

**DRAFT**  
**TIER 1 CI CALCULATION AND OPERATING CONDITIONS MANUAL**  
**FOR**  
**LCFS SIMPLIFIED CI CALCULATOR**

—  
**Sugarcane-Derived Ethanol**  
**Calculator Version: SIMCAL\_CANE\_001**

**A. Introduction**

This document provides an overview of the draft Simplified Carbon Intensity (CI) Calculator (“draft calculator”) spreadsheet developed for sugarcane-derived ethanol low carbon fuel standard (LCFS) pathways, and contains a description of the input fields which could be used to determine the carbon intensity (CI) value for ethanol produced from sugarcane-based juice and/or molasses feedstocks in Brazil. Staff requests stakeholder review and feedback on the draft calculator, and user instructions contained in this document. Each specific input requirement in the calculator has been numerically labeled (i.e., 1.1, 1.2 etc.) so that users can follow the sequence and enter information as required. The draft calculator can be downloaded from link below:

**Download the draft Simplified CI Calculator here:**

[https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/110617sugarcane-eto\\_h\\_draftcalculator.xlsm](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/110617sugarcane-eto_h_draftcalculator.xlsm)

The draft calculator has been automated to perform CI calculations using emissions factors from the version of the CA-GREET model (v3.0) being proposed to the Air Resources Board (Board) for adoption. Both the draft calculator, as well as the CA-GREET v3.0 model are available as downloadable spreadsheets from the LCFS meetings page. The draft calculator would potentially replace the existing Tier 1 Calculator of the CA-GREET v2.0 model, and other requirements for the pathway application process. The draft calculator however, is designed to work independently of the CA-GREET v3.0 model, but will still require operational and production data from the mill to be entered for the previous 24-months which includes at a minimum, two sugarcane harvest cycles of at least 9-month duration with 3-months of mill gestation data each. Once staff has finalized changes to the CA-GREET v3.0 model, the draft calculator will be updated to reflect all changes to that model. Presently, the draft calculator incorporates most of the changes proposed for the CA-GREET v3.0 model, but these changes are ongoing.

The calculator requires the applicant to add facility information and verifiable feedstock production, operational energy use, and fuel production data used in calculating the CI. **All data provided by the applicant (in yellow cells) are subject to verification unless specifically exempted.**

## B. Definitions

A list of definitions for the input data values used in the draft calculator is provided as follows:

Site Specific - An input value, or the raw operational data used to calculate an input value, which is required to be unique to the facility, pathway, and feedstock. All site-specific inputs that appear in the operational data summary form must be measured, metered or otherwise documented, and verifiable, e.g., consumption of utility natural gas or grid electricity at a fuel-production facility must be documented by invoices from the utility. Under this potential framework, an application might be rejected as incomplete if a site-specific input value cannot be determined.

Conditional Default - A conservative input value established by ARB staff, which may be used under specified conditions that is not subject to further conformance review. In a situation in which an applicant cannot provide the necessary information to determine and validate site-specific values, a conditional default may be used as a necessary substitute for the site-specific value. The conditions under which this value must be used are specific to each situation and would be defined by ARB Staff accordingly. Conditional default values would be subject to validation that the specified conditions are met, but would not be subject to further verification, with the rationale that the value is based on reasonable assumptions and is sufficiently conservative to encourage use of site-specific values when feasible.

Standard Value - An input value that would not appear in the CI application operational data summary form and could not be modified to a region or site-specific value unless the applicant receives permission from the Executive Officer. These values are intended to be the same for all applicants in the harvest region or State, and therefore would not be subject to CI conformance evaluation by ARB or third-party verifiers, e.g., the level of mechanized harvesting applicable to the State of Sao Paulo in light of implementation of green harvest protocols; much of the background data used in CA-GREET 3.0 model, including emission factors, truck cargo capacities and fuel economies, and agricultural and farming inputs.

### C. Color Legend Used in the Calculator

The Calculator worksheet uses the following color options to differentiate between required user inputs (yellow cells in the worksheet), intermediate and final calculated parameters (gray cells), calculation execution buttons (green cells), and final CI results (light blue cells). This legend is depicted in Table C.1.

**Table C.1. Illustration of the color legend used in the Calculator worksheet**

<b>Yellow Cells require user input</b>
<b>Light Blue cells show CI results</b>
<b>Green Cells show the calculation button</b>
<b>Gray Cells are calculated values</b>

### D. Calculator Overview

The following table provides an overview of the main tabs used in the draft calculator.

**Table D.1. Overview of tabs used in the simplified CI calculator**

<b>Tab Name</b>	<b>Description</b>
<b>Summary</b>	Summary worksheet. Contains an overall summary of the information entered in the “Calculator” tab and corresponding calculated CIs; no user input is required for this sheet.
<b>Calculator</b>	Main calculation worksheet. Contains the main component of the calculator with fields requiring user input and those calculated by the sheet. Calculations in light gray and light blue cells are automatically calculated but dependent on input from yellow cells in the corresponding sections of the calculator. This tab also includes a detailed sample CI calculation.
<b>EF Table</b>	Reference worksheet. Contains greenhouse gas emissions factors from the CA-GREET 3.0 model used in calculation of carbon intensities.
<b>Reference</b>	Reference worksheet. Includes standard values and assumptions related to the calculator.

#### *Summary Tab*

The “Summary” tab or worksheet presents a summary of the CI and the intermediate parameters used to determine the CI of the fuel. The summary results are determined from operational and production data entered in the Calculator worksheet. Unlike the Tier 1 worksheet of the CA-GREET v2.0 model in which a separate CI was calculated for each feedstock (either sugarcane juice- or sugarcane molasses-based ethanol), the Summary worksheet provides a composite CI of the fuel CIs for each feedstock. This is because in Brazil, most producers produce ethanol from both feedstocks, and a composite CI reduces the need to have multiple pathways. Moreover, the CIs for

ethanol based on each individual feedstock are marginally different from each other. The composite CI is also applicable to the entire volume of ethanol produced at the mill; there are no volume restrictions on its use, as long as all the ethanol produced meets the quality for export to California (anhydrous ethanol).

### *Calculator Tab*

The Calculator worksheet provides step-by-step instructions for entering the input parameters for the ethanol fuel CI determination. Site-specific parameters must be provided by the applicant for all applicable yellow cells in the worksheet. Some yellow cells have a drop down list of options for the user to select. The Calculator worksheet requires that the applicant provide facility information, verifiable feedstock information, operational energy use data, fuel and co-product production data, feedstock and finished fuel transport distances for each mode of transport employed, and other pertinent information such as the level of mechanized harvesting implemented over the harvest cycle, and the amount of surplus cogenerated electricity exported to the grid.

At a minimum, this data must be provided for a continuous 24-month period for all initial pathway applications seeking certification. For annual verifications, previous 24-month production data will be required. In the event that the applicant or mill operates on a 9-month sugarcane harvest cycle, then the applicant must disclose the data for two continuous harvest cycles and further demonstrate that no production existed during the 3-months that the mill did not operate. For the months where ethanol is not produced, energy use related to maintenance operations must be included in the sheet to account for all 24 months of operational data. The input information and operational condition choices are used to calculate a composite CI for a sugarcane-based ethanol pathway.

### *EF Tables Tab*

The EF Tables worksheet contains emissions factor tables from CA-GREET v3.0 used to calculate the composite CI of the fuel. Details of emissions are included for sugarcane farming and transport, mechanized harvest credit, electricity co-product credit, ethanol production, transport to California and final use as a blended component in gasoline. No user interface is necessary in this tab.

### *Reference Tab*

The References worksheet contains factors from CA-GREET v3.0 including reference information used to calculate the composite CI of the fuel. No user interface is necessary in this tab.

### E. Calculator Details (the “Calculator” tab)

The “Calculator” tab contains the main CI calculation worksheet which consists of the following major components:

- Pathway Summary and Estimated CI (g/MJ)
- Section 1: Enter Applicant & Mill Specific Information
- Section 2: Enter Fuel Transport Information
- Section 3: Enter Monthly Feedstock, Fuel, and Co-Product Production Data
- Section 4: Calculate Production Yields and Mass Allocation Ratio
- Section 5: Verify Fuel and Co-Product Production Information
- Section 6: Verify Pathway Credits
- Sample CI Calculations

#### *Pathway Summary and Estimated CI (g/MJ)*

A tabular summary of the modeled pathway composite CI is presented in this table. The CI is further disaggregated by feedstock, along with the quantity of ethanol produced from each feedstock. Ethanol yields from each feedstock are also provided in the table.

**Table E.1: Pathway summary and estimated CI**

<b>Pathway Summary and Estimated CI (gCO<sub>2</sub>e/MJ)</b>			
<b>Pathway Summary:</b> Sugarcane-based Ethanol produced in Brazil; transported by ocean-going vessels to California for use as a transportation fuel.			
Sugarcane Molasses-based Ethanol CI	42.14	Sugarcane Juice-based Ethanol CI	43.93
Ethanol Volume (Molasses Feedstock), gal	6,666,817	Ethanol Volume (Sugarcane Juice Feedstock), gal	7,659,685
Ethanol Yield (Molasses Feedstock), gal/tonne sugarcane	7.84	Ethanol Yield (Juice Feedstock), gal/tonne sugarcane	21.01
<b>Composite CI, gCO<sub>2</sub>e/MJ:</b>			<b>43.10</b>

#### *Section 1: Enter Applicant & Mill Specific Information*

Follow the instructions by first entering applicant and mill site-specific information (Section 1). Within the “Section 1” block, information must be entered sequentially by following the numbered boxes. An explanation of the field for which a value or information is required is presented in Table E.2.

24-months of production data is required, representing at least two complete 9-month harvest cycles in order to compute the CI for an initial pathway application for certification. For annual compliance audits, rolling 24-month production data with at least two 9-month harvest cycles is required.

**Table E.2. List of input fields for Section 1 of the simplified CI calculator.**

Field Description	Value
<b>1.1 Company Name</b>	Registered name of the company. Example “ABC Company, LLC” or “ABC Company, Ltda.”
<b>1.2 Company ID</b>	Enter U.S. EPA Company ID. If not available, contact CARB for LCFS Company ID.
<b>1.3. Facility ID</b>	Enter the Company's Facility ID. If not available, contact CARB for LCFS Facility ID.
<b>1.4 Mill Location</b>	Enter Mill location (Fazenda, Township, City)
<b>1.5 Mill State</b>	Enter the State (Example, Sao Paulo)
<b>1.6 Mill Country</b>	Enter the Country (Example, Brazil)
<b>1.7 Harvest Cycle(s)</b>	Period for which Data is Valid
<b>1.8 Application Type</b>	Choose one of the following: Initial Application for Certification, Annual Compliance Audit, or Amended Application for Certification
<b>1.9 Electric Transmission and Distribution Loss</b>	Pre-determined (Fixed at 8.1% for Brazil)
<b>1.10 Regional Electric Mix (Feedstock/Fuel)</b>	#29-Brazilian Mix, Fixed
<b>1.11 Credit for Mechanized Harvesting</b>	Choose Statewide-Average (Standard), or Enter Verifiable Value (Harvest Region-Specific)
<b>1.12 Credit for Export of Surplus Electricity</b>	Yes or No

The level of mechanized harvesting is a credit to the pathway that offsets the straw burning emissions impact, and is based to the level of mechanized harvesting implemented on applicant owned, leased, or partnership sugarcane farms. The applicable parameter to provide information for determination of mechanized harvesting credit is shown in field “1.11 Credit for Mechanized Harvesting” under the “Harvest Region-Specific” option. It offers both a standard as well as site-specific options. If ethanol plant sources all of the feedstock from Sao Paulo province, a standard mechanized harvest percentage of 80% is used as standard. For non-Sao Paulo regions, the standard value is 65%. Selecting standard values exempts the verification of mechanized harvest percentages during initial validation and on-going periodic verification. For applicants who elect to use a *site-specific* value for mechanized harvesting, it must be verifiable by a third party verifier.

Applicants who propose to use site-specific options for mechanized harvesting must consult with CARB staff and establish a protocol which a verifier can check to ensure

feedstock is sourced from regions to support the stated mechanized harvest rate. An application for pathway certification may be rejected as incomplete if a harvest region-specific input value is claimed, but cannot be verified. CARB staff will consider developing a guidance document in consultation with producers if requested by ethanol mills in Brazil.

**Section 2: Enter Fuel Transport Information**

Section 2 requires that the applicant then enter the fuel transport modes, share of the total transport distance, and distances for each mode employed. An explanation of each field in this block is provided in Table E.3.

To facilitate calculation of weighted transport distance, staff is suggesting a calculation methodology detailed below. The monthly weighted average for each mode (ethanol transport to a port in a given month may include more than one mode of transport) is included in the cell for ethanol transport for a given month. This methodology is suggested be used to report weighted average ethanol transport distance in the Calculator sheet.

Actual fuel transport and corresponding mode of transport and miles transported						
Modes of Transport						
	Truck (m3)	km	Rail (m3)	km	Pipeline (m3)	km
1	100,000	50		1,200		
2	200,000	150				
3			200,000	800		
4			100,000	200	100,000	250
5			50,000	1,000		
6						
7						
8						
Weighted average distance and corresponding quantities to be used for monthly reporting of fuel transported to a port						
	300,000	117	350,000	657	100,000	250
Example in sheet above:						
Entry 1	For the month, the facility transported 100,000 m3 by a mode which included 50 km by truck followed by 1200 km by rail					
Entry 2	For the month, the facility transported 200,000 m3 by a mode which included 150 km by truck					
Entry 3	For the month, the facility transported 200,000 m3 by a mode which included 800 km by rail					
Entry 4	For the month, the facility transported 100,000 m3 by a mode which included 200 km by rail and 250 km by pipeline					
Entry 5	For the month, the facility transported 50,000 m3 by a mode which included 1000 km by rail					
For these scenarios, the facility shall report 300,000 m3 with a weighted average distance of 117 km by HDD truck, 450,000 m3 with a weighted average distance of 678 km by rail and 100,000 m3 with a weighted average distance of 250 km by pipeline.						

**Table E.3. List of input fields for Section 2 of the simplified CI calculator.**

<b>Field Description</b>	<b>Value</b>
<b>2.1 Ethanol Transport Primary Mode</b>	By HDD Truck from Ethanol Plant to Port
<b>2.2 Ethanol Transport Distance for Primary Mode</b>	Enter Ethanol transport distance for the Primary Mode, km
<b>2.3 Ethanol Transport Secondary Mode</b>	By Rail to or towards Port
<b>2.4 Ethanol Transport Distance for Secondary Mode</b>	Enter Ethanol transport distance for the Secondary Mode, km
<b>2.5 Ethanol Transport Tertiary Mode</b>	By Pipeline to or towards Port
<b>2.6 Ethanol Transport Distance for Tertiary Mode</b>	Enter Ethanol transport distance for the Tertiary Mode, km
<b>2.7 Ethanol Ocean Transport Route to California</b>	Select Ethanol transport route to California by Ocean Tanker
<b>2.8 Ethanol Ocean Transport Distance to California</b>	Enter Ethanol transport distance to California from Brazilian Port, km
<b>2.9 Ethanol Transport Distance - By HDDT from Port to Terminal, miles</b>	Default value, 40 miles (US Transport)
<b>2.10 Ethanol Transport Distance – By HDDT from Terminal to Refueling Station, miles</b>	Default value, 50 miles (US Transport)

### *Section 3: Enter Monthly Feedstock, Fuel, and Co-Product Production Data*

Section 3 requires the applicant to enter monthly feedstock, fuel, and co-product production information. The data must span 24 months, two years, or two sugarcane harvest cycles of at least 9-month duration each for initial pathway applications seeking LCFS certification. For annual compliance audits and verification, the most recent 24-months of production data with at least two sugarcane harvest cycles of 9-month duration each will be required. An explanation of the fields in this table block is presented in Table E.4.

**Table E.4. List of input fields for Section 3 of the simplified CI calculator**

<b>Field Description</b>	<b>Value</b>
<b>3.1 Production Data (Monthly)</b>	Enter monthly production data for the 24-month period that concludes with the most recent harvest cycle, and includes at least two harvest cycles.
<b>3.2 Cane Sourced from Applicant-owned Farms</b>	Enter monthly quantity of sugarcane sourced from applicant-owned (Propria) sugarcane farms, metric tonnes per month
<b>3.3 Transport of Cane Sourced from Applicant-owned Farms</b>	Enter weighted average sugarcane transport distance by HDD Truck to mill from applicant-owned farms, km
<b>3.4 Cane Purchased from Partnership Farms (Terceiros)</b>	Enter Monthly quantity of sugarcane sourced from partnership (Terceiros) sugarcane farms, metric tonnes
<b>3.5 Transport of Cane Sourced from Partnership Farms</b>	Enter weighted average sugarcane transport distance by HDD Truck to mill, km
<b>3.6 Total Sugarcane Procured (calculated)</b>	Total Sugarcane procured by the mill from applicant-owned and partnership farms, metric tonnes (calculated)
<b>3.7 Fraction Cane Mechanically Harvested</b>	If Harvest Region-specific is selected in 1.11, consult CARB staff for guidance on third-party verification of mechanized harvest data. If standard option is selected,
<b>3.8 Filter Cake Transport &amp; Distribution Distance</b>	Filter cake transport distance to the fields or harvest origin (calculated parameter), km
<b>3.9 Externally Acquired or Purchased Bagasse<sup>1</sup></b>	Amount of sugarcane bagasse sourced from external sources for cogeneration purposes, metric tonnes.
<b>3.10 Electricity Generated from Externally Acquired Bagasse</b>	Enter amount of electricity generated from externally acquired biomass, in kWh per month
<b>3.11 Externally Acquired or Purchased Molasses</b>	Amount of sugarcane molasses sourced from external sources for ethanol production purposes, metric tonnes

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<sup>1</sup> Includes externally acquired biomass (cane straw, wood chips, etc.) for use in the biomass boilers.

**Table E.4. continued**

<b>Field Description</b>	<b>Value</b>
<b>3.12 Ethanol Produced from Externally Acquired or Purchased Molasses</b>	Enter amount of Ethanol produced from externally acquired molasses, in cu. meters per month
<b>3.13 Purchased Electricity from the Grid</b>	Amount of electricity purchased from the grid, monthly in kWh
<b>3.14 Surplus Electricity Cogenerated and Exported</b>	Enter verifiable amount of surplus, cogenerated electricity exported from the mill, monthly in kWh
<b>3.15 Juice Allocated to Sugar Production (weighted average)</b>	Monthly average share (%) of sugarcane juice allocated to finished sugar production
<b>3.16 Fraction Sucrose Entering Sugarcane Production</b>	Amount of sucrose (fermentable or crystalline sugars) in juice that enters the sugar production process (kg per metric tonne cane)
<b>3.17 Anhydrous Ethanol Production</b>	Monthly quantity of anhydrous ethanol produced, cubic meters
<b>3.18 Moisture Content (Anhydrous Ethanol)</b>	Average monthly level of moisture in anhydrous ethanol produced, %
<b>3.19 Adjusted Anhydrous Ethanol Production (calculated)</b>	Anhydrous ethanol produced less estimated ethanol from externally acquired molasses, cubic meters
<b>3.20 Hydrous Ethanol Production</b>	Monthly quantity of hydrous ethanol produced, cubic meters
<b>3.21 Moisture Content (Hydrous Ethanol)</b>	Average monthly level of moisture in hydrous ethanol produced, %
<b>3.22 Adjusted Hydrous Ethanol Production (calculated)</b>	Hydrous ethanol produced less estimated ethanol from externally acquired molasses, cubic meters
<b>3.23 Finished / Table Sugar Production</b>	Enter amount of finished or table sugar (Example, Crystal and VHP) produced, metric tonnes
<b>3.24 Total Ethanol Produced (dry volume), (calculated)</b>	Total amount of anhydrous and hydrous ethanol produced, dry cubic meters

#### Section 4: Calculate Production Yields and Mass Allocation Ratio

Section 4 in the Calculator worksheet module estimates the fuel ethanol production yields from each feedstock, and calculates the mass allocation ratio (which is critical to estimating how much of the upstream GHG impacts from sugarcane farming and transport can be attributed to sugar production). To estimate the yields, some mill-specific parameters must be entered. These parameters are called the Gopal-Kammen Model Parameters and are illustrated and discussed in Table E.5 and Table E.6, respectively. Once these parameters have been entered, the draft calculator is able to calculate the yields of ethanol from each feedstock, as well as model the two year reported production numbers of ethanol and finished sugar, by an iterative process.

**Table E.5. G-K Model Parameters Used in Calculator Worksheet in Section 4**

<b>Gopal-Kammen Model Parameters</b>	
<b>Mill-specific values for ethanol yield calculation and ethanol production modeling</b>	
4.1 $\eta_j$ (tonnes of fermentable sugars in juice/tonne of cane)	0.1320
4.2 $\eta_s$ (tonnes of sucrose in final sugar/tonne of sucrose into sugar factory)	0.63
4.3 Sucrose in Molasses (tonnes sucrose in molasses/tonne of sugarcane)	0.05
4.4 $\eta_e$ (dry tonnes of EtOH/tonne of fermentable sugars into distillery)	0.48
4.5 LHV of anhydrous EtOH (MMBtu/dry tonne EtOH)	25.55
4.6 $m_s$ (tonnes of sucrose in final sugar/tonne of final sugar product)	0.99
4.7 $m_m$ (tonnes of fermentable sugars in std molasses/tonne of std molasses)	0.50

**Table E.6. Description of Calculator Worksheet Inputs for Section 4**

<b>G-K Model Parameter</b>	<b>Description</b>
<b>4.1 <math>\eta_j</math> (tonnes of fermentable sugars in juice/tonne of cane)</b>	Called $\eta_j$ , this is the level of sucrose in the juice that enters the finished sugar or ethanol production process. Due to some process losses associated with pre-treatment and pH adjustment, $\eta_j$ is not the same as the amount of sucrose measured after the cane crush or at the gate. Note that “sucrose” is synonymous with fermentable sugars in the case of ethanol production.
<b>4.2 <math>\eta_s</math> (tonnes of sucrose in final sugar/tonne of sucrose into sugar factory)</b>	Called $\eta_s$ , this is the amount of sucrose that enters sugar production and is converted into finished sugar. It is a calculated parameter using the spreadsheet header Data “Solver” function.
<b>4.3 Sucrose in Molasses (tonnes sucrose in molasses/tonne of sugarcane)</b>	This is the ratio of the amount of sucrose in molasses per tonne of sugarcane that is available for conversion (fermentation) to ethanol. It is a calculated parameter.
<b>4.4 <math>\eta_e</math> (dry tonnes of EtOH/tonne of fermentable sugars into distillery)</b>	Called $\eta_e$ , this number represents the conversion efficiency of a sugar molecule into ethanol. Assuming “sucrose” is a simple C6 sugar, the theoretical conversion efficiency of sugar is 0.51. In reality, this efficiency is modeled in the range 0.43-0.48. It is a calculated parameter using the spreadsheet header Data “Solver” function.
<b>4.5 LHV of anhydrous EtOH (MMBtu/dry tonne EtOH)</b>	This number represents the LHV of ethanol (mmBtu/dry short ton), and is a fixed value
<b>4.6 <math>m_s</math> (tonnes of sucrose in final sugar/tonne of final sugar product)</b>	Called $m_s$ , this parameter represents the purity of the finished sugar product. For Crystal and VHP sugars produced at most Brazilian sugar mills, this value is assumed to be more than 99 percent pure. Value may be replaced with actual production data.
<b>4.7 <math>m_m</math> (tonnes of fermentable sugars in std molasses/tonne of std molasses)</b>	Called $m_m$ , this parameter represents the amount of fermentable sugars in standard molasses per tonne of standard molasses. Staff believes that molasses used for ethanol production typically have levels of fermentable sugars in the 50-60 percent range. This value may be substituted with actual production data.
<b>4.8. Mass Allocation Ratio for Upstream Emissions (calculated)</b>	Ratio used to apportion upstream GHG emissions associated with sugarcane production, harvest, transport, filter cake transport, and sugar production to molasses-based ethanol.

Once the G-K parameters and the juice shares have been confirmed, the applicant is ready to make the final fuel ethanol yield, and mass allocation ratio determination by modeling the 24-month production data previously entered. This is accomplished as follows:

1. Select "Data" from the spreadsheet header menu above. Then Click the "Solver" icon menu above to the far right of the Header. A "Solver Parameters" window opens up. Ensure that the "Set Objective" refers to **cell E88**, and is set to a Value Of: 0.0.
2. The variable cells "eta\_s" and "eta\_e" must be specified in the next sub-window. Do not change any of the constraints defined in the "Subject to the Constraints" window ( $0.41 > \text{eta}_e < 0.48$ , and  $\text{eta}_s \leq 0.99$ ).
3. Check box "Make Unconstrained Variables Non-Negative." Choose "GRG Nonlinear" for the Solving Method. Then Click the "Solve" button at the bottom.
4. The Solver will go through several iterations to find a solution. A new window "Solver Results" will open up. Solver will display the message that a solution has been found, and all constraints and optimality conditions have been satisfied. Choose to keep the Solver Solution.
5. Click OK. If a solution has not been found, then check the data for accuracy (Step 3, and then repeat Step 4 until a solution has been found, and all constraints and optimality conditions have been satisfied).
6. If a solution has not still been found, then check the juice shares (fraction juice allocated to sugar production), and the fraction of sucrose in the cane juice that enters production. The level of sucrose ( $\text{eta}_j$ ) could be lower due to process losses even if measured higher at the gate or after the cane crush.

Field "4.8.Mass Allocation Ratio" (Light Blue), is used to apportion upstream GHG emissions associated with sugarcane production, harvest, transport, filter cake transport, and sugar production to the molasses-based ethanol pathway. A well-to-tank CI for each feedstock has been calculated, but the composite CI is the CI that will be proposed for certification. This CI is depicted in the value for field "Composite CI, gCO<sub>2</sub>e/MJ" shown in the block "Pathway Summary and Estimated CI," of the Calculator worksheet. The Composite CI can also be calculated or updated by clicking on the "Calculate CI" button (green) in Section 4 of the Calculator worksheet. Clicking or selecting this button has the same effect as launching the Data Solver function in the worksheet.

The next block in the Calculator worksheet presents a summary of fuel yields from each feedstock, as well a summary of modeled finished sugar, ethanol production from each feedstock quantities, and surplus cogenerated electricity exported to the public grid (Table E.7). While the parameters in this block are calculated parameters, the applicant should verify the accuracy of the model with actual production data (see Section 3).

*Section 5: Verify Fuel and Co-Product Production Information*

This section does not require any user input, but presents the intermediate results of the Simplified CI calculator if the monthly production data has been entered correctly and the model has been executed without error. These intermediate results are shown in Table E.7.

**Table E.7. Summary of Fuel, Product, and Co-Product Information**

Section 5: Verify Fuel and Co-Product production Information									
5.1 Ethanol Volume from Cane Juice, dry gal	7,659,685	5.3 Ethanol Volume from Molasses, dry gal	6,666,817	5.5 Total Ethanol Volume, dry gal	14,326,502	5.7 Net Surplus Cogenerated Electricity Exported (kWh/yr)	116,760,000	5.9 Electricity Co-Product Credit (kWh/gal) (Molasses Feedstock)	3.20
5.2 Juice-to-Ethanol yield (gal/wet tonne cane)	21.01	5.4 Molasses-to-Ethanol yield (gal/wet tonne cane)	7.84	5.6 Total Annual Finished Sugar Production, metric tons	71,100	5.8 Composite Electricity Co-Product Credit (kWh/gal)	2.22	5.10 Electricity Co-Product Credit (kWh/gal) (Cane Juice Feedstock)	1.37

A discussion of each calculated parameter is provided in the Table E.8.

**Table E.8. List of calculated fields for Section 5 of the Calculator worksheet**

<b>Field Description</b>	<b>Value</b>
<b>5.1 Ethanol volume from Sugarcane Juice Feedstock (calculated)</b>	Modeled ethanol volume produced from sugarcane juice feedstock only, dry gal per year.
<b>5.2 Sugarcane Juice-to-Ethanol yield (calculated)</b>	Yield of ethanol, dry gal per wet metric tonne of sugarcane processed at the mill (from cane juice feedstock only),
<b>5.3 Ethanol Volume from Molasses Feedstock (calculated)</b>	Modeled ethanol volume produced from sugarcane molasses feedstock only, dry gal per year.
<b>5.4 Molasses-to-Ethanol yield (calculated)</b>	Yield of ethanol, dry gal per wet metric tonne of sugarcane processed at the mill (from molasses feedstock only).
<b>5.5 Total Ethanol Volume (calculated)</b>	Sum of the annual quantities of ethanol produced from each feedstock (cane juice and molasses), dry gal per year
<b>5.6 Total Annual Finished Sugar Production (calculated)</b>	Modeled throughput of finished sugar produced at the mill; it should match the average annual production input based on 24-month data, metric tonnes
<b>5.7 Net Surplus Cogenerated Electricity Exported (calculated)</b>	Net amount of surplus cogenerated electricity credited to the pathway, in kWh per year. Must be verifiable information (with invoices, or CCEE reports).
<b>5.8 Composite Electricity Co-Product Credit (calculated)</b>	Net amount of surplus cogenerated electricity credited to the pathway, in kWh per gal ethanol produced from all feedstocks
<b>5.9 Electricity Co-Product Credit (Molasses Feedstock) (calculated)</b>	Net amount of surplus cogenerated electricity credited to the pathway, in kWh per gal ethanol produced from Molasses feedstock.
<b>5.10 Electricity Co-Product Credit (Cane Juice Feedstock) (calculated)</b>	Net amount of surplus cogenerated electricity credited to the pathway, in kWh per gal ethanol produced from Sugarcane juice feedstock.

This table is followed by a summary of the applicable credits to the fuel pathway (Section 6). A final composite fuel pathway CI is determined based upon the 24-month production parameters entered in Section 3 of the Calculator worksheet (see “Pathway Summary and Estimated CI” block at the top of the worksheet). While the parameters in the blocks below are calculated parameters, the applicant should verify the accuracy of the model with actual production data.

*Section 6: Verify Pathway Credits*

This section does not require any user input, as it presents only the pathway credits which are calculated parameters. Pathway credits include a credit for the implementation of mechanized harvesting (6.1) practices, and a credit for the export of surplus cogenerated electricity (6.2) at the mill to the public grid. The credit for mechanized harvesting is either a value approved for the State (Standard), or site-specific (Harvest Region-Specific) value based upon an individual burn-area assessment using remotely-sensed data of the applicant owned and operated, or partnership sugarcane farms from where sugarcane is procured for finished sugar and ethanol production. If a site-specific value is claimed, it must be pre-approved by ARB staff or by third-party verifiers for use by the applicant. A summary of the pathway credits is presented in Table E.9.

**Table E.9. Summary of Fuel, Product, and Co-Product Information**

<b>Section 6: Verify Pathway Credits</b>			
<b>6.1 Applicable Mechanization Credit (7)</b>	<b>80.0%</b>	<b>6.2 Composite Electricity Co-Product Credit (kWh/gal)</b>	<b>2.22</b>

The applicant is advised that if any information in the Section 3 table is changed (for example, if the monthly sugarcane throughput or the measured sucrose level entering the sugar production process was to be lowered) after a “Solver” solution has been found, it will likely result in an imbalance in ethanol volume produced being reported in **cell E88** of the Calculator worksheet. In this case, the applicant must repeat Step 4 (Section 4), and find a new solution utilizing the “Solver” function. If any other non-production information is changed that warrants a new calculation of the CI value (for example, if the mechanized harvesting credit is changed from “Harvest Region Specific” to “Standard” (for statewide average), then the CI value will be updated automatically, or may be updated by pressing the F9 function key. For most input changes, the CI calculation is automatic and instantaneous, but F9 ensures that a value will always be updated. The user may also invoke the “Calculate CI” button to launch the “Solver” function of the draft calculator, and find a solution.

*Sample CI Calculations*

This section contains a detailed breakdown of the calculations used for CI determination based on information entered by the user and applicable reference data. Calculations are based on representative inputs as detailed in the input cells in this calculator. The Sample CI Calculations provide an aggregation of each GHG impact that results from harvesting the crop, to transport to mill, to fuel production, and transport and distribution of the fuel, and further gives the applicant an overview of the contribution to the composite CI.