Note- this instruction manual is an excerpt from a clean version of the final modified version of Attachment C: CA-GREET3.0 Technical Support Documentation, posted on August 13, 2018 as part of the rulemaking process supporting the LCFS amendments in effect from Q1 2019.

Tier 1 Simplified CI Calculator Instruction Manual

Biomethane from Anaerobic Digestion of Wastewater Sludge

A. Introduction

This document provides detailed instructions for the use of the Simplified CI Calculator for Tier 1 Wastewater Sludge to Renewable Natural Gas (RNG) pathway applications. This Calculator is to be used to calculate the carbon intensity (CI) for Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), and Liquefied and subsequently Compressed Natural Gas (L-CNG) produced from biogas (also referred to as digester gas) generated by the anaerobic digestion of wastewater sludge at a publicly-owned treatment works (POTW). Each required specific input 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.

Download the Simplified CI Calculator here:
https://www.arb.ca.gov/fuels/lcfs/ca-greet/ca-greet.htm

The Calculator has been automated to perform CI calculations using factors from the CA-GREET3.0 model. Applicants are required to add facility information and verifiable monthly feedstock, operational energy use, fuel production and co-product data, and transport distances used in calculating the CI of biomethane derived from the anaerobic digestion of wastewater sludge at a POTW. **All inputs selected and input by the applicant must meet the requirements of the monitoring plan for entities required to validate or verify pursuant to sections 95491.1(c) and are subject to verification unless specifically exempted.**

This Calculator also includes additional reference material such as greenhouse gas emissions factors used in CA-GREET3.0 and reference fuel specifications.
Also included with the Calculator is a detailed breakdown of the calculations used to determine the final CI of each fuel pathway.

The applicant may only enter values or make selections in input fields designated by CARB for user input/selection, and may not change any other values or fields in the Calculator.

B. Color Legend Used in the Calculator

The Calculator uses the following color legend to differentiate required inputs, calculated values, etc., described below:

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

C. Calculator Overview

The following table provides an overview of the tabs used in the Simplified CI Calculator (Calculator).

Table C.1. Overview of Tabs Used in the Simplified CI Calculator

Tab Name	Description
RNG Summary	Summary worksheet. Contains an overall summary of the information entered in the "RNG" tab of the calculator, and calculated CIs for wastewater sludge-derived CNG, LNG, and L-CNG. If desired, a **conservative margin of safety** may be added to the calculated CI in this tab in order to establish the final CI, pursuant to section 95488.4(a) of the regulation.
RNG	Main calculation worksheet. Contains the main components of the calculator with fields requiring user inputs, and other intermediate and final parameters calculated by the sheet. Calculations in grayed out cells are automatically calculated but dependent upon input to yellow cells in the corresponding sections of the calculator. This tab also includes CI calculations using inputs in this tab. Additional detailed instructions included below.
EF Table	Reference worksheet. Contains greenhouse gas emissions factors from the CA-GREET3.0 model used in calculation of carbon intensities.
Reference	Reference worksheet. Contains physical property specifications of fuels (i.e., HHV, LHV, density, carbon ratio, etc.), global warming potentials (GWP) of greenhouse gases, unit conversion factors, tailpipe emissions factors, LNG boil-off emissions factors, and other information used for calculating the CIs of the finished fuels.

D. RNG tab

The “RNG” tab contains the main CI calculation worksheet and consists of the following major sections:

- *Section 1. Applicant Information*
- *Section 2. Biomethane Production Data*
- *Section 3. CNG, LNG, and L-CNG Production and Transport Data*
- *Section 4. CI Calculation Details*

Section 1. Applicant Information for Biomethane Production

The following table lists the fields used in Section 1 of the RNG tab.

Table D.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 for LCFS Company ID.
1.3. Facility ID	Enter the Company’s Facility ID. If not available, contact CARB for LCFS Facility ID.
1.4. POTW Name and Location	Name and address of the POTW (Street, City, State).
1.5. LNG Liquefaction Facility Location	Location of the liquefaction facility (Street, City, State).
1.6. Application Number	Enter the application number generated by the AFP.
1.7. CNG Dispensing Station(s) Location	Location of California CNG dispensing station (Street, City, State). For multiple stations, use Bakersfield as the endpoint (the Standard Station Centroid location). See additional details for field 2.11.a below Table D.2.
1.8. LNG Dispensing Station(s) Location	Location of LNG dispensing station (Street, City, State). For multiple stations, calculate a centroid location based on a weighted average of fuel dispensing stations to which LNG is supplied. See additional details for field 3.6.b below Table D.3.
1.9. L-CNG Dispensing Station(s) Location	Location of L-CNG station (Street, City, State). For multiple stations, calculate a centroid based on a weighted average of fuel dispensing stations to which L-CNG is supplied. See additional details for field 3.6.b below Table D.3.

Section 2. Biomethane Production Data

The following table lists the fields used in Section 2 of the RNG tab. Additional details are included below Table D.2.

Table D.2. List of Input Fields for Biogas Processing

Field Name	Description
2.1. Select Regional Electricity Mix for Biomethane	Choose the electricity mix corresponding to the zip code for the region where the biogas upgrading plant is located. The Calculator includes 26 eGRID zone mixes, a Brazilian average mix, a Canadian average mix, and a User Defined Mix to select from in the pull down menu. For facilities in the U.S., select one of the 26 eGRID zones available. If upgrading facility is located outside the U.S., select "User Defined Mix." For facilities which use biogas for electricity production, choose the User Defined Mix option in field 2.1. After selecting an electricity mix option, click the "**Calculate**" button. If the "User Defined Mix" is selected, consult with CARB staff to develop an emissions factor for the User Defined Mix to be input as detailed in field 2.12. Additional details are included below Table D.2.
2.2. Provisional Pathway?	If there is less than 24 months of available data, select "Yes," otherwise choose "No." If the application is for a provisional pathway, input available months of operational data. A minimum of three months of operational data is required to meet provisional pathway certification requirements.
2.3. Monthly Data	Input the months and year(s) corresponding to the operational data provided.
2.4. Digester Gas Flow, (metered)	Input monthly dry digester gas production flow rate data for 24 months of operation. The volume measured must be corrected to 60^{o}F. Specific requirements are detailed below Table D.2.
2.5. Methane Content (% Methane)	Input monthly volume weighted average methane concentration data (measured as dry biogas) for 24 months of operation. Specific requirements are detailed below Table D.2.
2.6. Facility Use of Utility Sourced NG	Input monthly total buyback fossil natural gas use from a pipeline source (or other) in MMBtu from utility invoices (reported in HHV) for 24 months of operation. If buyback gas is used to boost the Btu of biomethane to meet pipeline specifications, do not include this quantity of NG in this field (monthly basis). This will be input separately in field 2.8.
2.7. Facility Electricity Use for Digester Gas upgrading	Input monthly total electricity use from the grid in kWh from utility invoices for 24 months in this field. If biogas-derived electricity is generated on-site, input metered quantity of electricity in this field in addition to ensuring that the emissions factor for the User Defined Mix is included in field 2.12. Electricity produced by the Combined Heat and Power (CHP) unit and consumed by other units of the wastewater treatment plant is considered to be part of the baseline case, and should not be included in the pathway.

2.8. Buy Back fossil NG to boost Btu prior to pipeline injection	Input monthly total quantity of buyback fossil NG (in MMBtu, HHV) in field 2.8 if NG is used to boost biomethane energy content to meet pipeline specification. This quantity is not used in CI calculations. Subtract this quantity of fossil NG when reporting pipeline injected biomethane in field 2.10. See additional details below Table D.2.
2.9. Propane used to boost Btu prior to pipeline injection	Input monthly total quantity of propane (if applicable, in gallons at ambient temperature) in field 2.9 if propane is used to boost biomethane energy content to meet pipeline specification. This quantity is not used in CI calculations. Subtract this quantity of propane when reporting pipeline injected biomethane in field 2.10. See additional details below Table D.2.
2.10. Biomethane injected into pipeline (metered)	Input monthly total biomethane injected into the pipeline in MMBtu (as HHV) for 24 months in field 2.10. The quantity must be supported by the installation of utility grade meters. Subtract monthly total fossil NG, or propane blended with biomethane to meet pipeline specifications from the injected quantity (in MMBtu). See additional details below Table D.2.
2.11. NG pipeline Transmission	This field includes a label for NG pipeline transmission and does not require an input.
2.11.a From upgrading facility to CNG Station	Input distance from biogas processing facility to the intended CNG station in California in field 2.11.a. If fuel is sent to multiple stations, use the Standard Station Centroid of Bakersfield as the endpoint. Additional details can be found below Table D.2.
2.11.b. From upgrading facility to LNG plant	Input distance from biogas processing facility to the liquefaction facility in field 2.11.b. This is required only if the application includes LNG and L-CNG fuel pathways. Additional details can be found below Table D.2.
2.12. Specify GHG Emissions Factor for Electricity Mix	If "User Defined Mix" is selected in field 2.1, consult with CARB staff to develop a user defined GHG emissions factor and input this field in cell K26. Data sources for User Defined electricity mixes must be documented in the Supplemental Documentation attached with the Simplified CI Calculator.
"Calculate" Button	After all data in Section 2 are entered, click the "Calculate" button (cell G22) in Section 2 to calculate CI for the CNG pathway.

Additional Details for Section 2 and Table D.2

Using biogas to generate electricity for biogas upgrading (Field 2.1)

Although the Calculator can accommodate facilities which use biogas to generate electricity for biogas upgrading, applicants must declare the use of on-site electricity generation and consult CARB staff to determine a user-defined emissions factor. A dedicated meter to quantify biogas-derived electricity in kWh must be used to report use of this electricity in the Calculator sheet.

Raw digester gas sourced from the anaerobic digester (Field 2.4)

Requires a dedicated flow measurement system with temperature measurement to enable reporting of the total monthly raw digester gas flow quantity at 1 atmosphere pressure and 60°F (dry gas corrected for moisture). The flow measurement system must be installed upstream of the valve used to divert gas flow to the flare, combined heat and power (CHP) unit, or the feed compressor to the biogas upgrading plant. The system must also be calibrated per manufacturer's requirement and scaled to measure the entire range of potential flow of biogas. Measurement must be continuous and all data must be electronically archived (manual recording is not acceptable). The direct metering of the quantity and percentage methane concentration of biogas captured from the digester are not used in CI calculations, but rather as a check to ensure that total biomethane sales do not exceed the biogas quantity produced or generated in the digester. If biogas is used for electricity generation, applicant must report metered quantity of biogas used for electricity generation in the supplemental document and metered quantity of electricity generated on-site.

Methane content (% Methane in Field 2.5)

Input monthly weighted average methane concentration (dry gas basis) in the digester gas. Methane concentration measurement must be recorded every 15 minutes (at a minimum) with instrumentation capable of electronic archival (manual recording will not be acceptable). The methane measurement system requires calibration per manufacturer's requirement and scaled to measure the entire potential range of methane concentration in the biogas.

Dedicated metering of buyback NG and propane (Field 2.8 and 2.9)

For biogas upgrading facilities which use buyback natural gas (NG) or propane to boost the Btu of biomethane prior to pipeline injection (to meet pipeline specifications), dedicated metering must be installed to substantiate quantities of NG or propane used for this purpose. If dedicated metering is not installed or not verifiable, all NG and propane reported in fields 2.8 and 2.9 respectively, will be added to NG reported in field 2.6 (and considered used for upgrading biogas).

Biomethane injected into the pipeline (Field 2.10)

The monthly total quantity of biomethane input in field 2.10 must correspond to the quantity of biomethane (in MMBtu) injected into the pipeline. However, since this quantity may include NG or propane blended with biomethane to meet pipeline specifications, the use of any non-renewable gas must be explicitly disclosed through invoices. The quantity entered in field 2.10 would include only the biomethane quantity; any fossil inputs must be subtracted from the actual quantity injected into the pipeline that was purchased by the local utility or other party. This reporting is consistent with quantities reported for RIN generation under the RFS, which is based on the Btu of the

pipeline quality biogas after treatment, and prior to any blending with non-renewable fuel or injection into a pipeline.

Note: CI calculations for biomethane are performed on a net MMBtu injected by subtracting all fossil NG and propane inputs (including quantities used in a flare, or thermal oxidizer) from renewable biomethane (in MMBtu) injected into the pipeline.

Pipeline transport distance for renewable natural gas (Fields 2.11.a and 2.11.b)

For pipeline transport distance from a biogas processing facility to a CNG dispensing station or to a liquefaction facility, driving distances between the two locations may be determined using a publicly available web-based driving distance estimator. For RNG to CNG pathways which use multiple dispensing stations, staff used fuel sales data for Q1 and Q2, 2017 and calculated a volume weighted Standard Station Centroid, which was found to be just below Bakersfield. Based on the centroid approach, applicants using multiple dispensing stations may use driving distance from the POTW in the U.S. or Canada, to Bakersfield, California as the pipeline transmission distance in the Simplified CI Calculator (or Tier 2 if applicable). Alternatively, the applicant could choose to use a more conservative value, such as the distance to the farthest fueling facility, in order to minimize the risk of exceeding the certified CI as a result of changes in the supply chain.

Section 3. CNG, LNG and L-CNG Production and Transport Data

Table D.3 provides details of inputs for LNG and L-CNG pathways. Additional details are included below in Table D.3.

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

Field Name	Description
3.1. Select Regional Electricity Mix for LNG Production	Choose the electricity mix corresponding to the zip code for the region where the liquefaction plant is located. The Calculator includes 26 eGRID zone mixes, a Brazilian average mix, a Canadian average mix, and a User Defined Mix in the pull down selection menu. For facilities located in the U.S., select one of the 26 eGRID zones available. After selecting an electricity mix option, click the "**Calculate**" button. Note, if the "User Defined Mix" is selected, consult with CARB staff to develop an emissions factor for the User Defined Mix to be input in field 3.7. Data sources for User Defined electricity mixes must be documented in the Supplemental Documentation included during submission of the Simplified CI Calculator.
3.2. NG from NG purchase invoices	Input monthly total fossil-based NG sourced from a pipeline source (or other) in MMBtu from utility invoices (reported in HHV) for 24 months of operation in field 3.2. The input includes fossil NG used as process fuel and liquefied to LNG. Renewable attributes to support renewable biomethane dispensed must be provided to verifier during on-site audit.
3.3. LNG Production from Production Log	Input monthly total LNG produced in gallons (reported at ambient temperature) for 24 months in field 3.3.
3.4. NG as process fuel (Calculated)	This field calculates NG used as process fuel using inputs in fields 3.2 and 3.3. No user input is required for this field.
3.5. Electricity from Utility Invoices	Input monthly total electricity use from the grid in kWh for the 24 months of operation in field 3.5.
3.6. LNG Transport and Distribution	This field serves as a label for LNG transport and distribution section. No input is required for field 3.6.
3.6.a. Select to affirm LNG delivery trucks are equipped with Boil-Off Recovery	If trucks transporting LNG are equipped to recover "Boil-Off", select "Yes," else "No" in field 3.6.a.
3.6.b. Enter Transport Distance from Liquefaction Plant to dispensing station	Input distance from liquefaction facility to the intended LNG or L-CNG dispensing station in California in field 3.6.b. Additional details are included below Table D.3.

3.7. Specify GHG Emission Factor for Electricity Mix	If "User Defined Mix" is selected in field 3.1, consult with CARB staff to develop a user defined GHG emissions factor, and input this emissions factor into cell S28. Data sources for User Defined electricity mixes must be documented in the Supplemental Documentation attached with the Simplified CI Calculator.
"Calculate" Button	After all data are input in Section 3, click the "Calculate" button (cell R22) to calculate pathway CIs for the LNG and L-CNG pathways.

Additional Details for Section 3

Transport of LNG to dispensing facility (Field 3.6.b)

Driving distance between any two locations may be determined using a publicly available web-based driving distance estimator if fuel is dispensed at a single station. If multiple dispensing facilities are utilized, a volume weighted average transport distance based on 24 months of sales records must be used for LNG distribution to fueling facilities. Alternatively, the applicant could choose to use a more conservative value, such as the distance to the farthest fueling facility, in order to minimize the risk of exceeding the certified CI as a result of changes in the supply chain.

Section 4. CI Calculation Details

This section provides a detailed breakdown of CI calculations using inputs in the RNG tab and applicable reference data. Standard inputs and corresponding GHG emissions are detailed in this section.