



**Tier 1 Simplified CI Calculator Instruction Manual**  
Hydroprocessed Ester and Fatty Acid Fuels

May 12, 2023

PRELIMINARY DRAFT FOR PUBLIC COMMENTS

## A. Introduction

This document provides detailed instructions for Hydroprocessed Ester and Fatty Acid Fuels (HEFA) pathway applications. The Tier 1 Simplified CI Calculator for HEFA (T1 HEFA Calculator) calculates the carbon intensity (CI) of HEFA produced from single or multiple feedstocks. HEFA finished fuel options in this calculator include Renewable Diesel (RD), Renewable Naphtha (RN), Renewable Propane (RP) and Alternative Jet Fuel (AJF).

**Download the T1 HEFA Calculator here:**

[LCFS Life Cycle Analysis Models and Documentation | California Air Resources Board](#)  
(link will be active when the ISOR is published)

The T1 HEFA Calculator requires the applicant to add monthly operational data for feedstock types and quantities, fuel production quantities, and transport distances to calculate the CI of HEFA pathways. Some CARB-approved input values may also be selected.

## B. T1 HEFA Calculator Overview

The following table provides an overview of the worksheets used in the T1 HEFA Calculator.

*Table B.1. Worksheets Used in the T1 HEFA Calculator*

Worksheet Name	Description
Introduction	Provides a brief introduction to the T1 HEFA Calculator.
Feedstock Inputs	Worksheet for entering feedstock data sourced by the HEFA production facility. Up to 10 feedstocks may be entered as a Tier 1 pathway for up to 4 finished fuels, yielding CIs for up to 40 fuel pathways per application.
HEFA Production Inputs	Worksheet for entering HEFA production data used for calculating the CI of pathway(s).
Pathway Summary	Calculates pathway-specific CIs and operating conditions, to be completed by CARB staff prior to pathway certification based on the data entered in the "Feedstock Inputs" and "HEFA Production Inputs" worksheets.
CA-GREET4.0	Contains predefined input values, emission factors, fuel specifications, and unit conversion values.

The cells in the T1 HEFA calculator have various fill colors per the legend below:

User Input
Calculated Value
CA-GREET4.0 Value

- "User Input" cells must be completed if the input is used by the fuel pathway. If the input is irrelevant, it may be left blank or hidden by deselecting the input checkbox in Section 4. For example, if a pathway uses natural gas as a process energy, the quantities of natural gas used must be entered into the user input cells under the correct field in Section 6. If the pathway does not use natural gas as a process energy, the user input cells in that field may be left blank or hidden by deselecting the appropriate Section 4 checkbox. **All User Inputs are subject to verification as part of initial pathway certification and annual fuel pathway reporting.**
- "Calculated Value" cells contain formula that provide a calculated result based on either user input data or CA-GREET4.0. In some instances, a "Calculated Value" cell may display a blank or "N/A" value if that input is not relevant based on user inputs.
- "CA-GREET4.0" cells contain input values from the CA-GREET4.0 model.

Calculated Value formula and CA-GREET4.0 values cannot be modified without prior approval from CARB. Approved modifications may elevate the pathway to a Tier 2 application.

### C. Feedstock Inputs

At the top of the worksheet is the navigation bar, where the applicant can select the number of feedstocks using a drop-down menu and navigate to feature to go to a specific feedstock. The applicant may select up to 10 feedstocks.



The navigation bar consists of two main sections. The first section is labeled "Number of Feedstocks" and contains a dropdown menu currently displaying the number "1". The second section is labeled "Navigate to" and contains a dropdown menu currently displaying "Feedstock 1".

For each individual feedstock, the worksheet consists of the following sections:

- Feedstock Information
- Section 1. Feedstock Inputs
- Feedstock Transport (calculated values)
- Fuel Production Facility Inventory (calculated values)
- Section 2. Feedstock Monthly Operational Data Inputs

## Feedstock Information

This field is automatically populated based on the number of feedstocks selected in the navigation bar and information provided in Section 1.

<b>Feedstock 1</b>
USA Canola Oil

### Section 1: Static Feedstock Inputs

Section 1: Static Feedstock Inputs	
1.1.1 Feedstock Type	
1.2.1 Feedstock Origin	
1.3.1 Production EF (gCO <sub>2</sub> e/dry lb oil)	
1.4.1 Transport Modes	<input type="checkbox"/> Truck <input type="checkbox"/> Rail <input type="checkbox"/> Ocean Tanker <input type="checkbox"/> Barge
1.5.1 Ocean Tanker EF (gCO <sub>2</sub> e/lb-mile oil)	N/A
	N/A

Table C.1 lists the details of fields in Section 1. The “x” value in the Field Name refers to the corresponding feedstock number.

*Table C.1. Input Field Instructions for Section 1 of the T1 HEFA Calculator*

Field Name	Description
1.1.x Feedstock Type	Using the drop-down menu, select the feedstock type. If other is selected, specify the feedstock.
1.2.x Feedstock Origin	Using the drop-down menu, select the origin of the feedstock. If other is selected, specify the origin.
1.3.x Production EF (gCO <sub>2</sub> e/dry lb oil)	This EF is a composite of feedstock production, transport and oil extraction steps. If the feedstock has a coproduct (e.g., animal feed), the emissions for these steps have been allocated on a mass basis. If a feedstock type/origin combination has a predefined production

	emission factor (EF) approved by CARB, select the “Default” option in the dropdown list below to select that EF. If a predefined production EF is not available, consult with CARB to develop an EF. Site-specific oil extraction/rendering EFs require validation and verification of the oil extraction/rendering facility’s operational data.
1.4.x Transport Modes	Please select transport mode from processing facility to production facility.
1.5.x Ocean Tanker EF (gCO <sub>2</sub> e/lb-mile oil)	If ocean tanker has been selected in field 1.6.x, Select from the dropdown the default ship size of 12,500 DWT or user defined. If user-defined has been selected, consult with CARB staff to develop an EF.

### *Feedstock Transportation*

These fields are automatically populated based on information provided in Section 2

<b>Feedstock Transport (lb-miles)</b>	
Truck	
Rail	
Barge	
Ocean Tanker	
Transport EF (gCO <sub>2</sub> e/lb oil)	

### *Fuel Production Facility Inventory*

These fields are automatically populated based on information provided in Section 2

<b>Fuel Production Facility Inventory (dry lbs)</b>	
Feedstock Received	
On-Site Inventory Change	
Feedstock Used	

## Section 2: Feedstock Monthly Operational Data Inputs

Table C.2 lists the fields used in Section 2 of the feedstock Input worksheet.

*Table C.2. Input Field Instructions for Section 2 of the T1 HEFA Calculator*

Field Name	Description
2.1.x Reporting Month (MM/YYYY)	This section will be automatically populated by the operational data period entered into Field 6.1.
2.2.x Beginning Inventory (lbs)	Enter the feedstock quantities stored the fuel production facility at the beginning of each month of operational data.
2.3.x Ending Inventory (lbs)	Enter the feedstock quantities stored the fuel production facility at the end of each month of operational data.
2.4.x Weight (lbs)	Enter the monthly feedstock quantities delivered to the fuel production facility.
2.5.x Moisture (%)	Enter the monthly weighted average moisture content for feedstock using an industry standard moisture measurement protocol.
2.6.x Truck - Weight (lbs)	Enter the monthly feedstock quantities transported by truck.
2.7.x Truck – Distance (miles)	Enter the monthly weighted average transport distance by this mode.
2.8.x Rail – Weight (lbs)	Enter the monthly feedstock transported by rail.
2.9.x Rail – Distance (miles)	Enter the monthly weighted average transport distance by this mode.
2.10.x Barge – Weight (lbs)	Enter the monthly feedstock transported by rail.
2.11.x Barge – Distance (miles)	Enter the monthly weighted average transport distance by this mode.
2.12.x Ocean Tanker – Weight (lbs)	Enter the monthly feedstock transported by ocean tanker.
2.13.x Ocean Tanker – Distance (miles)	Enter the monthly weighted average transport distance by this mode.

## D. HEFA Production Inputs

The HEFA Production Inputs worksheet consisting of the following major components:

- Section 3. Application Information
- Section 4. Pathway Inputs
- Section 5: Static Operational Data
- Section 6: Monthly Operational Data

### Section 3: Application Information

Section 3: Applicant Information	
3.1 Application #	
3.2 Company Name	
3.3 Company ID	
3.4 Fuel Production Facility ID	

Table D.1. Input Field Instructions for Section 3 of the T1 HEFA Calculator

Field Name	Description
3.1 Application #	Enter the application number provided by the AFP.
3.2 Company Name	Enter the company name as entered in the AFP.
3.3 Company ID	Enter the company ID as generated by the AFP. If not available, contact CARB staff for LCFS Company ID.
3.4 Facility ID	Enter U.S EPA Facility ID. If not available, contact CARB staff.

### Section 4: Pathway Inputs

Section 4 provides the option to select only input fields that apply to a given pathway, which hides irrelevant inputs in Section 6 of the worksheet. Figure 1 below shows the various input options permitted in the T1 HEFA Calculator. If a fuel pathway has additional emissions inside the system boundary that are not listed in Section 2, a Tier 2 application is required to document and account for those emissions.

Section 4: Pathway Inputs	
4.1 Fuel Production Inputs	<input type="checkbox"/> Natural Gas <input type="checkbox"/> Grid Electricity <input type="checkbox"/> Low-CI Electricity <input type="checkbox"/> Alternate Fuel <input type="checkbox"/> Imported Hydrogen <input type="checkbox"/> On-Site Hydrogen
4.2 Book-and-Claim (B&C) Inputs	<input type="checkbox"/> RNG <input type="checkbox"/> Low-CI Electricity
4.3 Coproducts Exported	<input type="checkbox"/> Light Hydrocarbons
4.4 Fuel(s) Produced	<input type="checkbox"/> Renewable Diesel <input type="checkbox"/> Renewable Naphtha <input type="checkbox"/> Renewable Propane <input type="checkbox"/> Alternative Jet Fuel
4.5 HEFA Transport	<input type="checkbox"/> Truck <input type="checkbox"/> Rail <input type="checkbox"/> Barge <input type="checkbox"/> Ocean Tanker

Table D.2. Input Field Instructions for Section 4 of the T1 HEFA Calculator

Field Name	Description
4.1 Fuel Production Inputs	Select the type(s) of process energy and hydrogen feedstocks used at the fuel production facility.
4.2 Book-and Claim (B&C) Inputs	If hydrogen is produced on-site, select if B&C inputs are matched to onsite use of NG or grid electricity.
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.
4.4 Fuel(s) Produced	Select the types of HEFA fuels produced at the fuel production facility.
4.5 HEFA Transport	Select the transport mode(s) used to deliver HEFA to California fueling stations.

### Section 5: Static Operational Data

Section 5 allows for entry of static operational data inputs. If a field is deselected in Section 4, it may be reflected in Section 5 with a gray cell displaying a "N/A" value.



Section 5: Static Operational Data	
5.1 Electricity Grid Region	
5.2 Electricity Grid EF (gCO <sub>2</sub> e/kWh)	
5.3 Low-CI Electricity EF (gCO <sub>2</sub> e/kWh)	
5.4 Alternate Fuel Type	
5.5 Alternate Fuel EF (gCO <sub>2</sub> e/MMBtu, HHV)	
5.6 Imported H <sub>2</sub> EF (gCO <sub>2</sub> e/kg H <sub>2</sub> )	
5.7 Imported H <sub>2</sub> Transport Distance (miles)	
5.8 B&C RNG FPC	
5.9 B&C RNG CI (gCO <sub>2</sub> e/MJ RNG, LHV)	
5.10 B&C Electricity FPC	
5.11 B&C Electricity CI (gCO <sub>2</sub> e/kWh)	
5.12 Light HC Fate Outside Fuel Pathway	
5.13 HEFA Transport - Truck (miles)	
5.14 HEFA Transport - Rail (miles)	
5.15 HEFA Transport - Barge (miles)	
5.16 HEFA Transport - Ocean Tanker (miles)	
5.17 Ocean Tanker EF (gCO <sub>2</sub> e/lb-mile oil)	

Table D.3. Input Field Instructions for Section 5 of the T1 HEFA Calculator

Field Name	Description
5.1 Electricity Grid Region	If the HEFA production facility uses grid electricity, select the electricity mix corresponding to the region where the facility is located. The calculator includes 27 eGRID zone mixes, Brazilian average mix, Canadian average mix and User Defined Mix included in the drop-down menu. A map of eGRID zones is provide in the "Predefined Inputs" worksheet. The eGRID region may also be determined using the <a href="#">eGRID Power Profiler tool</a> .
5.2 Electricity Grid EF (gCO <sub>2</sub> e/kWh)	The grid electricity EF will be displayed based on the 5.1 selection. If User-Defined is selected in Field 5.1, consult with CARB to develop an emission factor for a user-defined grid electricity mix.

5.3 Low-CI Electricity EF (gCO <sub>2e</sub> /kWh)	Consult with CARB staff to develop an appropriate emission factor for the low-CI electricity used by the HEFA production facility. Low-CI electricity must be physically supplied directly to the production facility per LCFS Regulation section 95488.8(h); indirect accounting (“book-and-claim”) is not permitted for HEFA pathways except for electricity used for electrolysis to produce hydrogen used by the pathway. The low-CI electricity source and all data sources used in calculating emission factors must be described in detail in the Supplemental Documentation submitted with the T1 HEFA Calculator.
5.4 Alternative Fuel Type	Please specify fuel type if another fuel source is used for fuel production
5.5 Alternative Fuel EF (gCO <sub>2e</sub> /MMBtu, HHV)	Consult with CARB staff to develop an appropriate emission factor for the alternate fuel. Alternate fuel sources and data sources used in calculating emission factors must be described in detail in the Supplemental Documentation submitted with the T1 HEFA Calculator. This description must at a minimum identify the alternative fuel and the source.
5.6 Imported Hydrogen EF (gCO <sub>2e</sub> /kg H <sub>2</sub> )	If hydrogen is imported to the fuel production facility, use the dropdown menu to either enter a site-specific EF of that hydrogen based on its certified pathway CI, or select a predefined EF. To determine the site-specific EF of a certified pathway, consult with CARB.
5.7 Imported H <sub>2</sub> Transport Distance (miles)	Enter the total mileage for hydrogen transport between the hydrogen production facility and the HEFA production facility. Transport mileage may be determined using a publicly available web-based driving distance estimator. If truck transport serves multiple distribution routes in California, a weighted average distance may be calculated, or the mileage of the farthest route may be applied.
5.8 B&C RNG FPC	If RNG attributes are retired to match NG used as a feedstock for on-site hydrogen production, enter the fuel pathway code (FPC) of the pathway associated with those attributes.
5.9 B&C RNG CI (gCO <sub>2e</sub> /MJ, LHV)	Enter the most recently certified CI associated with the FPC entered in field 5.7.
5.10 B&C Electricity FPC	If electricity attributes are retired to match grid electricity used as an input for on-site hydrogen production via electrolysis, enter the fuel pathway code (FPC) of the pathway associated with those attributes.
5.11 B&C Electricity CI (gCO <sub>2e</sub> /kWh)	Enter the most recently certified CI associated with the FPC entered in field 5.9.
5.12 Light HC Fate Outside Fuel Pathway	If light hydrocarbon (HC) coproducts are sent outside the fuel pathway, select either “Feedstock for H <sub>2</sub> Production” or “Process Energy” if either fate is accurate. If “Feedstock for H <sub>2</sub> Production” is selected, the H <sub>2</sub> 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.

5.13 HEFA Transport - Truck (miles)	Enter the total mileage for HEFA transport by truck. Truck transport mileage may be determined using a publicly available web-based driving distance estimator. If truck transport serves multiple distribution routes in California, a weighted average distance may be calculated, or the mileage of the farthest route may be applied.
5.14 HEFA Transport - Rail (Miles)	Enter the total mileage for HEFA transport via rail based on the rail network maps from either BNSF Railway <sup>1</sup> or Union Pacific. <sup>2</sup> If rail transport has multiple routes in California, a weighted average distance may be calculated, or the mileage of the farthest route may be applied.
5.15 HEFA Transport - Barge (Miles)	Enter the total mileage for HEFA transport via barge to the HEFA distribution terminal in California based on barge transport routes. Barge transport mileage may be determined using a publicly available web-based shipping distance estimator for barge transport. If barge transport has multiple routes in California, a weighted average distance may be calculated, or the mileage of the farthest route may be applied.
5.16 HEFA Transport - Ocean Tanker (Miles)	Enter the total mileage for HEFA transport via ocean tanker to the HEFA distribution terminal in California based on ocean tanker transport routes. Ocean Tanker transport mileage may be determined using a publicly available web-based shipping distance estimator for barge transport. If ocean tanker transport has multiple routes in California, a weighted average distance may be calculated, or the mileage of the farthest route may be applied.
5.17 Ocean Tanker EF (gCO <sub>2</sub> e/lb-mile oil)	If ocean tanker has been selected in Section 4, Select from the drop-down the default ship size of 12,500 DWT or user defined. If user-defined has been selected, consult with CARB staff to develop an EF.

### Section 6: Monthly Operational Data

Operational data for all fields selected by the user in Section 4 must be entered into the fields in Section 6 for each month of the operational data period. Fields that do not apply to the fuel pathway may either be unselected using the Pathway Input options in Section 4 or may be left blank. Any gaps in data reporting must comply with the Missing Data Provisions in LCFS Regulation section 95488.8(k).

<sup>1</sup> <http://www.bnsf.com/customers/where-can-i-ship/>

<sup>2</sup> <https://www.up.com/aboutup/usguide/index.htm>

Table D.4. Input Field Instructions for Section 6 of the T1 HEFA Calculator

Field Name	Description
6.1 Operational Data Period (MM/YYYY)	Enter the 24 consecutive months that reflect the most recent operational data available for the HEFA production facility. For fuel production facilities that have been in operation less than 24 months, or for facilities that CARB determines have met the process change requirements of LCFS Regulation section 95488.9(c), the operational data submitted is permitted to range from 3 to 24 months.
6.2 North American Natural Gas (MMBtu, HHV)	Enter the quantity of natural gas (NG) used by the <u>entire</u> HEFA production facility sourced from a common carrier NG pipeline in North America. This quantity should be inclusive of on-site hydrogen production. Any submetered NG used by the fuel production facility that is unrelated to the fuel pathway may be deducted from this quantity after consulting with CARB and the verification body. For NG sourced outside of North America, use Field 6.5.
6.3 Grid Electricity (kWh)	Enter the quantity of grid electricity used by the <u>entire</u> HEFA production facility. Any submetered electricity used by the fuel production facility that is unrelated to the fuel pathway may be deducted from this quantity after consulting with CARB and the verification body. This quantity should be inclusive of on-site hydrogen production.
6.4 Directly-Supplied Low-Cl Electricity (kWh)	Enter the quantity of low-Cl electricity supplied directly to the production facility per LCFS Regulation section 95488.8(h)
6.5 Alternate Fuel (MMBtu, HHV)	Enter the quantity of alternate fuel used by the <u>entire</u> HEFA production facility. Any submetered alternate fuel used by the fuel production facility that is unrelated to the fuel pathway may be deducted from this quantity after consulting with CARB and the verification body. This quantity should be inclusive of on-site hydrogen production.
6.6 Imported Hydrogen (kg)	Enter the quantity of hydrogen used by the fuel pathway that is produced outside the HEFA production facility.
6.7 Hydrogen Produced On-Site from Natural Gas (kg)	Enter the quantity of hydrogen used by the fuel pathway that is produced from NG at the HEFA production facility.
6.8 Maximum Matchable RNG (MMBtu, HHV)	This field calculates the maximum monthly quantity of RNG that can be matched to NG for hydrogen production at the HEFA production facility.
6.9 RNG Matched (MMBtu, HHV)	Enter the quantity of B&C RNG environmental attributes retired. Retired attributes cannot exceed the quantity calculated in field 6.8.
6.10 Grid Electricity Usage for On Site Electrolysis (kWh)	If hydrogen is produced on site using grid electricity, enter the metered quantity of electricity used by the electrolysis unit.

6.11 Maximum Matchable Low-Cl Electricity (kWh)	This field calculates the maximum monthly quantity of low-Cl electricity that can be matched to grid electricity used for hydrogen production at the HEFA production facility.
6.12 Low-Cl Electricity Matched (kWh)	Enter the quantity of B&C low-Cl electricity environmental attributes retired. Retired attributes cannot exceed the quantity calculated in field 6.11.
6.13 Exported Light Hydrocarbons (MMBtu, LHV)	Enter the quantity of light hydrocarbons exported use as a process fuel or hydrogen feedstock outside the HEFA fuel pathway. Heating value must be determined using a CARB-approved sampling and analysis protocol.
6.14 Beginning RD Inventory (gallons @ 60°F)	Enter the renewable diesel (RD) quantity stored at the fuel production facility at the beginning of each month of operational data.
6.15 Ending RD Inventory (gallons @ 60°F)	Enter the RD quantity stored the fuel production facility at the end of each month of operational data.
6.16 RD Sold (gallons @ 60°F)	Enter the RD quantity exported from the fuel production facility.
6.17 Beginning RN Inventory (gallons @ 60°F)	Enter the Renewable Naphtha (RN) quantity stored at the fuel production facility at the beginning of each month of operational data.
6.18 Ending RN Inventory (gallons @ 60°F)	Enter the RN quantity stored the fuel production facility at the end of each month of operational data.
6.19 RN Sold (gallons @ 60°F)	Enter the RN quantity exported from the fuel production facility.
6.20 Beginning RP Inventory (gallons @ 60°F)	Enter the Renewable Propane (RP) quantity stored at the fuel production facility at the beginning of each month of operational data.
6.21 Ending RP Inventory (gallons @ 60°F)	Enter the RP quantity stored the fuel production facility at the end of each month of operational data.
6.22 RP Sold (gallons @ 60°F)	Enter the RP quantity exported from the fuel production facility.
6.23 Beginning AJF Inventory (gallons @ 60°F)	Enter the Alternative Jet Fuel (AJF) quantity stored at the fuel production facility at the beginning of each month of operational data.
6.24 Ending AJF Inventory (gallons @ 60°F)	Enter the AJF quantity stored the fuel production facility at the end of each month of operational data.
6.25 AJF Sold (gallons @ 60°F)	Enter the AJF quantity exported from the fuel production facility.

## E. Pathway Summary Worksheet

The Pathway Summary worksheet aggregates site-specific user input data to calculate the carbon intensity of each fuel pathway in the T1 HEFA Calculator. This worksheet also serves as

a location where a Margin of Safety may be added to each pathway CI prior to pathway certification and pathway-specific Operation Conditions may be added by CARB staff.

The top sections of this worksheet (Applicant Information, Total Quantities, and Finished Fuel Quantities) provide a summary of site-specific inputs entered by the user.

The T1 HEFA Calculator provides a single CI for each feedstock used to produce HEFA fuel. These CIs are identical for all finished fuels associated with that feedstock; however, each feedstock will receive a unique fuel pathway code (FPC) upon certification.

The “Reportable for Operational Data Period” section calculates the total quantities of finished fuels attributable to each feedstock for the operational data period.

The Carbon Intensity (CI) Calculations Section of this worksheet provides a summary of each fuel production stage along with its calculated emissions and stage-specific CIs. The CIs are summed to provide a CI associated with the HEFA pathway. The applicant may opt to apply a conservative margin of safety to the fuel pathway CI to ensure that the pathway remains compliant with certified CIs.

The final section of this worksheet provides a space for CARB staff to publish Operating Conditions associated with the pathway.

## F. CA-GREET4.0 Worksheet

The CA-GREET4.0 Worksheet contains predefined input values from several sources, including Argonne National Labs GREET 2022,<sup>3</sup> EPA eGRID,<sup>4</sup> CARB EMFAC,<sup>5</sup> Purdue University GTAP and Stanford OPGEE<sup>6</sup> models. These input values cannot be modified without written permission from CARB and will elevate the pathway application to a Tier 2 status.

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<sup>3</sup> <https://greet.es.anl.gov/index.php>

<sup>4</sup> <https://www.epa.gov/eGRID>

<sup>5</sup> <https://arb.ca.gov/emfac/>

<sup>6</sup> <https://eao.stanford.edu/research-project/opgee-oil-production-greenhouse-gas-emissions-estimator>