Tier 1 Simplified CI Calculator Instruction Manual
Biodiesel

April 14th, 2023

A. Introduction

This document provides detailed instructions for biodiesel (BD) pathway applications. The Tier 1 Simplified CI Calculator for Biodiesel (T1 BD Calculator) calculates the carbon intensity (CI) of BD produced from single or multiple feedstocks.

Download the T1 BD Calculator here:

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

The T1 BD 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 BD pathways. Some CARB-approved input values may also be selected.

B. T1 BD Calculator Overview

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

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

Worksheet Name	Description
Introduction	Provides a brief introduction to the T1 BD Calculator.
Feedstock Inputs	Worksheet for entering feedstock data sourced by the biodiesel production facility. Up to 10 feedstocks may be entered as a Tier 1 pathway, yielding up to 10 fuel pathway CIs.
Biodiesel Production Inputs	Worksheet for entering biodiesel 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 "Biodiesel Production Inputs" worksheets.
CA-GREET4.0	Contains predefined input values, emission factors, fuel specifications, and unit conversion values.

The cells in the T1 BD 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 quantity 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. You may select up to 10 feedstocks.

Number of Feedstocks	10		Navigate to	Feedstock 7

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.

Feedstock 1
USA Soybean Oil Produced at Soybean Extraction Corp.

Section 1: Static Feedstock Inputs

Section 1: Static Feedstock Inputs	
1.1.1 Processor Name	
1.2.1 Processor Address	
1.3.1 Feedstock Type	
1.4.1 Feedstock Origin	
1.5.1 Production EF (gCO$_2$e/dry lb oil)	
1.6.1 Transport Modes	☐ Truck ☐ Rail ☐ Ocean Tanker ☐ Barge
1.7.1 Ocean Tanker EF (gCO$_2$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 BD Calculator

Field Name	Description
1.1.x Processor Name	Enter the crushing, rendering, or extraction facility name.
1.2.x Processor Address	Enter the address of the processor.
1.3.x Feedstock Type	Using the drop-down menu, select the feedstock type. If other is selected, specify the feedstock.
1.4.x Feedstock Origin	Using the drop-down menu, select the origin of the feedstock.

	If other is selected, specify the origin.
1.5.x Production EF (gCO$_2$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.
1.6.x Transport Modes	Please select transport mode from processing facility to production facility.
1.7.x Ocean Tanker EF (gCO$_2$e/lb-mile oil)	If ocean tanker has been selected in field 1.6.x, 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.

Feedstock Transportation

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

Feedstock Transport (lb-miles)	
Truck	
Rail	
Barge	
Ocean Tanker	
Transport EF (gCO$_2$e/lb oil)	

Fuel Production Facility Inventory

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

Fuel Production Facility Inventory (dry lbs)	
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 BD 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)	Input monthly beginning feedstock inventory data (in lbs.) in this field.
2.3.x Ending Inventory (lbs)	Input monthly ending feedstock inventory data (in lbs.) in this field.
2.4.x Weight (lbs)	Input monthly total feedstock delivered to the fuel production facility (in lbs.) in this field.
2.5.x Moisture (%)	Input monthly weighted average moisture content (in percentage) for feedstock in this field. Utilize an industry standard moisture measurement protocol to report weighted average moisture.
2.6.x Truck - Weight (lbs)	Input monthly total feedstock transported by HDD truck (in lbs.) for this field.
2.7.x Truck – Distance (miles)	Input monthly weighted average transport distance (in miles) by this mode.
2.8.x Rail – Weight (lbs)	Input monthly total feedstock transported by rail (in lbs.) for this field.
2.9.x Rail – Distance (miles)	Repeat instructions for field 2.7.x
2.10.x Barge – Weight (lbs)	Input monthly total feedstock transported by rail (in lbs.) for this field.
2.11.x Barge – Distance (miles)	Repeat instructions for field 2.7.x
2.12.1 Ocean Tanker – Weight (lbs)	Input monthly total feedstock transported by ocean tanker (in lbs.) for this field.
2.13.1 Ocean Tanker – Distance (miles)	Repeat instructions for field 2.7.1

D. Biodiesel Production Inputs

The Biodiesel 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 BD Calculator

Field Name	Description
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.
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 BD 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 Process Energy	☐ Natural Gas ☐ Low-CI Electricity	☐ Grid Electricity ☐ Alternate Fuel
4.2 Coproducts Exported	☐ Free Fatty Acids ☐ Distillate Bottoms	☐ Glycerin
4.3 Biodiesel Transport Modes	☐ Truck ☐ Ocean Tanker	☐ Rail ☐ Barge

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

Field Name	Description
4.1 Process Energy	Select the type(s) of process energy used at the fuel production facility.
4.2 Coproducts	Select co-products produced and exported at the fuel production facility.
4.3 Biodiesel Transport Modes	Select the transport mode(s) of the BD to California.

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$_2$e/kWh)	
5.3 Low-CI Electricity EF (gCO$_2$e/kWh)	
5.4 Alternate Fuel Type	
5.5 Alternate Fuel EF (gCO$_2$e/MMBtu, HHV)	
5.6 Free Fatty Acid Heating Value (Btu/lb, LHV)	
5.7 Distillate Bottoms Heating Value (Btu/lb, LHV)	
5.8 Biodiesel Transport - Truck (Miles)	
5.9 Biodiesel Transport - Rail (Miles)	
5.10 Biodiesel Transport - Barge (Miles)	
5.11 Biodiesel Transport - Ocean Tanker (Miles)	
5.12 Ocean Tanker EF (gCO$_2$e/lb-mile oil)	

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

Field Name	Description
5.1 Electricity Grid Region	If the BD 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.
5.2 Electricity Grid EF (gCO$_2$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$_2$e/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 BD 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 BD 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$_2$e/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 BD Calculator. This description must at a minimum identify the alternative fuel and the source.
5.6 Free Fatty Acid Heating Value (Btu/lb, LHV)	Consult with CARB staff to develop the appropriate energy density factor for free fatty acids, as applicable, for co-product credit (Btu/lb. for LHV).
5.7 Distillate Bottoms Heating Value (Btu/lb, LHV)	Consult with CARB staff to develop the appropriate energy density factor for distillate bottoms, as applicable, for co-product credit (Btu/lb. for LHV).
5.8 Biodiesel Transport - Truck (Miles)	Enter the total mileage for BD 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.

5.9 Biodiesel Transport - Rail (Miles)	Enter the total mileage for BD 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.
5.10 Biodiesel Transport - Barge (Miles)	Enter the total mileage for BD transport via barge to the BD 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.
5.11 Biodiesel Transport - Ocean Tanker (Miles)	Enter the total mileage for BD transport via ocean tanker to the BD 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.
5.12 Ocean Tanker EF (gCO$_2$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).

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

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

6.2 North American Natural Gas (MMBtu, HHV)	Enter the quantity of natural gas (NG) used by the entire BD production facility sourced from a common carrier NG pipeline in North America. For alternate NG sources, use Field 6.5.
6.3 Grid Electricity (kWh)	Enter the quantity of grid electricity used by the BD production facility.
6.4 Directly-Supplied Low-CI Electricity (kWh)	Enter the quantity of low-CI 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 to produce BD.
6.6 Beginning Methanol Inventory (gallons @ 60°F)	Enter monthly beginning inventory data for methanol.
6.7 Methanol Purchased (gallons @ 60°F)	Enter monthly total methanol purchased data in this field.
6.8 Ending Methanol Inventory (gallons @ 60°F)	Enter monthly ending inventory data for methanol.
6.9 Free Fatty Acids (dry lbs)	Enter monthly total free fatty acids production (dry lbs.) in this field. To ensure co-product credit, appropriate evidence of export of the co-product must be demonstrated in the Supplemental Documentation submitted with the T1 BD Calculator. If part of the free fatty acids is used as process fuel, co-product credit will not be offered for the fraction used as process fuel.
6.10 Glycerin (dry lbs)	Enter monthly total glycerin production (dry lbs.) must be input in this field. To ensure co-product credit, appropriate evidence of export of all co-products need to be demonstrated in the Supplemental Documentation submitted with the T1 BD Calculator. If part of the glycerin is used as process fuel, co-product credit will not be offered for the fraction used as process fuel.
6.11 Distillate Bottoms (dry lbs)	Enter monthly total distillate bottoms production (dry lbs.) must be input in this field. To ensure co-product credit, appropriate evidence of export of all co-products need to be demonstrated in the Supplemental Documentation submitted with the T1 BD Calculator. If part of the glycerin is used as process fuel, co-product credit will not be offered for the fraction used as process fuel.
6.12 BD Beginning Inventory (gallons @ 60°F)	Enter monthly beginning inventory data for BD (gallons at 60°F)
6.13 BD Ending Inventory (gallons @ 60°F)	Enter monthly total ending inventory for BD (gallons at 60°F)
6.14 BD Sales (gallons @ 60°F)	Enter monthly total sales data of BD (gallons at 60°F)

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 BD 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 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 the BD 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,[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.

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[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