

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

—
Starch and Corn Fiber Ethanol
Calculator Version: SIMCAL_STFIB_001

A. Introduction

This document provides detailed instructions for the use of the Simplified CI Calculator for Tier 1 starch (from corn and sorghum) and corn fiber ethanol pathway applications. This calculator is to be used to calculate the carbon intensity (CI) for ethanol produced from corn, sorghum, and corn fiber (if applicable using Edeniq's¹ process). The inputs to this Calculator will be subject to periodic verification. 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 to input information.

Download the draft Simplified CI Calculator here:

https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/110617starch-etoh_draftcalculator.xlsm

The draft calculator has been automated to perform CI calculations using factors from the draft CA-GREET 3.0 model. The calculator is expected to replace the existing Tier 1 calculator and the operational data template in pathway application packages. The calculator requires the applicant to add facility information and verifiable monthly feedstock, operational energy use, fuel and co-product data, and transport distances used in calculating the CI of starch and corn fiber ethanol pathways. **All inputs selected and input by the applicant are subject to verification unless specifically exempted.**

This calculator also includes additional reference material such as greenhouse gas emissions factors used in CA-GREET 3.0 and reference fuel specifications. Also included with the calculator is a detailed breakdown of the calculations used to determine the final CI of the fuel.

B. Definition

Below is a list of definitions for the input data values used in the calculator:

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,

¹ A proprietary technology licensed by Edeniq, Inc. enabling the conversion of corn fiber into ethanol in situ during the traditional process of converting corn starch to ethanol via fermentation. The U.S. Environmental Protection Agency has approved the use of the Edeniq process for generation of D3 Cellulosic RINs. The Edeniq pathway certified by the EPA can be found here: <https://www.epa.gov/sites/production/files/2015-08/documents/2014-16413.pdf>

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 site-specific value unless the applicant receives permission from the Executive Officer. These values are intended to be the same for all applicants of a given fuel type, and therefore would not be subject to CI conformance evaluation by ARB or third-party verifiers, e.g., the pipeline transmission distance for fossil natural gas; much of the background data used in CA-GREET 3.0 model, including emission factors, truck capacities, and farming inputs.

C. Color Legend Used in the Calculator

The Calculator has color options to differentiate required inputs, calculated values, etc. and they are described below:

| |
|--|
| Yellow Cells require user input |
| Light Blue Cells show CI results |
| Green Cells show the calculation button |
| Gray Cells are calculated values |

D. Calculator Overview

The following table provides an overview of the tabs used in the simplified CI calculator.

Table D.1. Overview of Tabs used in the Simplified CI calculator

| Tab Name | Description |
|-------------------|---|
| Summary | Summary worksheet. Contains an overall summary of the information entered in the “EtOH” tab of the Calculator and calculated CIs and corresponding ethanol volumes. This tab uses information from the “EtOH” tab to provide a summary of pathway inputs, carbon intensities and corresponding ethanol volumes for the various streams from an ethanol production facility. |
| EtOH | Main calculation worksheet. Contains an overview of the calculated CIs for a given pathway, and the main components of the Calculator with fields requiring user inputs and those calculated by the sheet. Calculations in grayed out cells are automatically calculated but dependent on input to yellow cells in the corresponding sections of the Calculator. This tab also includes a detailed sample CI calculation (cells A167 through AI 241). |
| EF Table | Reference worksheet. Contains emissions factors from the CA-GREET 3.0 model used in calculation of carbon intensities. |
| References | Reference worksheet. Includes standard values and assumptions related to the Calculator. |
| Fuel_Specs | Reference worksheet. Contains specifications of fuels, global warming potentials of greenhouse gases, and carbon and sulfur ratios of pollutants. |
| Misc. | Reference worksheet. Contains information used in CI calculations such as tailpipe emissions and indirect land use change. |

EF Table Tab

This tab includes GHG emission factors used in calculating CIs in the Calculator. All factors are expressed in gCO₂e/MJ. These are calculated using factors from CA-GREET 3.0 and from pathway applications certified in the LCFS program during the period January 2016 through July 2017. Factors are included for farming (both corn and sorghum), enzyme use, co-product credit, feedstock transport and ethanol production from various process energy sources. Two examples of CI factors are detailed below:

Example 1: Cell C4 has a listed CI value of 3.25 gCO₂e/MJ from farming operations (for a plant with a yield of 2.75 gallons/bushel). For an ethanol facility producing 2.75 gallons per bushel, the contribution to the CI will be 3.25 gCO₂e/MJ. If an applicant's facility has a different yield, this value (i.e., 3.25), the factor is scaled proportionally to calculate an appropriate CI contribution to the ethanol pathway.

Example 2: Cell C8 has a listed CI of 0.39 gCO₂e/MJ for corn transport of 10 miles by Medium Duty Diesel Truck. If an application includes corn transport of 10 miles using this mode of transport, the contribution to the pathway CI will be 0.39 gCO₂e/MJ. If an applicant has a different transport distance for corn, this CI value is proportionally scaled.

References Tab

This sheet details standard inputs in the Calculator for starch (both from corn and sorghum) and corn-fiber ethanol. These inputs are not subject to change by the applicant. Most of these inputs are from the Argonne GREET1 2016 version. The standard inputs include corn transport distance from farm to stack, farming energy, farming fertilizer and other chemical inputs, nitrous oxide production rate in soil based on nitrogen content of fertilizer used, CI for enzyme and chemical used in ethanol production, moisture content in oil (extracted after fermentation) and syrup produced from corn and sorghum, displacement factor for oil, indirect land use change, and ethanol transport distance from blending terminals to retail fueling stations.

Fuel_Specs Tab

This sheet includes fuel specifications (i.e., HHV, LHV, density, carbon ratio) for various process fuels, Global Warming Potentials of various greenhouse gases, carbon and sulfur ratios of greenhouse gas species, sulfur content in gasoline and diesel, unit conversions and CI calculations related to addition of denaturant in ethanol.

Misc. Tab

This tab includes loss factors from corn and sorghum ethanol pathways, indirect land use change, and detailed emissions calculations from blending of denaturant in ethanol.

E. Calculator Details (the “EtOH” tab)

The “EtOH” 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 Information
- Section 2. Enter Feedstock and Co-Product Data for Ethanol Production
- Section 3. Enter Fuel Production Energy Consumption and Fuel Transport Data
- Sample CI Calculations

All CI values are calculated based on relevant site-specific inputs which have to be entered in the respective input fields. Only after all site-specific inputs for a given facility have been entered, the calculated CIs will represent the pathway CIs for the various streams as detailed in this tab and the “Summary” tab. Details for entering data in all required fields is detailed below.

Pathway Summary and Estimated CI (g/MJ)

This part of the calculator contains the calculated CI results for a given ethanol pathway and user-specified inputs. The final results are displayed here after the data are entered and user clicks the “Calculate CI” button.

Section 1: Enter Applicant Information

Begin by selecting the “EtOH” tab and entering the company name, city and state where the ethanol production facility is located. As provided, this tab has ‘zero’ values in all cells which require user inputs. Applicants must replace input cell values only for those fields which are applicable to the ethanol plant.

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

| Field Name | Description |
|--|--|
| 1.1 Company Name | Registered name of the company. Example “ABC Company, LLC” or “ABC Company, Inc.” |
| 1.2. Company ID | Enter U.S. EPA Company ID. If not available, contact CARB staff for LCFS Company ID. |
| 1.3. Facility ID | Enter the Company’s Facility ID. If not available, contact CARB staff for LCFS Facility ID. |
| 1.4. Feedstock Production Location | Enter City, State, and Country for feedstock production |
| 1.5. Ethanol Production Location | Enter City, State, and Country for ethanol production |
| 1.6. Electricity Mix Region for Feedstock | Electricity mix for feedstock; set to single value: “1-U.S Ave Mix” and cannot be changed by the applicant |

Section 2: Enter Feedstock and Co-Product Data for Ethanol Production

The following table lists the fields used in Section 2 of the calculator. Additional details are provided in sections following Table E.2.

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

| Field Name | Description |
|---|---|
| 2.1. Monthly Data | Label for all 24 months for which data inputs are required. No inputs are required for 2.1. |
| 2.2. Beginning Corn Inventory | Corn inventory data must be input only for the beginning month in field 2.2. No inputs are required for the remaining months since these are calculated using inputs in fields 2.4 and 2.5. The input must be in bushels (with 15 percent standard moisture). If alternate approaches are used to inventory corn, applicant must provide conversion factor used to report inventory in bushels. |
| 2.3. Corn Used (Calculated) | Monthly corn used (in bushels) is automatically calculated in section 2.3. No inputs are required for this field. |
| 2.4. Corn Received | Monthly total corn (in bushels) purchased must be input in this field for all 24 months of operation. If alternate approaches are used to inventory corn, applicant must provide conversion factor used to report inventory in bushels. |
| 2.5. Ending Corn Inventory | Monthly total corn inventory (in bushels) must be input in this field for all 24 months of operation. If alternate approaches are used to inventory corn, applicant must provide conversion factor used to report inventory in bushels. |
| 2.6. Corn Transport Data Category | Field 2.6 provides three options for corn transport in a drop down menu: 1) Conditional Default for corn transport outside of CA; 2) Conditional Default for corn transport to CA; and 3) Site-Specific for corn transport. Applicant must select one of these options and click “Update” (green button). |
| 2.7. Corn Transport from Collection Center to Ethanol Plant (Monthly weighted average) | Field 2.7 provides three options for corn transport modes fields: 1) By HDDT, miles; 2) By Rail, miles; and 3) By Barge, miles. Monthly weighted average transport details must be input if applicant selects “Site-Specific” option in field 2.6. No inputs are required if applicant selects one of the |

| | |
|---|---|
| | Conditional Default options. <u>Additional details for feedstock transport is provided in the section below this Table.</u> |
| 2.8. Beginning Sorghum Inventory | Same as field 2.2 if sorghum is used as a feedstock. |
| 2.9. Sorghum Used (Calculated) | Monthly sorghum used data in this field will be automatically calculated. No inputs are required for this section. |
| 2.10. Sorghum Received | Same as field 2.4 if sorghum is used as a feedstock. |
| 2.11. Ending Sorghum Inventory | Same as field 2.5 if sorghum is used as a feedstock. |
| 2.12. Sorghum Transport Data Category | Same as field 2.6 if sorghum is used as a feedstock. |
| 2.13. Sorghum Transport from Collection Center to Ethanol Plant (Monthly weighted average) | Same as field 2.7 if sorghum is used as a feedstock. |
| 2.14. Dry DG Beginning Inventory | Dry Distiller Grains inventory data must be input (in tons) only for the beginning month in field 2.14. No inputs are required for the other months since these are calculated from inputs in fields 2.15-2.17. <u>If facility does not produce dry DGS, no inputs are required for fields 2.14 through 2.19 and must be 'zero' for all input fields in these fields.</u> |
| 2.15. Dry Distiller Grains Produced | Monthly Dry Distiller Grains produced data under section 2.15 will be automatically calculated. No inputs are required for this field. |
| 2.16. Dry Distiller Grains Sales | Monthly Total Dry Distiller Grains sales data (in tons) must be input in this field for all 24 months of operation. |
| 2.17. Dry DG Ending Inventory | Monthly Total Dry Distiller Grains ending inventory data (in tons) must be input in this field for all 24 months of operation |
| 2.18. Moisture Content | Monthly weighted average moisture content (in percentage) for dry DGS must be input in this field for all 24 months of operation. Moisture measurements must utilize an industry standard moisture measurement protocol. |

| | |
|---|--|
| 2.19. Drying Energy | Monthly weighted average drying energy data (mmBtu of NG expressed in HHV) must be input in this field for all 24 months of operation and must be supported by dedicated energy meter records. |
| 2.20. Modified DG Beginning Inventory | Same as field 2.14 but for modified DGS. |
| 2.21. Modified Distiller Grains Produced | Same as field 2.15 but for modified DGS. |
| 2.22. Modified Distiller Grains Sales | Same as field 2.16 but for modified DGS |
| 2.23. Modified DG Ending Inventory | Same as field 2.17 but for modified DGS |
| 2.24. Moisture Content | Same as field 2.18 but for modified DGS |
| 2.25. Drying Energy | Same as field 2.19 but for modified DGS |
| 2.26. Wet DG Beginning Inventory | Same as field 2.14 but for wet DGS. |
| 2.27. Wet Distiller Grains Produced | Same as field 2.15 but for wet DGS. |
| 2.28. Wet Distiller Grains Sales | Same as field 2.16 but for wet DGS |
| 2.29. Wet DG Ending Inventory | Same as field 2.17 but for wet DGS |
| 2.30. Moisture Content | Same as field 2.18 but for wet DGS |
| 2.31. Syrup Beginning Inventory | Syrup inventory data must be input (in tons) only for the beginning month in field 2.31. No inputs are required for the other months since these are calculated from inputs in fields 2.32-2.34. <u>If facility does not produce syrup, no inputs are required for fields 2.31 through 2.34 and must be 'zero' for all inputs in field 2.31.</u> |
| 2.32. Syrup Produced | Monthly syrup produced data in field 2.32 will be automatically calculated. No inputs are required for this field. |

| | |
|--|---|
| 2.33. Syrup Sales | Monthly syrup sales data (in tons) must be input in this field for all 24 months of operation. |
| 2.34. Syrup Ending Inventory | Monthly total syrup ending inventory data (in tons) must be input in this field for all 24 months of operation. |
| 2.35. Beginning Oil Inventory | Corn/Sorghum Oil inventory data must be input (in lbs.) only for the beginning month in field 2.35. No inputs are required for the other months since these are calculated from inputs in fields 2.36-2.38. <u>If facility does not produce corn or sorghum oil, no inputs are required for fields 2.35 through 2.38 and must be 'zero' for all inputs in field 2.35.</u> |
| 2.36. Oil Produced | Monthly total oil produced data under section 2.36 will be automatically calculated. No inputs are required for this field. |
| 2.37. Oil Sales | Monthly total Corn/Sorghum Oil sales data (in lbs.) must be input in this field for all 24 months of operation. |
| 2.38. Ending Oil Inventory | Monthly total Corn/Sorghum Oil ending inventory data (in lbs.) must be input in this field for all 24 months of operation. |
| 2.39. Co-product Yield | Co-product Yield (dry matter basis, expressed in lbs./gallon of ethanol) data in field 2.39 will be automatically calculated. No inputs are required for this field. |
| 2.40. Beginning Undenatured Ethanol | Undenatured ethanol inventory data must be input (in gallons at 60F.) only for the beginning month in field 2.40. No inputs are required for the other months since these are calculated from inputs in fields 2.41 through 2.44. |
| 2.41. Denatured Ethanol Sales | Monthly total denatured ethanol sales data (in gallons at 60F) must be input in this field for all 24 months of operation. |
| 2.42. Undenatured Ethanol Sales | Monthly total undenatured ethanol sales data (in gallons at 60F) must be input in this field for all 24 months of operation. Appropriate evidence to support sales of denatured ethanol must be available. |
| 2.43. Ending Undenatured Ethanol | Monthly total undenatured ethanol ending inventory (in gallons at 60F) must be input in this field in this field for all 24 months of operation. |
| 2.44. Undenatured Ethanol Produced | Monthly undenatured ethanol produced data in this field will be automatically calculated. No inputs are required for this field. |
| 2.45. Denaturant Data Category | Field 2.45 includes options for denaturant data category in a drop down menu: 1) Denaturant as Standard Value; and 2) Site-Specific Denaturant. Applicant must select one of |

| | |
|---|--|
| | these options and click the “Update Denaturant” green button. Following the category selection (in either cases), data must be input in this section only if the site-specific option is selected and actual monthly total quantity of denaturant used (in gallons at 60F) must be input in this field for all 24 months of operation. |
| 2.46. Beginning Cellulosic Enzyme | Beginning cellulosic enzyme inventory data must be input (in lbs.) only for the beginning month in field 2.46. No inputs are required for the other months since these are calculated from inputs in fields 2.47 through 2.49. |
| 2.47. Cellulosic Enzyme Purchase | Monthly total cellulosic enzyme purchase data (in lbs.) must be input in this field for all 24 months of operation. |
| 2.48. Cellulosic Enzyme Use | Monthly total cellulosic enzyme use data (in lbs.) in field 2.48 will be automatically calculated. No inputs are required for this field. |
| 2.49. Ending Cellulosic Enzyme | Monthly total cellulosic enzyme ending inventory (in lbs.) must be input in this field for all 24 months of operation. |
| 2.50. Corn Fiber Allocation | Monthly average corn fiber percentage data must be input in this section (see also section on <i>Facilities which have incorporated a Corn Fiber Ethanol Process</i>) |
| 2.51. Undenatured Corn Fiber Ethanol | Monthly undenatured corn fiber ethanol production (in gallons at 60F) will be automatically calculated in field 2.51. No inputs are required for this field. |

Feedstock Production (Fields 2.2 to 2.5 for corn and 2.8 to 2.11 for sorghum)

For feedstock production, enter data for site-specific inputs for feedstock (corn) inventory to enable calculation of quantity of feedstock used in ethanol production. Cells which are grayed out are calculated values and do not require applicant input. The first input must be the beginning inventory of corn or sorghum (in bushels) and all calculations for beginning inventory for subsequent months are automatically calculated from the inputs to other cells in this section of the sheet. The applicant must enter monthly totals for corn or sorghum received (as purchased) in bushels and total monthly ending corn or sorghum inventory in bushels. The monthly totals must be inclusive of moisture (and not to be reported on a dry basis). The inventory data must be used to determine the total corn or sorghum used as feedstock for ethanol production. (If corn or sorghum inventory is not quantified in bushels, the applicant must convert to bushels using a conversion factor of 56 lbs./bushel before reporting in these input cells).

Feedstock Transport (Fields 2.7 and 2.13)

The monthly weighted average transport distance for feedstock transported by truck, rail and barge must be entered for corn or sorghum in their respective fields. The calculator offers a conditional-default and a site-specific option for corn transport. For ethanol production facilities in one of nine corn growing states as specified by ANL known as “corn belt states” (South Dakota, Minnesota, Iowa, Nebraska, Illinois, Michigan, Ohio, Indiana, and Wisconsin)² a conditional default value of 80 miles by HDD truck transport is available for selection. (Click the green “Update” field to see the pre-populated conditional value.) If applicant selects this option (and is appropriate based on physical location of the ethanol production facility), transport distance will be subject to one time validation during initial certification. For ethanol plants located in California, a conditional default selection will include a 50 mile by HDD truck transport and 1,400 mile by rail transport to California. If an ethanol production facility located in California must seek to use this option, transport distance will be subject to one time validation during initial certification. For applicants who elect to use the site-specific option, inputs will be subject to initial validation and periodic verification.

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

| Modes of Transport | | | | | | |
|--|--|-------|---------|-------|---------|-------|
| | Truck | Miles | Rail | Miles | Barge | Miles |
| 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 feedstock | | | | | | |
| | 300,000 | 117 | 450,000 | 511 | 100,000 | 250 |
| Example in sheet above: | | | | | | |
| Entry 1 | For the month, the facility received 100,000 bushels by a mode which included 50 miles by truck followed by 1200 miles by rail | | | | | |
| Entry 2 | For the month, the facility also received 200,000 bushels by truck only with a transport distance of 150 miles | | | | | |
| Entry 3 | For the month, the facility also received 200,000 bushels by rail only with a transport distance of 800 miles | | | | | |
| Entry 4 | For the month, the facility also received 100,000 bushels which included 200 miles by rail followed by 250 miles by barge | | | | | |
| Entry 5 | For the month, the facility also received 50,000 bushels using only rail transport for a distance of 1000 miles | | | | | |

² Shapouri et al. USDA July 2002 - “The Energy Balance of Corn Ethanol: An Update” –Table 2 - Extracted May 2017

For transport of feedstock, applicants must calculate the appropriate mileage for each mode of transport as described below. For rail transport, mileage must be based on the rail network maps from either BNSF Railway³ or Union Pacific.⁴ For facilities which are not on the BNSF or Union Pacific rail network, applicants may use a publicly available web-based driving distance estimator for the distance between the facility and the nearest rail depot. Truck transport distance between two points may be determined using a publicly available web-based driving distance estimator. Barge transport distance must be calculated using a reputable online mapping system, reported in miles.⁵ Nautical miles calculated by the online mapping system must be converted to miles using the conversion factor of 1 nautical mile/1.152 miles.⁶

Note: For facilities which directly from an aggregator but do not have detailed transport distances, staff suggests an applicant elect to use the conditional default if applicable.

The same approach for sorghum feedstock input and transport must be used in completing the appropriate cells if sorghum is used as a feedstock for ethanol production.

Co-products (Fields 2.14 to 2.39)

This section contains input information related to reporting quantities of co-product produced during ethanol production. The co-products include distillers' grains solubles, distillers' corn oil and corn syrup. The sheet allows producers to account for co-product streams of dry, modified and wet distillers' grain solubles. Facilities must include only streams applicable to their production cycles over the 24 months for which data is submitted. Facilities which report dry or modified DGS co-product streams will be required to report monthly total drying energy by installing dedicated energy meters in their facilities. Meters must record energy use for the entire duration in which dryers are utilized to dry DGS and all records to demonstrate energy use for drying must be electronically archived. The meters must be comparable to utility-grade energy meters installed in the facility to record natural gas use.

Note: If co-product streams or other energy sources are used for drying, the applicant must declare it in the supplemental documentation. The Simplified CI calculator is not capable to estimate GHG emissions when energy sources other than natural gas is used for drying energy. Applicants may be required to use a Tier 2 approach using the CA-GREET 3.0 model and must consult staff for appropriate course of action.

³ BNSF railway system: <http://www.bnsf.com/customers/where-can-i-ship/>

⁴ Union Pacific system: <https://www.up.com/aboutup/usguide/index.htm>

⁵ Example of an online nautical distance mapping system: <https://www.marinetraffic.com/en/voyage-planner>

⁶ Nautical miles to miles conversion factor source: <http://www.metric-conversions.org/length/uk-nautical-miles-to-miles.htm>

Inputs for all co-product inventory streams must be reported in tons except for distillers' corn oil which must be reported in pounds (lbs.). Energy use must be reported in MMBtu using higher heating values (HHV).

For inputting co-product quantities, the applicant must include monthly total quantities for all co-products detailed in the input sheet. For all DGS reporting:

- Input beginning dry DGS inventory (for this input only for the first month);
- Monthly DGS sales;
- Ending monthly inventory;
- The monthly weighted average moisture content for dry and modified DGS co-product streams;
- Monthly total drying energy, consistent with the metering requirements listed above for dry and modified DGS streams if applicable to the facility.

For the corn syrup and distillers' corn oil (DCO) co-product streams, the required inputs are similar except these do not require drying energy inputs and moisture content. Moisture content for corn oil is set to a standard value of 1% and corn syrup at 30%.

Note: All co-product credits for corn/sorghum oil are currently attributed to the corn ethanol pathway(s).

Ethanol Production (Fields 2.40 to 2.51)

For ethanol production, the applicant must input (all volumes standardized at 60°F):

- Beginning inventory for undenatured ethanol (only required for the first month);
- Monthly total denatured ethanol sales;
- Monthly total undenatured ethanol sales scheduled for export;
- Ending monthly undenatured ethanol inventory;
- For monthly denaturant volumes (gallons), the sheet offers two options: Standard Value or Site-Specific. If user selects Standard Value denaturant, a value of 2.5% is used as denaturant volume blended with ethanol. If Site-Specific denaturant is selected, monthly total denaturant values (in gallons at 60F) must be input in field 2.45. Click the green "Update Denaturant" button after selecting either option. For an applicant who elects to use the site-specific input option, monthly total denaturant volumes must be input in this field.

Facilities which have incorporated a Corn Fiber Ethanol Process (Fields 2.46 to 2.51)

For facilities which utilize the Edeniq process for conversion of corn-fiber to cellulosic ethanol, the calculator includes a "Cellulosic Enzyme and Corn Fiber" section for site-specific inputs inclusive of fields from 2.46 through 2.51. Applicants must input beginning inventory of cellulosic enzymes, monthly total cellulosic enzyme purchases,

and monthly total ending cellulosic enzyme inventories (all enzyme quantities to be reported in lbs.). Under the Federal RFS2 program administered by the Environmental Protection Agency (EPA), Edeniq is required to demonstrate upon initiation of cellulosic fiber ethanol production, percentage of cellulosic ethanol production attributable to their proprietary process. Applicants must input this value in the corn fiber allocation percentage⁷ field (i.e., 2.50 and all entries must remain the same unless it is updated as part of the periodic validation required under the RFS2 program).

The RFS2 program requires facilities approved for D3 RINs to demonstrate, at periodic intervals (i.e., every 500,000 gallons or one year, whichever is more frequent), that cellulosic volumes produced meet or exceed the originally certified level for a given facility. ARB will adopt this same requirement as a condition of pathway certification. At the time of initial registration, applicants must provide a copy of the RFS approval for the facility. Ongoing reports⁸ must be submitted to CARB staff periodically as required by the RFS program. If any periodic demonstration shows that the cellulosic converted fraction is lower than previously calculated, all cellulosic volumes reported after the most recent chemical analysis will be updated to reflect lower production volumes, and credits generated by the applicant will also be adjusted downward to reflect the lower production quantities of cellulosic ethanol. Credit adjustments will be retroactive to the prior period when a similar demonstration was completed for this facility.

⁷ This value is used to calculate cellulosic ethanol production and is subtracted from total ethanol production to enable attribution of starch ethanol to other streams in the ethanol plant.

⁸ Link to section §80.1426 of RFS code: <https://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol16/pdf/CFR-2011-title40-vol16-sec80-1426.pdf>

Section 3: Enter Fuel Production Energy Consumption and Fuel Transport Data

The following table lists the fields in Section 3 of the calculator.

Table E.3. List of Input Fields for Section 3 of the Simplified CI Calculator

| Field Name | Description |
|---|--|
| 3.1. Electricity Mix Region for Fuel | Section 3.1 contains 30 regional electricity mixes. Applicant must select a regional mix from the dropdown menu based on zip code of the facility location matched to e-grid zone. |
| 3.2. NG Use | Monthly Natural Gas consumption data (in mmBtu HHV) must be input in this field for all 24 months of operation. |
| 3.3. Biogas Use | Monthly Biogas consumption data (in mmBtu HHV) must be input in this field for all 24 months of operation. |
| 3.4. Biomass Use | Monthly Biomass consumption data (in tons) must be input in this field for all 24 months of operation. |
| 3.5. Biomass Moisture | Monthly Biomass moisture percentage data must be input in this field for all 24 months of operation. |
| 3.6. Biomass Transport Distance | Monthly Biomass Transport distance data (in miles) must be input in this field for all 24 months of operation. |
| 3.7. Coal Use from Invoices | Monthly Coal consumption data (in dry tons) must be input in this field for all 24 months of operation. |
| 3.8. Electricity Use from grid | Monthly Electricity use (in kWh) from grid data must be input in this field for all 24 months of operation. |
| 3.9. Electricity from Co-located Solar or Wind | Monthly Electricity from co-located Solar or Wind data must be input in this field for all 24 months of operation. |
| 3.10. Finished Fuel Transport | Field 3.10 is designated for finished Fuel Transport and Distribution. No inputs are required for this section. |
| 3.10.a. By Rail | Field 3.10.a is designated for Rail Transport Mode. Mileage data must be input in this section. |
| 3.10.b. By HDD Truck | Field 3.10.b is designated for Heavy Duty Truck Transport Mode. Mileage data must be input in this section. |
| 3.10.c. By Barge | Field 3.10.c is designated for Barge Transport Mode. Mileage data must be input in this section. |

Electricity Mix (Field 3.1)

The applicant must select a regional electricity mix for ethanol production from the cell labeled “3.1. Electricity Mix Region for Fuel”. The dropdown menu consists of 30 sub-regions (26 from the U.S based on eGRID 2014⁹, one from Brazil, one from Canada, one from U.S average, and one for User Defined region¹⁰).

Energy Consumption (Fields 3.2 to 3.9)

The applicant must input applicable energy inputs in this section. The applicant must input monthly total natural gas usage from utility invoices (in MMBtu reported as higher heating value). If a production facility uses biomethane (or biogas) as process fuel, monthly total biomethane (or biogas) use from invoices must be input (in MMBtu reported as higher heating value). The landfill or other source of biomethane must have a dedicated supply line to the ethanol production facility in order to be eligible for consideration as a process fuel. The applicant must also provide details if the biogas is processed at a purification plant prior to transport to the ethanol facility. The transmission distance from the landfill (or other source of biomethane or biogas) to the ethanol production facility must be input in miles (the same value must be input in all the cells in the field 3.3 designated for transport distance). For facilities which use biomass as a process fuel, monthly totals from invoices must be input in dry tons. The applicant must also input monthly weighted average moisture content of the biomass. Monthly weighted average biomass transport distance (HDD truck is the only option offered in this sheet) of biomass must be input in miles. Reporting of miles must conform to the same approach as described in the corn transport section. Facilities which use coal as a process fuel must input monthly total coal use in dry tons. The transport mode and distance for coal transport to the ethanol facility is a standard value in CA-GREET 3.0 and is not subject to verification. The applicant must input monthly total electricity purchased from the grid from utility invoices (in kWh). If electricity from solar generation or wind power is available for use by the ethanol production facility, appropriate monthly total electricity dedicated for use by the facility must be input in the renewable electricity cells. Renewable electricity must meet the requirements for such power as detailed in section 95488.7(i) in the LCFS regulatory text.

Fuel Transport (Field 3.11)

For transport of finished fuel to California, applicants must input the appropriate transport distance inclusive of HDD truck, barge and rail transport as applicable. Emissions from transport modes are additive to reflect all legs of transport of finished fuel to California.

Note: For applicants who expect to use various combinations of transport modes to ship fuel to California, staff suggests calculating the CIs for each combination and

⁹ “Emissions & Generation Resource Integrated Database (eGRID)” - U.S EPA, extracted 02-2017: <https://www.epa.gov/energy/emissions-generation-resource-integrated-database-eGRID>

¹⁰ Although Canada and Brazil are included in the drop down menu, the starch calculator is designed only for starch ethanol and corn fiber ethanol produced in the U. S.

inputting the combination with the highest CI among the various combinations. The supplementary documentation provided with the application must include the CIs for each of the anticipated combinations and highlight the combination used in the Calculator.

Once all the applicable inputs have been entered in the sheet, click the green button labeled **“Click here to Calculate CI after Inputs”** (in the Pathway Summary and Estimated CI (g/MJ) section of the EtOH tab). The EtOH tab now presents carbon intensities with corresponding fuel volumes corresponding to all inputs used in the EtOH tab. The Summary tab also displays these CIs with corresponding volumes and also provides an overview of facility information and aggregated inputs.

Sample CI Calculations

This section contains an example pathway CI calculation with a detailed breakdown of all calculations used for CI determination based on information entered by the user and applicable reference data. These calculations are included in cells A167 through AI 241 in the EtOH tab. Calculations are based on representative inputs used in the input cells in this calculator. None of the user-defined options have been used in the sample calculations.