USER-INSTRUCTIONS
DRAFT SIMPLIFIED CI CALCULATOR
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Starch- and Corn Fiber-Derived Ethanol
Version posted July 31, 2017

This document includes an overview of the input fields shown in the draft Simplified CI Calculator for Tier 1 starch ethanol pathway applications, which could be used to determine the carbon intensity (CI) value for ethanol made from corn, sorghum, and corn fiber cellulosic ethanol produced using the Edeniq[1] process. Staff requests stakeholder review and feedback on the draft calculator.

Download the draft Simplified CI Calculator here:
https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/etoh_calculator_updated.xlsm

The draft calculator has been automated to perform CI calculations using the current, Board-approved version of the CA-GREET 2.0 model and is available as a spreadsheet download from the LCFS meetings page. Once staff has developed the new CA-GREET 3.0 model, the Simplified CI Calculator will be updated to determine CI values using that model. The calculator would potentially 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 ethanol pathways. All yellow cells are site specific and staff suggests that all data entered in them should be subject to verification.

The tab labeled Reference includes standard values and assumptions related to this fuel pathway. The applicant should begin by selecting the "EtOH tab" and entering the company name (cell E1), the feedstock production region (cell I1), and the ethanol production facility region (cell L1). Since this calculator is designed to determine the CI for ethanol produced in the U.S. using feedstock sourced from within the U.S., applicants should enter the feedstock production region as the U.S. and the applicable state and city/town for the ethanol production location.

Feedstock Production
In cell A4, applicants should select the appropriate Feedstocks and Co-products option from the dropdown menu, and then double-click the "Select Feedstock" button in cell A-2. There are eight options depending on feedstocks used and drying levels (wet, dry or modified) for DGS by the ethanol plant. Table 1 below shows the full list of available

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[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. Environment al 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

feedstock and co-product options. If a composite CI option is chosen, a single CI value for each feedstock (i.e., corn, sorghum and corn fiber, if applicable) used by the production facility will be determined. If an option with segregated DGS is selected, the calculator will display multiple CIs for each feedstock-DGS combination.

Table 1. Feedstock and co-product options

Corn (composite DGS)
Corn (segregated DGS)
Corn and Sorghum (composite DGS)
Corn and Sorghum (segregated DGS)
Corn (composite DGS) and Corn Fiber
Corn (segregated DGS) and Corn Fiber
Corn and Sorghum (composite DGS) and Corn Fiber
Corn and Sorghum (segregated DGS) and Corn Fiber

The applicant would click the "Select Feedstock" button after selecting an option from the pull-down menu. This will format rows 2-7 of the sheet to display applicable CIs based on feedstock and DGS drying levels utilized. The CI's are not displayed until all required site-specific inputs have been entered in the respective input fields.
See Tables 2 and 3 below for the cell locations for segregated and composite CIs.

Applicants would select the appropriate electricity mix for feedstock production subregion from the dropdown list in cell F8.

Cells B12 to H35 include site-specific inputs required for feedstock transport and inventory tracking of corn. The first input is the beginning inventory of corn in bushels and this needs to be included in cell B12. For cells D12-D35, the applicant would enter monthly totals for corn purchased (received), and in cells E12-E35 the applicant would enter monthly ending corn inventory. The inventory data would be used to determine total feedstock used for ethanol production. A monthly weighted average corn transport distance would be input for each applicable transport mode (in miles) in the following cells: F12-F35 for heavy duty truck transport, and H12-H35 for rail.

Cells J12-Q35 include site-specific inputs required for feedstock transport and inventory tracking of sorghum. The first input is the beginning inventory of sorghum in bushels and this needs to be included only in cell J12. For cells L12-L35, the applicant would enter monthly totals for sorghum purchased (received), and in cells M12-M35 the applicant would enter monthly ending sorghum inventory. The inventory data would be used to determine total feedstock used for ethanol production. A monthly weighted average sorghum transport distance would then be input into the calculator. The applicant will enter the weighted average distance for

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each applicable transport mode (in miles) in the following cells: N12-N35 for heavy duty truck transport, and P12-P35 for rail.

Inputs Related to Co-products/Ethanol Production

Moving right across the sheet, the applicant would input the beginning inventory for ethanol, monthly total sales, monthly ending inventories and monthly weighted average moisture content for each applicable co-product in cells R12 through AO35. These include the unadjusted mass (inclusive of moisture content) and percentage moisture content for each of the following co-product streams: Dry DGS, Modified DGS, Wet DGS, Corn syrup, and Corn oil. The total DGS yield, adjusted to dry pounds of DGS per gallon of ethanol as currently input to the CA-GREET model, is calculated in the last column of this section (not a site-specific input).

For facilities which segregate DGS, for reporting Dry DGS (DDGS), applicants would input beginning inventory for the first month in cell R12 (tons). If Dry DGS is not applicable, applicants would enter the number zero in all cells applicable to Dry DGS. Monthly DDGS sales should then be input in cells T12-T35 (tons). DDGS ending inventory would be entered in cells U12-U35 (tons). Monthly weighted average moisture content percentage would be entered in cells V12-V35, and metered drying energy would be entered in cells W12-W35 (MMBtu reported as higher heating value).

For facilities which segregate DGS, for reporting Modified DGS (MDGS), applicants would input beginning inventory for the first month in cell X12 (tons). If Modified DGS is not applicable, applicants would enter the number zero in all cells applicable to Modified DGS. Monthly MDGS sales should then be input in cells Z12-Z35 (tons). MDGS ending inventory would be entered in cells AA12-AA35 (tons). Monthly weighted average moisture content percentage would be entered in cells AB12-AB35, and metered drying energy would be entered in cells AC12-AC35 (MMBtu reported as higher heating value).

For facilities which segregate DGS, for reporting Wet DGS (WDGS), applicants would input beginning inventory for the first month in cell AD12 (tons). If Wet DGS is not applicable, applicants would enter the number zero in all cells applicable to Wet DGS. Monthly WDGS sales should then be inputted in cells AF12-AF35 (tons). WDGS ending inventory would be entered in cells AG12-AG35 (tons). Monthly weighted average moisture content percentage would be entered in cells AH12-AH35.

For corn syrup produced as a co-product, applicants would enter monthly syrup sales in cells AJ12-AJ35 (tons). Syrup ending inventory would be entered in cells AK12-AK35 (tons).

For corn oil produced as a co-product (DCO), applicants would enter monthly DCO sales in cells AM12-AM35 (lbs.). DCO ending inventory would be entered in cells

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AN12-AN35 (lbs.). Applicants would enter monthly DCO used for biodiesel and renewable diesel production in cells AO12-AO35 (lbs.).

The energy and ethanol production and transport inputs are included in cells AQ12 through BH35. This includes site-specific inputs for ethanol production, cellulosic inventories, facility energy use and fuel transport to be completed by the applicant. The applicant would select a regional electricity mix for ethanol production from the pull-down menu in cell AZ9.

The applicant would then enter the beginning inventory for the first month for undenatured ethanol in cell AQ12 (undenatured gallons at 60°F). The applicant would then enter monthly denatured ethanol sales in cells AR12-AR35 (denatured gallons at 60°F). Next, the ending undenatured ethanol monthly inventories would be input in cells AS12-AS35 (undenatured gallons at 60°F). Applicants are advised to report appropriate undenatured and denatured volumes as required in the respective columns.

For facilities which employ the Edeniq process for conversion of corn-fiber to ethanol, the calculator includes cells in Columns AU-AX with required site-specific inputs. Beginning cellulosic enzyme inventory would be entered in cell AU12 (lbs.). Monthly total cellulosic enzyme purchases would then be entered in cells AV12-AV35 (lbs.). Monthly total ending cellulosic enzyme would be entered in cells AX12-AX35 (lbs.). Corn fiber allocation percentage would be entered in cells AY12-AY35. Lastly, gallons of undenatured corn fiber ethanol (temperature corrected to 60°F) would be entered for each month in cells AZ12-AZ35. The enzyme use is correlated to corn fiber ethanol produced based on chemical analysis conducted by Edeniq. The applicant would provide documentation related to the analysis conducted by Edeniq. The requirements are similar to those under the U.S. EPA Renewable Fuels Standard (RFS) program but modified to match LCFS requirements.

The RFS 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 anticipates adopting this requirement as a condition of pathway certification. At the time of initial registration, applicants would provide a copy of the RFS approval for the facility. Ongoing reports[2] required under the RFS program would be submitted to the LCFS annually. If the new data shows that the cellulosic converted fraction is lower than previously calculated, all cellulosic volumes reported after the most recent chemical analysis would be updated to reflect lower production volumes, and necessary changes to credits generated by the applicant would also be adjusted downward to reflect the lower production quantities of cellulosic ethanol.

Next, the applicant would enter all applicable energy inputs to the facility, located in cells BA12-BH35. First, the applicant would enter monthly natural gas usage in cells

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[2] 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

BA12-BA35 (MMBtu reported as HHV). If applicable to a production facility, the next two energy sources would be input in cells BB12-BD35. The first one is the use of biomass as process fuel. If applicable, monthly total biomass use from invoices would be entered in bone dry short tons (cells BB12-BB35). Monthly weighted average biomass transport distances would be entered in miles by mode: heavy duty truck in cell BC13 and rail in cell BC15. The second one is the use of biogas (from landfills or digesters). For facilities which use biogas, monthly total invoices would be entered in cells BD12-BD35 (MMBtu reported as HHV). Pipeline transmission distance for this biogas would be entered in cell BE13. To account for the inclusion of alternate sources of thermal energy, the calculator includes cells BF12-BF35 to input energy use (MMBtu reported as HHV) for the alternate source of thermal energy. The applicant would consult with staff prior to application submission to develop appropriate emission factors for the alternate source of thermal energy. Use of electricity from the grid would be input in kWh in cells BG12-BG35. To account for the inclusion of alternate sources of electricity (such as wind-derived, photovoltaic sources), the calculator includes cells BH12-BH35 to input such electricity use in kWh. The applicant would consult with staff prior to application submission to develop appropriate emission factors for the alternate source of electricity.

Lastly, applicants should enter total transport mileage for finished fuel supplied to California. The transport modes available are rail and heavy-duty diesel truck, with an option for the applicant to specify two additional modes (to account for non-traditional or non-typical modes of transport. Applicant would consult with staff to develop emission factors for any of the two additional modes of transport). Rail transport mileage of ethanol would be reported in cell BK12, and its share of the total mileage would be entered in BJ12. Heavy duty diesel truck mileage would be entered in cell BK15, and its share of the total mileage would be entered in BJ15. Mileage for the first additional mode of transport would be entered in cell BK22, and its share of total transport mileage in cell BJ22. Mileage for the second mode of additional transport mode would be entered in cell BK23, and its share of total transport mileage in cell BJ23. Emissions from transport modes are additive to reflect all legs included in the transport of finished fuel to California.

Once all the required inputs have been entered in the sheet, applicable CIs will be displayed in rows 2-7 based on the applicant's selection of feedstock and co-product options. These CIs will be displayed in the following cells:

Table 2. Cell locations for Segregated CIs, assuming all feedstocks selected

Segregated CIs	Feedstock	Cell Location
Dry DGS	Corn ethanol CI	F2
	Sorghum ethanol CI	I2
Modified DGS	Corn ethanol CI	F4
	Sorghum ethanol CI	I4

Wet DGS	Corn ethanol CI	F6
	Sorghum ethanol CI	I6
Corn Fiber Ethanol	Corn fiber ethanol CI	L2

Table 3. Cell locations for Composite CIs, assuming all feedstocks selected

Composite CIs	Feedstock	Cell Location
Combination DGS	Corn ethanol CI	F2
	Sorghum ethanol CI	I2
Corn Fiber Ethanol	Corn fiber ethanol CI	L2