Tier 1 Simplified CI Calculator Instruction Manual

Starch and Fiber Ethanol

February 21st, 2023

PRELIMINARY DRAFT FOR PUBLIC COMMENTS

A. Introduction

This document provides detailed instructions for the use of the Tier 1 Simplified CI Calculator for Starch and Fiber Ethanol (T1 SFE Calculator). This calculator is to be used to calculate the carbon intensity (CI) for ethanol produced from corn and/or sorghum feedstocks.

Download the T1 SFE Calculator here:

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

The T1 SFE Calculator requires the applicant to add monthly operational data, fuel production quantities, and transport distances to calculate the CI of starch and corn fiber ethanol pathways. Some CARB-approved default and conditional default input values may also be selected.

B. T1 SFE Calculator Overview

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

Table B.1. Worksheets Used in the T1 SFE Calculator

Worksheet Name	Description
Introduction	Provides a brief introduction for the Tier 1 SFE Calculator.
Site-Specific Inputs	Worksheet for entering project input data used for calculating the carbon intensity (CI) of the pathway.
Pathway Summary	Contains the calculated CIs for the given pathway based on the data entered in the "Site-Specific Inputs" worksheet. Also contains a section for pathway-specific operating conditions, to be completed by CARB staff prior to pathway certification.
Predefined Inputs	Reference worksheet. Contains inputs and emission factors from used in calculations of carbon intensities and specifications of fuels, global warming potentials of greenhouse gases, and unit conversion values.

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

User Input
Calculated Value
CA-GREET4.0

- "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 2. For example, if a pathway uses natural gas as a process energy, the quantity of natural gas used must be entered into the user input cells under the correct field in Section 4. 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 2 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.
- "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 written permission from CARB. Approved modifications may require the use of a Tier 2 pathway application.

C. Site-Specific Inputs Worksheet

The Site-Specific Inputs worksheet contains the main CI calculation worksheet which consists of the following major components:

- Section 1. Applicant Information
- Section 2. Pathway Inputs
- Section 3. Static Operational Data
- Section 4: Monthly Operational Data

All relevant site-specific inputs must be entered in the respective input fields. Once all site-specific inputs for a given facility have been entered, the pathway CIs for the various streams will be displayed in the Pathway Summary worksheet.

Section 1: Applicant Information

Begin by selecting the Site-Specific Inputs worksheet, then enter information for the following input sections listed in Tables C.1 – C.4 below.

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

Field Name	Description
1.1 Application Number	Enter the application number provided by the AFP.
1.2 Company Name	Enter the company name as entered in the AFP.
1.3 Company ID	Enter the company ID as generated by the AFP. If not available, contact CARB staff for LCFS Company ID.
1.4 Fuel Production Facility Address	Enter city, state, and zip code for the ethanol production facility.
1.5 Facility ID	Enter U.S EPA Facility ID. If not available, contact CARB staff.

Section 2: Pathway Inputs

Section 2 provides the option to select only input fields that apply to a given pathway, which hides irrelevant inputs in Section 4 of the worksheet. Figure 1 below shows the various input options permitted in the T1 SFE 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.

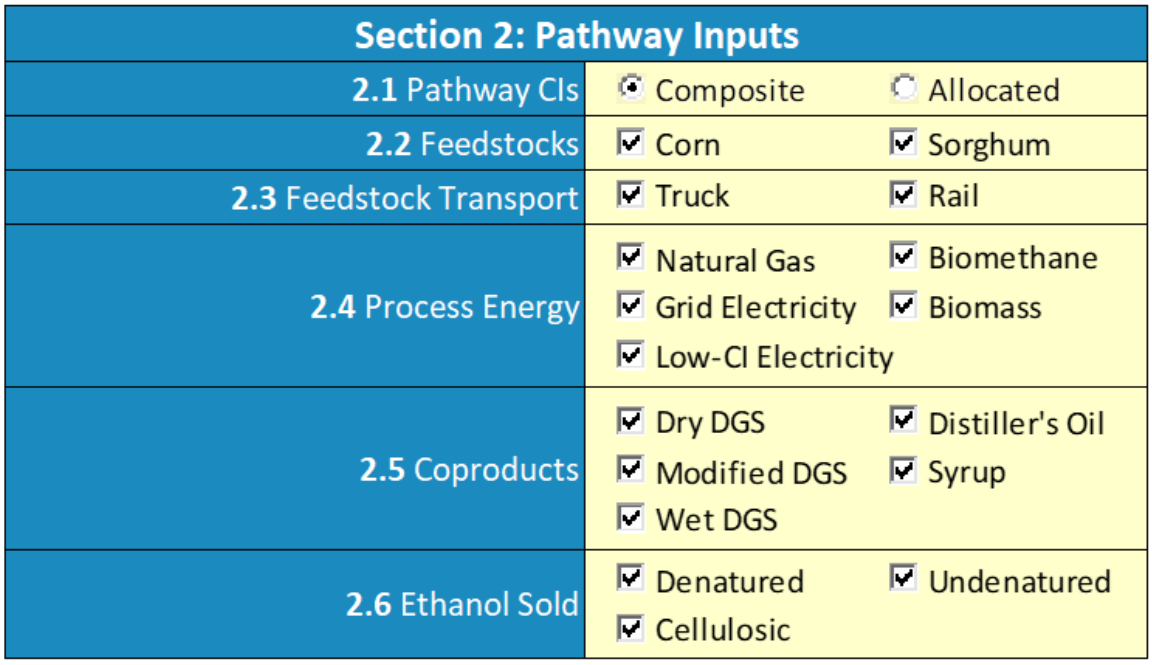

Figure C.1. SFE Calculator Input Selection Panel

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

Field Name	Description
2.1 Pathway CIs	Select whether the pathway CI should be calculated on a feedstock basis (composite CI) or a DGS coproduct basis for each feedstock (allocated CI). A composite CI evaluates the total emissions and fuel produced used to produce the finished fuel attributed to a single feedstock (corn or sorghum). All coproduct emissions and credits for the feedstock are included in the composite CI. An allocated CI divides emissions and finished fuel quantities for a single feedstock according to the quantity of wet, modified and/or dry DGS coproducts associated with that feedstock. This allows the fraction of ethanol associated with each coproduct to receive a unique CI score.
2.2 Feedstocks	Select corn and/or sorghum. Alternate feedstocks will require a Tier 2 application.
2.3 Feedstock Transport	Select transport mode(s) used to deliver feedstock from stack to fuel production facility.
2.4 Process Energy	Select the type(s) of process energy used at the fuel production facility.
2.5 Coproducts	Select co-products produced at the fuel production facility.
2.6 Ethanol Sold	Select the type(s) of ethanol sold at the fuel production facility.

Table C.3. Input Field Instructions for Section 3 of the T1 SFE Calculator

Field Name	Description
3.1 Feedstock Transport Data	Select a default or site-specific feedstock transport mileage value in the drop-down menu. A site-specific value requires entry of monthly weighted average mileages to be entered in Section 4 of the Site-Specific Inputs worksheet. For ethanol production facilities in South Dakota, Minnesota, Iowa, Nebraska, Illinois, Michigan, Ohio, Indiana or Wisconsin, the "Default for 9 Midwest States" option may be selected. This option applies a default value of 40 miles for corn transport or 80 miles for sorghum transport by Heavy Heavy-Duty Truck (HHDT). For ethanol plants located in California, the "Default for California" option may be selected. This option applies a default value of 50 miles by HHDT and 1,900 miles for rail transport for corn or sorghum transport to California.

3.2 Grid Electricity Region	If the ethanol 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 eGRID Power Profiler tool.
3.3 Grid CI (gCO_2e/kWh)	The grid electricity CI will be displayed based on the 3.2 selection. If User-Defined is selected in Field 3.2, consult with CARB to develop an emission factor for a user-defined grid electricity mix.
3.4 Biomass CI (gCO_2e/dry short ton)	Consult with CARB staff to develop an appropriate emission factor for biomass used as a process fuel. Information necessary for calculating a biomass the emission factor must be described in detail in the Supplemental Documentation submitted with the T1 SFE Calculator.
3.5 Biomethane CI (gCO_2e/MJ, LHV)	Consult with CARB staff to develop an appropriate emission factor for the biogas or biomethane used as process fuel. Biogas or biomethane 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 ethanol pathways. The biogas or biomethane source and all data sources used in calculating emission factors must be described in detail in the Supplemental Documentation submitted with the T1 SFE Calculator.
3.6 Low-CI Electricity CI (gCO_2e/kWh)	Consult with CARB staff to develop an appropriate emission factor for the low-CI electricity used by the ethanol 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 ethanol pathways. 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 SFE Calculator.
3.7 Ethanol Transport – Truck (miles)	Enter the total mileage for ethanol transport by heavy heavy-duty truck (HHDT). 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.
3.8 Ethanol Transport – Rail (miles)	Enter the total mileage for ethanol transport via rail based on the rail network maps from either BNSF Railway[1] or Union Pacific.[2] 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.

[1] http://www.bnsf.com/customers/where-can-i-ship/
[2] https://www.up.com/aboutup/usguide/index.htm

3.9 Ethanol Transport – Barge (miles)	Enter the total mileage for ethanol transport via barge to the ethanol 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.

Section 4: Monthly Operational Data

Operational data for all fields selected by the user in Section 2 must be entered into the fields in Section 4 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 2 or may be left blank. Any gaps in data reporting must comply with the Missing Data Provisions in LCFS Regulation section 95488.8(k). For Fields 4.2 thru 4.13, feedstock quantities should be reported inclusive of moisture content. Feedstocks received by the ethanol production facility with a moisture content lower than 15% must report quantities adjusted to a 15% moisture content basis. If corn or sorghum inventory should be reported in bushels using a conversion factor of 56 lbs/bushel.

Table C.4. Input Field Instructions for Section 4 of the T1 SFE Calculator

Field Name	Description
4.1 Operational Data Period (MM/YYYY)	Enter the 24 consecutive months that reflect the most recent operational data available for the ethanol 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.
4.2 Corn Delivered by HHD Truck (bushels)	Enter the monthly quantities of corn delivered to the ethanol production facility by HHD Truck .
4.3 Transport Distance by HHD Truck (weighted av. miles)	This input is required if "Site-Specific Data" is selected in Field 3.1. If "Default for California" or "Default for 9 Midwest States" this Field will be hidden, and no user input is required. The weighted average transport mileage must be calculated based on the feedstock quantity from each supplier and its transport distance between the stack and ethanol production facility . Applicants should include supplemental calculations to support weighted average distances.
4.4 Corn Delivered by Rail (bushels)	Enter the quantity of corn delivered to the ethanol production facility by rail .
4.5 Transport Distance by Rail	Repeat instructions for Field 4.3.

(weighted av. miles)	
4.6 Beginning Corn Inventory (bushels)	Enter the quantity of corn stored at the ethanol production facility as measured at the beginning of each month for the operational data period.
4.7 Ending Corn Inventory (bushels)	Enter the quantity of corn stored at the ethanol production facility, as measured at the end of each month for the operational data period.
4.8 Sorghum Delivered by HHD Truck (bushels)	Repeat instructions for Field 4.2 with sorghum as a feedstock.
4.9 Transport Distance by HHD Truck (weighted av. miles)	Repeat instructions for Field 4.3.
4.10 Sorghum Delivered by Rail (bushels)	Repeat instructions for Field 4.4 with sorghum as a feedstock.
4.11 Transport Distance by Rail (weighted av. miles)	Repeat instructions for Field 4.3.
4.12 Beginning Sorghum Inventory (bushels)	Repeat instructions for Field 4.6 with sorghum as a feedstock.
4.13 Ending Sorghum Inventory (bushels)	Repeat instructions for Field 4.7 with sorghum as a feedstock.
4.14 Natural Gas (MMBtu, HHV)	Enter the quantity of natural gas used by the entire ethanol production facility, including gas used for coproduct drying, .
4.15 Biomethane (MMBtu, HHV)	Enter the quantity of biomethane or biogas used .
4.16 Biomass (short tons)	Enter the quantity of biomass used .
4.17 Biomass Moisture Content (%)	Enter the biomass weighted average moisture content .
4.18 Biomass Transport Distance (weighted av. miles)	Enter the weighted average biomass transport distance . The weighted average transport mileage must be calculated based on the biomass quantity from each supplier and its transport distance to ethanol production facility . Applicants should include supplemental calculations to support weighted average distances.
4.19 Grid Electricity (kWh)	Enter the quantity of grid electricity used by the ethanol production facility .
4.20 Direct Supply Solar or Wind (kWh)	Enter the quantity of solar or wind electricity directly supplied to the ethanol production facility . This electricity must meet the requirements of LCFS Regulation section 95488.8(h)(1).

4.21 Beginning DDGS Inventory (short tons)	Enter the quantity of DDGS stored at the ethanol production facility, as measured at the beginning of each month for the operational data period.
4.22 Ending DDGS Inventory (short tons)	Enter the quantity of DDGS stored at the ethanol production facility, as measured at the end of each month for the operational data period.
4.23 DDGS Sold (short tons)	Enter the quantity of DDGS sold each month by the ethanol production facility for the operational data period.
4.24 DDGS Moisture Content (%)	Enter the DDGS weighted average moisture content . Moisture measurements must utilize an industry standard moisture measurement protocol.
4.25 DDGS Metered Drying Energy (MMBtu, HHV)	Enter the quantity of natural gas used for DDGS drying . Dedicated meters with electronic archival must be used to measure the reported drying energy. Drying energy from sources other than natural gas combustion require a Tier 2 application.
4.26 Beginning MDGS Inventory (short tons)	Repeat instructions for Field 4.21 for MDGS.
4.27 Ending MDGS Inventory (short tons)	Repeat instructions for Field 4.22 for MDGS.
4.28 MDGS Sold (short tons)	Repeat instructions for Field 4.23 for MDGS.
4.29 MDGS Moisture Content (%)	Repeat instructions for Field 4.24 for MDGS.
4.30 MDGS Metered Drying Energy (MMBtu, HHV)	Repeat instructions for Field 4.25 for MDGS.
4.31 Beginning WDGS Inventory (short tons)	Repeat instructions for Field 4.21 for WDGS.
4.32 Ending WDGS Inventory (short tons)	Repeat instructions for Field 4.22 for WDGS.
4.33 WDGS Sold (short tons)	Repeat instructions for Field 4.23 for WDGS.
4.34 WDGS Moisture Content (%)	Repeat instructions for Field 4.24 for WDGS.
4.35 Beginning Syrup Inventory (short tons)	Repeat instructions for Field 4.21 for syrup.
4.36 Ending Syrup Inventory (short tons)	Repeat instructions for Field 4.22 for syrup.
4.37 Syrup Sold (short tons)	Repeat instructions for Field 4.23 for syrup.

4.38 Syrup Moisture Content (%)	Repeat instructions for Field 4.24 for syrup.
4.39 Beginning Distiller's Oil Inventory (lbs)	Repeat instructions for Field 4.21 for distiller's oil.
4.40 Ending Distiller's Oil Inventory (lbs)	Repeat instructions for Field 4.22 for distiller's oil.
4.41 Distiller's Oil Sold (lbs)	Repeat instructions for Field 4.23 for distiller's oil.
4.42 Cellulosic Enzyme Purchased (lbs)	Enter the total cellulosic enzyme purchased . Quantities should be reported on an as-received basis without moisture correction.
4.43 Beginning Cellulosic Enzyme Inventory (lbs)	Enter the quantity of cellulosic enzyme stored at the ethanol production facility, as measured at the beginning of each month for the operational data period. Quantities should be reported on an as-received basis without moisture correction.
4.44 Ending Cellulosic Enzyme Inventory (lbs)	Enter the quantity of cellulosic enzyme stored at the ethanol production facility, as measured at the end of each month for the operational data period. Quantities should be reported on an as-received basis without moisture correction.
4.45 Fiber Ethanol Allocation (%)	Enter the monthly average fiber ethanol percentage data.
4.46 Beginning Undenatured Ethanol Inventory (gallons @ 60˚F)	Repeat instructions for Field 4.21 for undenatured ethanol.
4.47 Ending Undenatured Ethanol Inventory (gallons @ 60˚F)	Repeat instructions for Field 4.22 for undenatured ethanol.
4.48 Undenatured Ethanol Sold (gallons @ 60˚F)	Repeat instructions for Field 4.23 for undenatured ethanol.
4.49 Denaturant Added (gallons @ 60˚F)	Enter the quantity of denaturant blended at the ethanol facility. Alternately, click the "Default Value" button in this field to apply a default addition of 2.5% (v/v) CARBOB denaturant.
4.50 Denatured Ethanol Sold (gallons @ 60˚F)	Repeat instructions for Field 4.23 for denatured ethanol.

D. 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 SFE 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, Finished Fuel Quantities) provide a summary of site-specific inputs entered by the user.

In the T1 SFE Calculator, there are multiple pathway options shown in columns I thru Q: up to two composite pathways or six allocated pathways for starch ethanol, and a pathway for fiber ethanol. The selection between composite and allocated pathway CIs is provided in Field 3.1 of the Site-Specific Inputs workbook. The fuel producer may report any quantity of ethanol produced at the facility and sold as a transportation fuel in California up to the quantity listed in row 9 of the Finished Fuels Quantity table (gallons of denatured ethanol units).

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 then summed to provide a CI associated with each 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 the certified CI.

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

E. CA-GREET4.0 Worksheet

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

[3] https://greet.es.anl.gov/index.php
[4] https://www.epa.gov/egrid
[5] https://arb.ca.gov/emfac/
[6] https://eao.stanford.edu/research-project/opgee-oil-production-greenhouse-gas-emissions-estimator