To: Adam Saul, Department of Ecology, Climate Pollution Reduction Program
From: Donna Albert, PE (Retired)
Subject: Clean Fuel Standard rulemaking - General comments

The models which this rulemaking relies on, including GTAP, GREET and RFS2, greatly underestimate the climate emissions of biofuels

Here are two older papers which explain the errors in logic which have resulted in underestimating the climate emissions of biofuels:

> LINK 1: Correcting a fundamental error in greenhouse gas accounting related to bioenergy, by Helmut Haberl, et al, Energy Policy.
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> LINK 2: Biofuels and the need for additional carbon, by Timothy Searching, Environmental Research Letters.

MY NOTE: Some of the papers I have referenced in these comments tend to completely disregard Planetary Boundaries, especially the concept that in order to bring atmospheric carbon levels down, a healthy biosphere is required. For instance, in LINK 1, *Table1. Degree of likely accounting error when CO2 emissions from biomass combustion are not properly considered,* "planting high-yielding energy crops on unused invasive grasslands" is designated as having a "low degree of likely accounting error." This refers only to the CO2 emissions accounting errors described in the paper. It is clear that evaluating the potential for restoring natural function on unused invasive grasslands was outside the scope of the paper. That doesn't mean all such lands can be safely used to grow bioenergy crops. Biodiversity, and setting aside as much as half of the earth to restore its natural functions, is not optional. A functioning biosphere which supports life on earth and sequesters carbon is required if we are to recover from the excess climate emissions already in the atmosphere. The web of life is fraying under the stress of climate change, expanding resource extraction, and development. **Incentivizing increasing amounts of biofuel production uses large amounts of land, and makes this situation worse.** I have included some references on Planetary Boundaries at the end of these comments.

> LINK 3: Environmental outcomes of the US Renewable Fuel Standard, by Tyler J. Lark, et al, Proceedings of the National Academies of Sciences of the United States of America (PNAS), a scientific journal.
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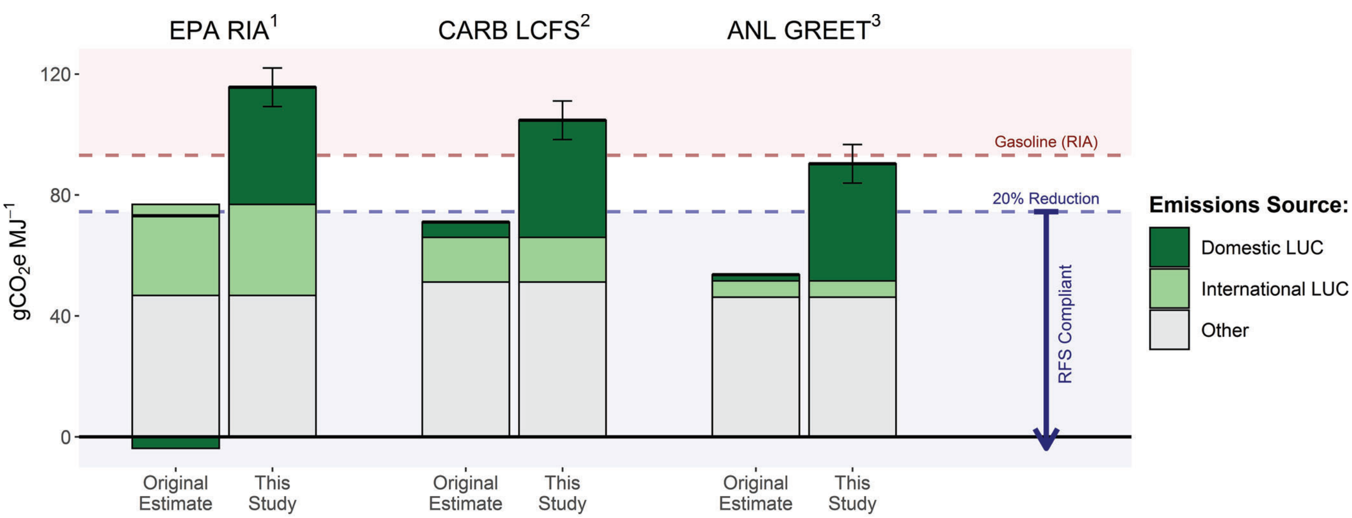
> Figure 3 on the next page is from the Lark et al paper above, which explains the corn ethanol example, and application to biofuels of all types.



[1]U.S. Environmental Protection Agency (EPA) Regulatory Impact Assessment (RIA); Projection for 2022.

[2]California Air Resources Board (CARB) Low Carbon Fuel Standard (LCFS); Estimated from approved values for 2019, see SI Appendix.

[3]Argonne National Laboratory (ANL) Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model; Default values from 2020.

The PNAS Commentary article below, “The Sobering Truth About Corn Ethanol,” is a layman’s guide to underlying studies, with links to references included. Note the following excerpt:

> “The findings of Lark et al. (4) also suggest that **greater scrutiny should be given to the models that are used in a regulatory context to evaluate the GHG emissions associated with fuels of all types**. The authors compare their results with those from three other modeling efforts—1) the US Environmental Protection Agency’s Regulatory Impact Assessment for RFS2; 2) the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model from Argonne National Laboratory, and 3) the Global Trade Analysis Project (GTAP) model as used by California Air Resources Board—all of which show considerably lower GHG emissions from domestic land use change caused by recent production of corn ethanol. This difference supports other recent concerns that these commonly used models underestimate the emissions consequences of land use change (11–13), which in turn leads to their overestimating the climate change benefits of corn ethanol (e.g., refs. 14–16).”

This PNAS Commentary article explains that the climate emissions of agricultural biofuels (ethanol, biodiesel, most drop-in fuels for internal combustion engines, and renewable natural gas to replace fossil natural gas) are worse than using fossil fuels. (My note: The climate emissions of aviation fuels from forest-sourced feedstock would also be high, when lost opportunity costs are accounted for.) Proponents of biofuels will tell you it’s more complicated than this. It is not.

You will hear that “advanced” biofuels (cellulosic-, synth-, methanol-, electro-fuels) are on the horizon, and are better for climate than agricultural biofuels. ALL of these drop-in substitutes for gasoline, diesel, boiler, or jet fuel share the same inherent flaw — when burned, the tailpipe climate emissions are comparable to fossil fuels. None of the methods used to create these fuels absorb enough CO2 from the atmosphere to make up for this inherent flaw (most actually net emit rather than absorb when lost opportunity costs are accounted for). Fuels made from captured carbon have the same climate emissions flaw - the once-captured CO2 ends up in the atmosphere after a delay of only months.

> LINK 4. The Sobering Truth About Corn Ethanol, by Jason Hill, University of Minnesota, Proceedings of the National Academies of Sciences of the United States of America (PNAS), a scientific journal.

Lost Opportunity Cost

Link below to an explanation by EarthJustice of the lost Carbon Opportunity Cost of biofuels due to its massive land use, and explains lost biodiversity (could have rewilded) and food security (could have grown food). In ADDITION to Lost Carbon Opportunity Cost, note the following excerpt regarding nitrogen:

> “Growing biofuel crops such as corn also requires intense nitrogen fertilization — most of which runs off into surface or ground water or is converted into nitrous oxide — a GHG approximately 300 times more potent than carbon dioxide. Indeed, **increased biofuel emissions from nitrogen fertilization alone can completely negate any emissions savings from reduced fossil fuel usage**. Increased crop production for biofuels also i**ncreases air, water, and soil pollution and threatens wildlife**.”

LINK 5. Growing Crops For Fuel Is Not a Climate Solution. Sustainable agricultural practices aren't going to change that. (EarthJustice article covers research by Timothy Searchinger of Princeton)

Food Security (understanding the relationship between biomass/biofuels and food), and Biodiversity

LINK 6. Accounting for land dictates the climate effect of alternative proteins, presentation by Tim Searchinger. This presentation provides a good general explanation of land carbon opportunity costs, which apply to any agricultural land use (any land use actually, including plantation forestry), including using agricultural land for growing biomass. At minute 49:00 the host asks Searchinger about how to consider the capacity of the land for recovering biodiversity and at the same time the capacity of the land to sequester carbon. In the reply, "the overwhelming issue is to stop clearing land…if you factor in the biodiversity cost, land use would be even more important." (My note: he was not asked about novel entities such as plastics, and other hazardous pollutants, which are affecting our food and human health now, and are also impacting other life on earth — see the Planetary Boundaries links.)

Planetary Boundaries (must be considered in every policy decision)

Washington State is a climate leader. Others will follow us. We should always consider the consequences of implementing climate solutions on a global scale.

LINK 7. Johan Rockström on navigating planetary boundaries video introduction (Note: climate, biodiversity, water, nitrogen, novel entities, and other boundaries interact)

LINK 8. Links to studies here, including a new study looking forward which is published in the journal Nature.

Thank you for considering my comments.