in the United States with induced land use change impacts. *Bioresource technology*, *251*, pp.249-258.

Education

- Bachelor of Applied Science, Mechanical Engineering, University of British Columbia (1973)

Professional Memberships

- Association of Professional Engineers and Geoscientists of British Columbia
- Association of Professional Engineers of Ontario
- Society of Automotive Engineers

Awards

- Canadian Renewable Fuels Association. Outstanding Dedication to the Advancement of Renewable Fuels in Canada. 2007.