Don Gilstrap
Manager, Fuels Regulations

May 31, 2023

Cheryl Laskowski
Branch Chief
Air Resources Board
1001 I Street
Sacramento, CA 95814

Dear Dr. Laskowski:

Subject: Hydroprocessed Esters and Fatty Acids (HEFA) Tier1 Calculator

Chevron appreciates the opportunity to review and comment on the Tier 1 Calculators for LCFS pathways.

Chevron is a major refiner and marketer of petroleum products and renewable fuels in the state of California and a regulated party under the Low Carbon Fuel Standard (LCFS). With the recent acquisition of Renewable Energy Group, Inc., Chevron is also an international producer of lower carbon intensity fuels with a global integrated procurement, distribution, and logistics network, and 11 biorefineries in the U.S. and Europe. In 2021, Chevron Renewable Energy Group produced 480 million gallons of renewable fuels, resulting in 4.1 million metric tons of CO2 reduction, and is helping lead the energy transition to a lower carbon future.

The following are our comments on HEFA Calculator. We are also submitting comments on the Biodiesel Calculator in **Appendix A** and as a separate document per the instructions on CARB's website. Some comments, particularly as they relate to feedstock production and transport, apply to both calculators. Thus, we would encourage CARB staff responsible for the HEFA Calculator to also review our comments on the Biodiesel Calculator as consistency in the inputs common to both calculators is essential.

Timeline for Feedback:
CARB has set the deadline for providing feedback on proposed Tier 1 simplified calculators and lookup tables as May 31, 2023. While this is sufficient time for some of the calculators, such as those published in February and March, it is not sufficient time for those published in mid-May, including the HEFA Calculator. In fact, as of the date that this letter was submitted, the "biomethane for anaerobic digestion of dairy and swine manure" draft calculator had not been published.

Structure of the HEFA Calculator:
We find the HEFA Calculator more user-friendly and simply constructed than the currently approved Tier 1 calculator for biodiesel and renewable diesel ("BD/RD Calculator"). However, that simplification comes

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at the loss of calculation details. As discussed more fully in our comments on the draft Biodiesel Calculator, the detailed calculations can be a valuable way to identify potential efficiency gains and corresponding GHG reductions in a fuel pathway. We recommend that CARB add details of the calculations and identify precisely where in GREET2022 the inputs were extracted.

Specific Technical Comments on the HEFA Calculator:

Feedstocks – Please refer to our comments on the draft Biodiesel Calculator for detailed comments on feedstocks used in the Biodiesel and HEFA Calculators.

Miscellaneous Chemical Use – Miscellaneous chemical use for hydrotreated oils and fats increased from 0.03 gCO2e/MJ in the current BD/RD Calculator to 0.65 gCO2e/MJ in the draft HEFA Calculator. This appears to be an inadvertent carryover from the biodiesel production assumptions in the BD/RD Calculator as 0.65 gCO2e/MJ is also used in the draft Biodiesel Calculator. We recommend that CARB staff update the draft HEFA Calculator with the appropriate value (0.03 gCO2e/MJ) for miscellaneous chemical use.

Shipping Emissions – The draft HEFA (and Biodiesel) Tier 1 Calculator(s) have hard-coded values for shipping emission factors, which are based on relatively small ships (22,500 DWT for HEFA transport, 12,500 DWT for SBO transport). Larger ships are typically used to transport petroleum products, e.g., Medium Range (30-45,000 DWT) and Long Range 1 (60-80,000 DWT) ships.

Has CARB given consideration for user-input values for DWT and speed within the calculators to calculate shipping emissions? We understand a producer can apply alternative values, but those would likely be based on extracting values from GREET, so including the calculation within the Tier 1 Calculators would eliminate that extra step.

Coproducts Exported – Could CARB please confirm that "Coproducts Exported" refers to coproducts exported outside the *fuel pathway* rather than exported completely outside of the boundary of a fuel production facility. This has implications when a biofuel production pathway is incorporated into a larger fuel production facility that may also process fossil fuels. Some facilities may have multiple operations at the same location so the LCA boundary may exist within a portion of the plant with compliant traceability and data gathering. The User's Guide for the HEFA Calculator has the following guidance:

4.3 Coproducts Exported	Select if light hydrocarbon co-products are produced at the fuel production facility and exported for other uses. Coproducts must meet one of the alternate use options provided in field 5.11 and cannot be used in any way by the HEFA fuel pathway.
5.12 Light HC Fate Outside Fuel Pathway	If light hydrocarbon (HC) coproducts are sent outside the fuel pathway, select either "Feedstock for H2 Production" or "Process Energy" if either fate is accurate. If "Feedstock for H2 Production" is selected, the H2 produced will be considered imported hydrogen for field 5.6. If requesting credit for an alternate fate other than those listed, a Tier 2 application may be required.

Figure 1- Excerpt of the User's Guide for the HEFA Calculator.

The guidance language in Figure 1 is not entirely clear when comparing Section 4.3 to Section 5.12. We believe the verbiage in Section 4.3 should refer to light hydrocarbon coproducts exported outside the fuel pathway rather than exported outside the fuel production facility. We suggest the following clarification to the text in Section 4.3:

> Select if light hydrocarbon co-products are produced within the fuel pathway and are exported outside the fuel pathway for other uses.

Coproduct Credits for Light Hydrocarbons Sent Outside the Fuel Pathway – It is unclear why different treatment is applied to light hydrocarbon coproduct credits when used as process energy versus feed to a hydrogen plant. In both cases, the bio-based light hydrocarbons are likely displacing natural gas make-up, either to a hydrogen plant or to the fuel gas system. If used as hydrogen feed in the HEFA Calculator, full natural gas displacement is applied, which is consistent with the current BD/RD Calculator, and it is consistent with the actual disposition of the light hydrocarbons. However, if used as process energy in the draft HEFA calculator, the following approach is used, which is more akin to energy allocation rather than displacement:

% Lt HC energy = Lt HC / (Lt HC + RD + Naphtha + …) = Assume 5% for the ensuing calculation
Lt HC credit = 5% * (Feedstock + Fuel Production Emissions)

We strongly recommend applying natural gas displacement to both common end-uses (process energy and hydrogen production) of light hydrocarbons produced when hydrotreating oils and fats as this is consistent with the actual disposition.

Hydrogen Transport Emissions – The draft HEFA Calculator lists the gaseous hydrogen transport emission factor as 8.34 gCO2e/kg-mile H2, which seems very high at first blush. Further review of this value identified its source as the draft Hydrogen Calculator. However, gaseous hydrogen transport in the draft Hydrogen Calculator is based on high-pressure, tube trailer transport. This is not a common means of transporting hydrogen in a refinery setting, which is typically accomplished via pipeline for consistent delivery, safe handling, and efficient operations.

The draft HEFA Calculator needs to clearly identify that the "G-H2 Transport EF" is for on-road transport via tube trailer, and another option should be added for gaseous hydrogen transport via pipeline. Similarly, the "L-H2 Transport EF" entry should clearly state that transport is via on-road liquid tanker truck. The "HEFA Production Inputs" tab should be updated to allow user-input for these various options.

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HEFA Transport Emissions – The draft HEFA Calculator HEFA transport emission factors are replicated below, along with the renewable diesel and biodiesel transport emission factors from the current BD/RD Calculator. The highlighted cells in the Table 1 below are exact matches between the draft HEFA Calculator and values from the Tier 1 BD/RD Calculator. As with miscellaneous chemical use, it appears that the biodiesel transport emission factors were inadvertently assigned to HEFA in the draft HEFA Calculator. The difference between biodiesel and renewable diesel is a result of a slightly higher density for biodiesel relative to renewable diesel (HEFA).

Also please note that the Rail and Ocean Tanker emission factors in the draft HEFA Calculator are exactly the same. This is also likely an error.

Table 1- Comparison of Emission Factors

Transport Mode	CA-GREET4.0 Draft HEFA Calculator	CA-GREET3.0 Tier 1 BD/RD Calculator (for Renewable Diesel)	CA-GREET3.0 Tier 1 BD/RD Calculator (for Biodiesel)	Units
HHDT	0.465	0.408	0.465	gCO_2e/gallon-mile HEFA/Biodiesel
Rail	0.0977	0.0887	0.1011	
Barge	0.0831	0.0728	0.0831	
Ocean Tanker	0.0977	0.0857	0.0977	

Electricity Emissions – Please refer to our comments on the draft Biodiesel Calculator for detailed comments on electricity emissions for both the Biodiesel and HEFA Calculators.

General Comment Throughout – Instead of simply referring to "GREET 2022" as the source of the various emission factors in the draft calculators, CARB should identify precisely which tabs and cells were used for the calculations. Additionally, the year of analysis and any other inputs to the GREET2022 model that impact the output from that model should be identified. Also, identify whether the October 2022 release of GREET2022 or whether Revision 1 of the model (released March 2023) was used in the calculations. Finally, any other revisions to GREET2022 that are used in creating the Tier 1 calculators should be identified.

If you have any questions regarding our comments, please contact me at dgilstrap@chevron.com.

Sincerely,

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Appendix A – Comments on the Biodiesel Calculator

Overarching comments:

Generally, the calculator is easy to navigate and less redundant than the CA-GREET 3.0 calculator. We have a few overarching comments and suggestions, which, based on our experience, would enhance the calculator's functionality and its applicability to current operations in the energy industry. Please consider making these changes to current and future versions of the biodiesel calculators:

1. Modify the model to allow inclusion of more feedstock types and additional co-product types to capture the unique processes at biodiesel facilities based on their specific operations.
2. Some values are hard coded and there is no background information to support them. We therefore request that CARB provides an explanatory document for all the changes between CA-GREET 3.0 and CA-GREET 4.0.
3. We request that calculation components are clarified and broken out. Seeing the broken-out calculations in CA-GREET 3.0 allows applicants to target their improvement efforts which will be important for lowering fuel carbon intensity.
4. The simplified CA-GREET 4.0. for BD only includes 10 types of feedstocks. In anticipation of greater feedstock diversity and joint applicants between now and 2030 we recommend that at least 25 total feedstock pathways be available in the CA-GREET 4.0 BD calculator to avoid making calculator modifications continuously and ensure that the spreadsheet can handle the complexity of the industry until the next iteration of the regulation.

Specific Comments:

- The eGRID factors listed in the CA-GREET 4.0 sheet do not appear to match the 2021 factors released on the EPA website. We would like to confirm the data source and any conversions and modifications carried out.
    - The difference ranges between -37% and 261% at the extremes.
    - It appears that eGRID does not include upstream fuel production/transport emissions. We would like to understand how the numbers in CA-GREET 4.0 were generated and what lifecycle stages are included, as well as their source.
- There should be an option for a non-LCFS feedstock type to be entered into the calculator. These feedstocks are needed for mass balance purposes but are not registered as LCFS pathways. Providing a complete accounting of feedstocks is challenging if there are no non-LCFS feedstock options.
- There should be an additional co-product type to account for other types of co-products that may be produced at a BD facility depending on the technologies in place.
- During our review some users had functionality issues with selecting buttons/checkboxes used in the spreadsheet. There may be workarounds to use these, but the sheet should be modified to remove/modify the buttons so that users can easily use the workbook without macro or

other IT firewalls. Dropdowns are an effective way to select multiple options and we have not experienced any issues using them.

- CA-GREET 4.0 uses feedstock used for BD production to calculate feedstock transportation emissions rather than feedstock received. Feedstock used is a more accurate representation of reality because it reflects what happens in the system at the plant-level. We support this modification.

- There is no allocation for tallow transportation in 4.0 (‘Pathway Summary’!N17). This appears to be an error, so we ask that CARB this error be fixed so that tallow transportation is allocated in the same manner as other feedstock.

- The SUM formulas for methanol, BD production, and BD transport all omit a cell for beginning inventory which causes overcalculation of the total quantities.
    - ‘Pathway Summary’!F9 omits 'Biodiesel Production Inputs'!P30 in the formula
    - ‘Pathway Summary’!D24 omits 'Biodiesel Production Inputs'!L30 in the formula
    - ‘Pathway Summary’!D25-28 omit 'Biodiesel Production Inputs'!P30 in the formulas

- There is no allocation to coproducts for methanol, which is a different approach than was used in CA-GREET 3.0. This causes an increased CI score for BD:
    - In 3.0, the total emissions from methanol are calculated by multiplying the total energy of methanol by the emission factor and BD loss factor and then allocating a portion to coproducts on an energy basis.
    - In 4.0, the emission factor and BD loss factor for methanol are the same, but there is no multiplication of the total emissions (‘Pathway Summary’!H24) by the allocation factor (‘Pathway Summary’!F11).
    - As an example, ignoring the allocation of 80% of emissions to biodiesel increases the methanol CI by 25% with the same production data, as seen below:

	CA-GREET 3.0	CA-GREET 4.0
Methanol Emissions (gCO2e)	5	5
Energy of BD (MJ, LHV)	4	4
Energy of Coproducts (MJ, LHV)	1	1
Energy Allocation to BD	0.8	0.8
Methanol CI portion	1	1.25

- The emission factors for rail and vessel BD transport are identical. The value used for both transportation modes is equal to the emission factor used for vessel transport in version 3.0, which results in lower emissions for rail transportation. Please review these numbers and modify accordingly:

	Sheet	Cell	Rail EF	Cell	Ocean Tanker EF
CA-GREET 3.0	EF Table	C49	0.101080983363219	C50	0.0977307316158949

CA-GREET 4.0	CA-GREET 4.0	E25	0.0977307316158949	E27	0.0977307316158949

- We recommend that feedstock production calculations be disaggregated and clearly shown in the spreadsheet. This will enable applicants to identify areas for improvement and understand the components feeding into the calculation.
    - For example, it would be beneficial for applicants to understand the disaggregated methanol CI calculation so it is clear how the conversion was performed to arrive at the methanol factor from the original gCO2e/MMBTU figure.

- Tallow's emission factor in the CA-GREET 4.0 calculator of 304 gCO2e/lb ('CA-GREET4.0'!E13) does not match the GREET 2022 value of ~125 gCO2e/lb (cells BX413-BZ413 below) when all emissions are calculated. CA-GREET 3.0 has a score of ~303 gCO2e/lb ('EF Table'!C43), which aligns with the 2016 Argonne model number of 308 gCO2e/lb (cells DS314-DU314 below) when all emissions are totaled.
    - Figure 2 shows a screenshot of ANL's GREET 2022. Note that calculations have been added to GREET 2022, cells BX413 – BZ413 on the BioOil tab (highlighted in yellow). The final CI score is highlighted in green.

	A	B	BW	BX	BY	BZ
1	Soybeans, Palm, Canola, Jatropha and Camelina to Biodie					
400		Petroleum		Rendering Fat to Tallow		
401		Water consumption, gallons/mmBtu of fuel throughput		Rendering	Displacement Credit	Transportation
402		Total emissions: grams/mmBtu of fuel throughput, except as noted		Per lb. of Tallow		
403		VOC		0.019	0.000	0.001
404		CO		0.078	0.000	0.011
405		NOx		0.114	0.000	0.012
406		PM10		0.009	0.000	0.000
407		PM2.5	Blue formulas copied from B450, B451, C450, C451	0.007	0.000	0.000
408		SOx		0.039	0.000	0.000
409		BC		0.001	0.000	0.000
410		OC		0.002	0.000	0.000
411		CH4		0.319	0.000	0.007
412		N2O		0.003	0.000	0.000
413		CO2		109	0	6
414		VOC from bulk terminal	CO2 (w/ C in VOC & CO)	109	TOTAL rendering, Transportation GHGS	125
415		VOC from ref. Station	GHGs	119		

Figure 2- Screenshot of Argonne National Laboratory's GREET 2022 model.

- Below is a screenshot of ANL's GREET 2016. Note that cells DS314 - DU314 on the BioOil tab contain calculations that contribute to the LCA (highlighted in yellow). The total CI score is highlighted in green. (Note that calculations were copied into a separate Excel workbook due to technical issues).

A	B	C	D	E	F
	2016 Tallow Excerpt		DS	DT	DU
ROW #			Rendering	Displacement Credit	Transportation
302	**Water consumption, gallons/mmBtu of fuel throughput**		0.112298493	0	0.002014172
303	**Total emissions: grams/mmBtu of fuel throughput, except as noted**		Per lb. of Tallow		
304	VOC		0.037974575	0	0.002463672
305	CO		0.140579939	0	0.008101279
306	NOx		0.396010398	0	0.028438094
307	PM10		0.054901659	0	0.000617685
308	PM2.5		0.029084228	0	0.000571189
309	SOx		0.869423303	0	0.001926524
310	BC		0.002840972	0	6.62196E-05
311	OC		0.004692248	0	0.000391573
312	CH4		0.786634808	0	0.017113217
313	N2O		0.006228955	0	5.28338E-05
314	CO2		274.7409182	0	8.16192199
315	~~VOC from bulk terminal~~	CO2 (w/ C in VOC & CO)	275.08		
316	~~VOC from ref. Station~~	GHGs	300.33	TOTAL	308.49
	Urban emissions: grams/mmBtu of fuel throughput				

Figure 3 - Screenshot of Argonne National Laboratory's GREET 2016 model.

- CARB's numbers should align with the latest values published in the scientific literature, which we believe are reflected in the latest GREET model. If CARB chooses to use different numbers, we would like to understand the reasoning for the modified values.

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