7 January 2022

Dr. Cheryl Laskowski
Transportation Fuels Branch
Industrial Strategies Division
California Air Resources Board

Dear Dr. Laskowski:

Thank you for the opportunity to provide written comments following the December 7, 2021 *Public Workshop to Discuss Potential Future Changes to the LCFS Program*. I am an independent climate & energy policy consultant operating under the business name Hammerschlag LLC. The following are my thoughts regarding the upcoming, LCFS five-year Scoping Plan.

One of my areas of specialization is life-cycle assessment of fuels, so I have assisted and am assisting several Tier 2 pathway applications under the LCFS. Over time, my Tier 2 pathway clients have been frustrated by confusing processes, opaque application tools, and ambiguous regulatory guidance. The level of frustration is sufficiently high that I believe the LCFS is probably discouraging the most innovative fuel pathways: it is simply not worth the innovator's time and money to try to understand the Tier 2 process, and then navigate it.

I notice two primary sources of trouble: (1) the order of events in the application process, and (2) CA-GREET. The troubles with CA-GREET are especially concerning because California is the leader in clean fuels regulation, and frequently emulated by other states. We now have an "OR-GREET" and are soon to see a "WA-GREET" as well. California has a particular weight on its shoulders to build high-quality clean fuels evaluation methodologies, because where California goes others will follow.

Below I will offer an alternative to CA-GREET and the current order of events. I hope that the upcoming Scoping Plan can embrace this solution, or any other solution that lowers the barriers to innovation in clean fuels and increases the methodological integrity of their evaluation.

Problem 1: Order of Events

When Tier 2 pathway applications are submitted, the order of events typically follows:

1. **Applicant submits LCA Report and modified CA-GREET.**

   This first step makes navigating CA-GREET a prerequisite for application, and as I will describe below it is an onerous prerequisite. Most applicants, even those with otherwise strong technical resources, find themselves needing to hire a GREET specialist like myself. In

many cases this is before they even know whether their pathway is financially viable, let alone legally viable under the LCFS.

2. **CARB checks for completeness.**

3. **Verification body validates application and underlying data.**

   Note that in most cases this will be the second consultant the applicant has had to hire, before even getting engineering review from CARB. The applicant *still* may not be sure their pathway is financially viable at this point.

4. **CARB executes engineering review.**

   This is the stage at which I find frustration to peak. Applicants are frustrated because they have submitted an apparently-complete application, *and* the verification body has vetted their data, but then CARB has the capacity to require seemingly capricious changes to methodology and associated recalculation. Sometimes, changes required by engineering review cause a return to the validation process with new data.

   The verification bodies are frustrated because they cannot know what methodology they are actually validating against. The engineering review can also be perceived as an insult to their professionalism. Verification bodies have undergone a rigorous process designed to ensure their technical qualification, but then CARB devalues their work by calling for changes afterward.

5. **Public provides comments.**

   The public finds frustration in the LCFS process as well. By the time a pathway has reached the public comment stage so much work has been done by the applicant, the verification body, and CARB staff that there is no will to make any further material changes. Yet, public requests for change are almost always on material topics. The result is that the majority of public comments are written off as "out of scope" or argued away with defensive logic. This gives the public the impression that their material concerns are being given no regard by the program.

6. **CARB approves pathway(s).**

Problem 2: CA-GREET

The LCFS program anchors carbon intensity computations on CA-GREET, an adaptation of the U.S. Department of Energy's GREET Microsoft Excel workbook. CARB's good intentions are to base CI calculation on prior work, to provide a uniform platform for comparable computations, to ensure best practices, and to provide a ready resource of relevant physical and engineering constants. Unfortunately GREET, and therefore CA-GREET, has foundational shortcomings that make it more a barrier than an enabler of good clean fuels policy. Specifically:

- **CA-GREET offers significant barriers to entry**. CA-GREET 3.0 makes such high demands on even a modern workstation, that the workbook is designed to disable Microsoft Excel's default automatic calculation mode, and furthermore disable the autosave feature of the user's Excel installation. The former behavior can cause significant administrative or technical errors when the user incorrectly assumes other Excel workbooks open on their desktop are continuing to produce current outputs. The latter behavior causes data loss if GREET or anther workbook induces an Excel crash.

  Furthermore, there is no obvious interface for entering operating data or computing LCFS-relevant CI values for an applicant's unique fuel pathway. The 'Results' tab delivers nonconforming CI values embedded among some twenty different emission categories, and in units of g/mmBtu rather than g/MJ. A party considering a new and innovative pathway has no idea where to start.

- **CA-GREET is intractable**. CA-GREET 3.0 contains 51 tabs, several of which contain in the neighborhood of 1,000 rows and/or 100 columns. Organization defies logic, with no self-evident sequence of computations throughout the workbook. Within cells, formulae attain mind-numbing lengths that defy any attempt to understand the underlying computational processes. Just as one, typical example, here is the formula in cell 'Results'!B322, which computes the final value for feedstock CO_2 emissions of corn-based E85 burned in a flexible fuel vehicle:

```
=HLOOKUP($E$10,$S$5:$W$6,2,FALSE)/HLOOKUP($E$11,$S$7:$T$8,2,FALSE
)*Vehicles!$K$60/1000000*((1-Vehicles!$C$29)*(1-Vehicles!$C$8)*Fu
el_Specs!$B$15/((1-Vehicles!$C$29)*(1-Vehicles!$C$8)*Fuel_Specs!$
B$15+Vehicles!$C$29*(1-Vehicles!$C$8)*Fuel_Specs!$B$17+Vehicles!$
C$8*Fuel_Specs!$B$32)*(Petroleum!B279*Petroleum!$D$262)+Vehicles!
$C$29*(1-Vehicles!$C$8)*Fuel_Specs!$B$17/((1-Vehicles!$C$29)*(1-V
ehicles!$C$8)*Fuel_Specs!$B$15+Vehicles!$C$29*(1-Vehicles!$C$8)*F
uel_Specs!$B$17+Vehicles!$C$8*Fuel_Specs!$B$32)*(Petroleum!B279*P
etroleum!$F$262)+Vehicles!$C$8*Fuel_Specs!$B$32/((1-Vehicles!$C$2
9)*(1-Vehicles!$C$8)*Fuel_Specs!$B$15+Vehicles!$C$29*(1-Vehicles!
$C$8)*Fuel_Specs!$B$17+Vehicles!$C$8*Fuel_Specs!$B$32)*(EtOH!BR50
6*EtOH!$BS$489))+HLOOKUP($E$10,$S$5:$W$6,2,FALSE)/HLOOKUP($E$11,$
S$7:$T$8,2,FALSE)*Vehicles!K82+B326*Fuel_Specs!$B$109/Fuel_Specs!
$B$112+B327*Fuel_Specs!$B$110/Fuel_Specs!$B$112
```

  Because the dependency tree for any given GHG emissions output includes hundreds of cells, many with equally opaque formulae, it is essentially impossible for a human to audit and understand the methodology underlying a CI result.

- **"Tier 1 Simplified CI Calculators" exacerbate the problem.** Since CA-GREET 3.0 is intractable, it is impossible to literally adapt or simplify it for specific cases. So with each Tier 1 pathway type, CARB is taking upon itself the task of building an entire, dedicated calculator from scratch. And indeed, each Tier 1 Simplified CI Calculator bears no resemblance to the primary CA-GREET 3.0 model, other than a few shared constants. The

result is that program participants face a variety of calculator designs that bear little relationship to each other and fail to offer best practices for life-cycle assessment.[1]

- **CA-GREET is nonapplicable**. Per LCFS §95488.7(a)(1), "Tier 2 pathway carbon intensities must be calculated using the CA-GREET3.0 model, with the most current 24 months of operational data...." The impression is given that a user can input 24 months of data somewhere, and read Tier 2 pathway carbon intensity output somewhere else. Though the Tier 1 Simplified CI Calculators work that way, no such thing is possible in CA-GREET 3.0 proper. There are no places to enter 24 months of data, and there is no LCFS-compliant output field. The best that a Tier 2 applicant can do, is use CA-GREET 3.0 as a source of physical and engineering values underlying their own, independent computations.

Recommended Solution

I believe that the LCFS program would nurture a broader spectrum of innovation, operate with greater environmental integrity, and increase process efficiency if it dispensed with the CA-GREET model and rebuilt the program around the international standard ISO 14067 *Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification*. A program built around ISO 14067 is a program anchored on internationally agreed upon life-cycle assessment best practices, yet flexible enough to accommodate the most interesting new developments. Here is my vision of how that could work:

One-Time Actions Kicking Off an ISO 14067-Centered Program

1. Eliminate the "Tier 1" approach – CARB should not be in the business of designing and releasing calculators. CIs should originate only from the lookup table computed by CARB, or from applicants' ISO 14067-compliant carbon footprint of product reports (CFP Reports).

2. Issue CARB-authored, ISO 14067-compliant CFP Reports for each lookup table CI. These reports can serve to set an example for applicants.

3. Publish a definitions document that states
   - requirements for the system boundary (the boundary within which all GHG sources and sinks must be included);
   - the threshold for *de minimis* source exclusion;
   - the list of GHGs to be included;
   - standard physical and engineering constants to be used; and
   - any other ISO 14067 criteria CARB wishes to fix for all pathways.

[1] Life-cycle assessment methodology has been discussed at great length in peer-reviewed literature, and consensus best practices are formally encoded in several International Standards Organization (ISO) standards. But GREET and CA-GREET do not provide a manifest framework for changes that comport with those standards.

Note that the content of this document must be determined in conjunction with CARB's derivation of lookup table values.

Application Process under an ISO 14067-Centered Program

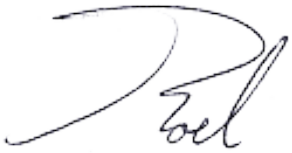
1. Require that each pathway application begin with submission of a draft CFP Report. Launch CARB engineering review immediately, and trade CFP Report iterations with the applicant until CARB is satisfied that the applicant's methodology meets the requirements of the definitions document, as well as LCFS generally.

2. Once CARB engineering review has concluded, post the proposed CFP Report for public comment. If public comments are substantive, CARB collaborate with the applicant to make any final changes to pathway methodology accordingly, or reject the pathway if the public discovers an existential conflict with LCFS requirements.

3. Submit the CFP Report and underlying data to third-party validation.[2] Third-party validation can induce changes to the computed CI commensurate with improvements to data quality, but at this point the project methodology will be fixed as per the final changes made during Step 2.

I don't know that this solution is the right one. I only want to offer a starting point for change. Perhaps this comment can spark a discussion about what really makes for an innovative and environmentally integral LCFS -- a discussion that embraces the full extent of the program right down to its foundational tools.

Respectfully submitted,



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[2] Verification bodies could be encouraged to consult ISO 14067 *General principles and requirements for bodies validating and verifying environmental information* for the sake of consistency with an ISO-oriented program.