CALIFORNIA
AIR RESOURCES BOARD

# Tier 1 CI Calculator for Hydroprocessed Ester and Fatty Acid (HEFA) Fuels

*Instruction Manual*

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# I. Introduction

This document provides detailed instructions for the Tier 1 CI Calculator for Hydroprocessed Ester and Fatty Acid Fuels (T1 HEFA Calculator) to calculate the carbon intensities (CI) of Renewable Diesel (RD), Renewable Naphtha (RN), Renewable Propane (RP) and/or Alternative Jet Fuel (AJF) produced from up to 20 unique feedstocks for use as a transportation fuel in California.

*Click here to download the T1 HEFA Calculator*

The T1 HEFA Calculator requires the applicant to enter monthly operational data for feedstock types and quantities, fuel production quantities, and transport distances.

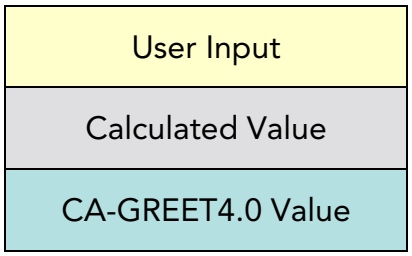
# II. T1 HEFA Calculator Overview

Table 1 provides a summary of the worksheets present in the Tier 1 HEFA Calculator.

**Table 1: T1 HEFA Calculator Worksheet Overview**

| Worksheet Name | Description |
|---|---|
| Introduction | Introduction to the T1 HEFA Calculator. |
| Feedstock Inputs | Worksheet for feedstock data entry. |
| HEFA Production Inputs | Worksheet for fuel production data entry. |
| Pathway Summary | Worksheet that displays fuel production quantities, calculates CIs, and site-specific operating conditions. |
| CA-GREET4.0 | Worksheet for predefined input values, emission factors, fuel specifications, and unit conversion values from the CA-GREET4.0 model. |

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




To calculate the fuel pathway CI, the user must enter site-specific data into "User Input" fields if that field is relevant to the fuel pathway. If the input field is not relevant to the fuel pathway, it may be left blank or hidden by deselecting the input checkboxes located in Sections 1 and 4.

All User Inputs are subject to verification as part of initial pathway certification and annual fuel pathway reporting. If a fuel pathway has additional emissions inside the system boundary that are not captured in the User Input fields, a Tier 2 application is required to document and account for those emissions.

"Calculated Value" cells contain formula that provide a calculated value based on user input data or CA-GREET4.0. In some instances, a "Calculated Value" cell may display a blank value if that input is not relevant or insufficient user input data has been entered.

"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 and may elevate the pathway to a Tier 2 application.

## III. Feedstock Inputs

The Feedstock Inputs worksheet contains fields for entering information or up to 20 feedstocks, yielding CIs for up to 80 fuel pathways per application. At the top of the Feedstock Inputs worksheet are two drop-down menus that allows the user to specify the number of feedstocks in the pathway and navigate to a given feedstock.

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

- Section 1. Static Feedstock Inputs
- Section 2. Monthly Feedstock Inputs

**Table 2: Instructions for Section 1: Static Feedstock Inputs**

| Field Name | Instructions |
|---|---|
| 1.1.x Feedstock Type | Using the drop-down menu, select the feedstock type. If "Other (Specify Below)" is selected, specify the feedstock in the cell below the drop-down menu. |

| Field Name | Instructions |
|---|---|
| 1.2.x Feedstock Origin | Using the drop-down menu, select the origin of the feedstock. If "Other (Specify Below)" is selected, specify the feedstock origin in the cell below the drop-down menu. |
| 1.3.x Production EF ($gCO_2e$/dry lb oil) | Using the drop-down menu, select a default or site-specific production emission factor (EF). This EF is a composite of farming, transport and oil extraction or rendering emissions per unit of feedstock. If a predefined production EF is not available, consult with CARB to develop an EF. Site-specific extraction or rendering EFs require validation and verification of the extraction or rendering facility's operational data. |
| 1.4.x Transport Modes | Select the transport mode(s) from processing facility to production facility. |
| 1.5.x Ocean Tanker EF ($gCO_2e$/lb-mile oil) | If ocean tanker transport is selected in field 1.4.x, use the drop-down menu to select the ocean tanker. If user-defined has been selected, consult with CARB to develop an EF. |

Section 2 inputs (Table 3) must be entered for each month of the operational data period.

**Table 3: Instructions for Section 2 - Monthly Feedstock Inputs**

| Field Name | Instructions |
|---|---|
| 2.1.x Reporting Month (MM/YYYY) | This section will be automatically populated with each month of operational data entered in Field 6.1. |
| 2.2.x Feedstock Inventory - Stored at Fuel Production Facility - Beginning Inventory (lbs) | Enter the quantity of feedstock stored at the fuel production facility the first day of each month. |
| 2.3.x Feedstock Inventory - Stored at Fuel Production Facility - Ending Inventory (lbs) | Enter the quantity of feedstock stored at the fuel production facility the last day of each month. |
| 2.4.x Feedstock Inventory - Delivered to Fuel Production Facility - Weight (lbs) | Enter the quantity of feedstock delivered to the fuel production facility. |
| 2.5.x Feedstock Inventory - Delivered to Fuel Production Facility - Moisture (%) | Enter the weighted average moisture content for feedstock delivered to the fuel production facility. |
| 2.6.x Feedstock Transport -Truck - Weight (lbs) | Enter the quantity of feedstock transported by truck. |

| Field Name | Instructions |
|---|---|
| 2.7.x Feedstock Transport -Truck - Distance (miles) | Enter the distance for feedstock transport from the point of origin to the fuel production facility by truck using a publicly available distance estimator tool that reflects the actual transport route. If feedstock is transported from multiple origins, a weighted average distance may be calculated, or the mileage of the farthest route may be applied. |
| 2.8.x Feedstock Transport - Rail - Weight (lbs) | Enter the quantity of feedstock transported by rail. |
| 2.9.x Feedstock Transport - Rail - Distance (miles) | Repeat instructions in 2.7.x for feedstock transported by rail. |
| 2.10.x Feedstock Transport - Barge - Weight (lbs) | Enter the quantity of feedstock transported by barge. |
| 2.11.x Feedstock Transport - Barge - Distance (miles) | Repeat instructions in 2.7.x for feedstock transported by barge. |
| 2.12.x Feedstock Transport – Ocean Tanker - Weight (lbs) | Enter the quantity of feedstock transported by ocean tanker. |
| 2.13.x Feedstock Transport – Ocean Tanker - Distance (miles) | Repeat instructions in 2.7.x for feedstock transported by ocean tanker. |

# IV. 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

**Table 4: Instructions for Section 3 - Application Information**

| Field Name | Instructions |
|---|---|
| 3.1 Application Number | 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. |

| Field Name | Instructions |
|---|---|
| 3.4 Facility ID | Enter U.S EPA Facility ID. If not available, contact CARB. |

Section 4 inputs (Table 5) provide the option to select only input fields that apply to a given pathway. Unselected inputs in Section 4 do not require corresponding user entries in Sections 5 and 6 of the worksheet.

**Table 5: Instructions for Section 4 - Pathway Inputs**

| Field Name | Instructions |
|---|---|
| 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 Exported Coproducts | Select if light hydrocarbon co-products are produced at the fuel production facility and exported outside the fuel pathway, either elsewhere at the fuel production facility or an external facility. |
| 4.4 Finished Fuel(s) | 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. |

**Table 6: Instructions for Section 5 - Static Operational Data**

| Field Name | Instructions |
|---|---|
| 5.1 Electricity Grid Region | If the HEFA production facility uses grid electricity, select the electricity mix corresponding to the eGRID region where the facility is located. A map of eGRID zones is provided in the "CA-GREET4.0" worksheet. The eGRID region may also be determined using the eGRID Power Profiler tool.[1] |
| 5.2 Electricity Grid EF ($gCO_2e/kWh$) | The grid electricity EF will be displayed based on the selection for Field 5.1. If User-Defined is selected in Field 5.1, consult with CARB to develop an emission factor for a user-defined grid electricity mix. |

[1] United States Environmental Protection Agency, *eGRID Power Profiler tool*. (Updated June 5, 2023). *https://www.epa.gov/egrid/power-profiler#/*

| Field Name | Instructions |
|---|---|
| 5.3 Low-CI Electricity EF ($gCO_2e/kWh$) | Consult with CARB 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). 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 | Specify the type of alternative fuel being utilized. |
| 5.5 Alternative Fuel EF ($gCO_2e$/MMBtu, HHV) | Consult with CARB to develop an emission factor for the alternate fuel. Alternate fuel emission factors must be described in detail in the Supplemental Documentation submitted with the application. |
| 5.6 $H_2$ EF ($gCO_2e/kg\ H_2$) | Select an emission factor (EF) for hydrogen used in HEFA production from the drop-down menu.<br><br>For imported hydrogen, the user may elect to input either a default EF for hydrogen produced by steam methane reforming (SMR), or the CI from the T1 H2 Calculator associated with the hydrogen production facility.<br><br>If the CI from a T1 H2 Calculator is used for this field, that calculator must be provided in the application materials either by the applicant or by the hydrogen pathway holder. The T1 H2 and T1 HEFA calculators must share a common operational data period.<br><br>If hydrogen production is located at the HEFA production facility and all hydrogen production inputs are included in Section 6 fields, the user may select "H2 Production Inputs Included in Section 6". |
| 5.7 Imported $H_2$ Transport Mode | Select the transport mode used for hydrogen imported to the HEFA production facility |
| 5.8 Imported $H_2$ Transport Distance (miles) | Enter the distance for hydrogen transport mode selected in Field 5.7 using a publicly available distance estimator tool that reflects the actual transport route. If hydrogen is shipped from multiple sources, a weighted average distance may be calculated, or the mileage of the farthest route may be applied. |
| 5.9 HEFA Transport - Truck (miles) | Enter the distance for HEFA transport by truck using a publicly available distance estimator tool that reflects the actual transport route. If HEFA is shipped to multiple destinations, a weighted average distance may be calculated, or the mileage of the farthest route may be applied. |
| 5.10 HEFA Transport - Rail (Miles) | Repeat instructions for Field 5.10 for HEFA transported by rail. |
| 5.11 HEFA Transport - Barge (Miles) | Repeat instructions for Field 5.10 for HEFA transported by barge. |
| 5.12 HEFA Transport - Ocean Tanker (Miles) | Repeat instructions for Field 5.10 for HEFA transported by ocean tanker. |

| Field Name | Instructions |
|---|---|
| 5.13 Ocean Tanker EF ($gCO_2e$/lb-mile oil) | If ocean tanker has been selected in Section 4, Select from the drop-down the default ship size of 22,500 DWT or user defined. If user-defined has been selected, consult with CARB to develop an EF. |

Section 6 inputs (Table 7) must be entered for each month of the operational data period. Any gaps in data reporting must comply with the Missing Data Provisions in LCFS Regulation section 95488.8(k). Quantities entered should be inclusive of the entire fuel production facility; quantities used by the facility that are outside the fuel pathway system boundary may only be excluded with written permission from CARB.

**Table 7: Instructions for Section 5 - Monthly Operational Data**

| Field Name | Instructions |
|---|---|
| 6.1 Reporting Month (MM/YYYY) | Enter the 24 consecutive months that reflect the most recent operational data available for the HEFA production facility. Applications must not have an interval of greater than 3 months between the end of the operational data month and the date of submission. 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) sourced from a common carrier NG pipeline in North America. |
| 6.3 Grid Electricity (kWh) | Enter the quantity of electricity sourced from the grid. |
| 6.4 Directly-Supplied Low-CI Electricity (kWh) | Enter the quantity of low-CI electricity supplied directly per LCFS Regulation section 95488.8(h). |
| 6.5 Alternate Fuel (MMBtu, HHV) | Enter the quantity of alternate fuel used by the fuel production facility. |
| 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 (kg) | Enter the quantity of hydrogen used by the fuel pathway that is produced at the HEFA production facility. |
| 6.8 Light Hydrocarbons Used as H2 Feedstock (MMBtu, HHV) | Enter the quantity of light hydrocarbons used as a feedstock for hydrogen production. Any hydrogen thereby produced is modeled outside the HEFA fuel pathway. If that hydrogen is then used by the HEFA fuel pathway, it should be reported as imported hydrogen in input for fields 5.6 and 6.6 of the T1 HEFA Calculator. Heating value must be determined using a CARB-approved sampling and analysis protocol. |

| Field Name | Instructions |
|---|---|
| 6.9 Light Hydrocarbons with Alternate Use (MMBtu, HHV) | Enter the quantity of light hydrocarbons with an alternate use fate outside the HEFA fuel pathway. |
| 6.10 Beginning RD Inventory (gallons @ 60°F) | Enter the quantity of Renewable Diesel (RD) stored at the fuel production facility on the first day of the month. |
| 6.11 Ending RD Inventory (gallons @ 60°F) | Enter the quantity of RD stored at the fuel production facility on the last day month. |
| 6.12 RD Sold (gallons @ 60°F) | Enter the quantity of RD sold by the fuel production facility. |
| 6.13 Beginning RN Inventory (gallons @ 60°F) | Repeat Field 6.10 instructions for renewable naphtha. |
| 6.14 Ending RN Inventory (gallons @ 60°F) | Repeat Field 6.11 instructions for renewable naphtha. |
| 6.15 RN Sold (gallons @ 60°F) | Repeat Field 6.12 instructions for renewable naphtha. |
| 6.16 Beginning RP Inventory (gallons @ 60°F) | Repeat Field 6.10 instructions for renewable propane. |
| 6.17 Ending RP Inventory (gallons @ 60°F) | Repeat Field 6.11 instructions for renewable propane. |
| 6.18 RP Sold (gallons @ 60°F) | Repeat Field 6.12 instructions for renewable propane. |
| 6.19 Beginning AJF Inventory (gallons @ 60°F) | Repeat Field 6.10 instructions for alternative jet fuel. |
| 6.20 Ending AJF Inventory (gallons @ 60°F) | Repeat Field 6.11 instructions for alternative jet fuel. |
| 6.21 AJF Sold (gallons @ 60°F) | Repeat Field 6.12 instructions for alternative jet fuel. |

Section 7 of the calculator allows book-and-claim matching from up to 24 individual RNG ~~or Low-CI Electricity~~ pathways. Quantities entered in this section are with respect to the entire operational data period, and do not require monthly data.

**Table 8: Instructions for Section 7 - Book-and-Claim Accounting of RNG for On-Site Hydrogen Production**

| Field Name | Instructions |
|---|---|
| 7.1 Fuel Pathway Code | Enter the fuel pathway code(s) (FPC) for up to 24 LCFS-certified RNG pathways used to match book-and-claim RNG environmental attributes to NG used as a feedstock for hydrogen production. |
| 7.2 CI Score ($gCO_2e$/MJ, LHV) | Enter the certified CI score associated with each RNG pathway FPC. |
| 7.3 RNG Pathway Pipeline Distance (miles) | Enter the pipeline distance from the RNG injection location to the CNG station in California as calculated the certified RNG pathway. If the pipeline distance is not available from the RNG pathway holder, consult with CARB. |
| 7.4 H2 Pathway Pipeline Distance (miles) | Enter the pipeline distance from the RNG injection location to the hydrogen production facility using a publicly available web-based driving distance estimator. |
| 7.5 Quantity Matched (MMBtu, HHV) | Enter the total quantities of RNG matched to hydrogen produced on-site at the HEFA production facility. Maximum matchable Book-and-Claim quantities are calculated on the 'Pathway Summary' worksheet. |
| ~~7.6 Pathway FPC~~ | ~~Enter the fuel pathway code(s) (FPC) for up to 24 LCFS-certified Low-CI Electricity pathways used to match book-and-claim Low-CI Electricity environmental attributes to grid electricity used as a process input for hydrogen production.~~ |
| ~~7.7 CI Score (gCO2e/kWh)~~ | ~~Enter the certified CI scores associated with each Low-CI Electricity pathway FPC.~~ |
| ~~7.8 Quantity Matched (kWh)~~ | ~~Enter the total quantity of Low-CI Electricity matched from each pathway to gaseous hydrogen produced at the fuel production facility for the entire operational data period. Maximum matchable Book-and-Claim quantities are calculated on the 'Pathway Summary' worksheet.~~ |

## V. Pathway Summary Worksheet

The Pathway Summary worksheet calculates the CI of each fuel pathway from operational data and user selections in the Feedstock Inputs and HEFA Production Inputs worksheets.

The top section of this worksheet (Applicant Information and HEFA Production Quantities) provides application identification information and a summary of the total feedstock used and fuel produced by the facility.

The Carbon Intensity Calculations section provides a summary of each fuel production stage inputs along with its calculated emissions and stage-specific CIs. The CIs are then 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. A completed version of this worksheet is shared with the applicant for review and approval prior to pathway certification.

## VI. CA-GREET4.0 Worksheet

The CA-GREET4.0 Worksheet contains predefined input values from the CA-GREET4.0 model. These input values cannot be modified without written permission from CARB, which will elevate the application to a Tier 2 pathway.