Tier 1 Simplified CI Calculator Instruction Manual

Biomethane from Anaerobic Digestion of Wastewater Sludge

March 8, 2023

A. Introduction

This document provides detailed instructions for pathways upgrading wastewater sludge (WWS) to biomethane using the Tier 1 Simplified CI Calculator for Biomethane from Anaerobic Digestion of Wastewater Sludge (T1 WWS Calculator). The T1 WWS Calculator calculates the carbon intensity (CI) of biomethane generated from biogas (also referred to as digester gas) generated by the anaerobic digestion of wastewater sludge at a publicly-owned treatment works and pipeline-injected into a common carrier natural gas pipeline for use as a transportation fuel in California via indirect ("book-and-claim") accounting as compressed biomethane (Bio-CNG), liquified biomethane (Bio-LNG), or liquified biomethane that has been re-gasified at the fueling station (Bio-L-CNG). The model also permits the calculation of CI for biomethane dispensed at the production site without the requirement of book-and-claim.

Download the T1 WWS Calculator here:

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

The T1 WWS Calculator requires the applicant to add monthly operational data, fuel production quantities, and transport distances to calculate the CI of biomethane pathways. Some CARB-approved default and conditional default input values may also be selected.
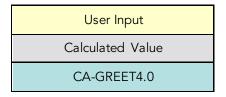
B. T1 WWS Calculator Overview

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

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

Worksheet Name	Description
Introduction	Provides a brief introduction for the Tier 1 WWS Calculator.
Site-Specific Inputs	Worksheet for entering project input data used for calculating the carbon intensity (CI) of the pathway.
Pathway Summary	Contains the calculated CIs for the given pathway based on the data entered in the "Site-Specific Inputs" worksheet. Also contains a section for pathway-specific operating conditions, to be completed by CARB staff prior to pathway certification.
CA-GREET4.0	Reference worksheet. Contains inputs and emission factors from used in calculations of carbon intensities and specifications of fuels, global warming potentials of greenhouse gases, and unit conversion values.

The cells in the T1 WWS calculator have various fill colors per the legend below:

User Input
Calculated Value
CA-GREET4.0

- "User Input" cells must be completed if the input is used by the fuel pathway. If the input is irrelevant, it may be left blank or hidden by deselecting the input checkbox in Section 2. For example, if a pathway uses natural gas as a process energy, the quantity of natural gas used must be entered into the user input cells under the correct field in Section 4. If the pathway does not use natural gas as a process energy, the user input cells in that field may be left blank or hidden by deselecting the appropriate Section 2 checkbox. **All User Inputs are subject to verification as part of initial pathway certification and annual fuel pathway reporting.**
- "Calculated Value" cells contain formula that provide a calculated result based on either user input data or CA-GREET4.0.
- "CA-GREET4.0" cells contain input values from the CA-GREET4.0 model.

Calculated Value formula and CA-GREET4.0 values cannot be modified without written permission from CARB. Approved modifications will elevate the pathway to a Tier 2 application.

C. Site-Specific Inputs Worksheet

The Site-Specific Inputs worksheet contains the main CI calculation worksheet which consists of the following major components:

- Section 1. Applicant Information
- Section 2. Pathway Inputs
- Section 3. Static Operational Data
- Section 4: Monthly Operational Data

All relevant site-specific inputs must be entered in the respective input fields. Once all site-specific inputs for a given facility have been entered, the pathway CIs for the various streams will be displayed in the Pathway Summary worksheet.

Section 1: Applicant Information

Begin by selecting the Site-Specific Inputs worksheet, then enter information for the following input sections listed in Tables C.1 – C.4 below.

Table C.1. Input Field Instructions for Section 1 of the T1 WWS Calculator

Field Name	Description
1.1 Application Number	Enter the application number provided by the AFP.
1.2 Company Name	Enter the company name as entered in the AFP.
1.3 Company ID	Enter the company ID as generated by the AFP. If not available, contact CARB staff.
1.4 Fuel Production Facility ID	Enter U.S EPA Facility ID. If not available, contact CARB staff.

Section 2: Pathway Inputs

Section 2 provides the option to select only input fields that apply to a given pathway, which hides irrelevant inputs in Section 4 of the worksheet. Figure 1 below shows the various input options permitted in the T1 WWS Calculator. If a fuel pathway has additional emissions inside the system boundary that are not listed in Section 2, a Tier 2 application is required to document and account for those emissions.

Section 2: Pathway Inputs	
2.1 Facilty Process Energy Usage	☑ Natural Gas ☑ LPG / Propane ☑ Grid Electricity ☑ Diesel
2.2 Blended Fossil Fuels	☑ Natural Gas ☑ LPG / Propane
2.3 Finished Fuels	☑ Bio-CNG ☑ Bio-LNG ☑ Bio-L-CNG

Figure C.1. WWS Calculator Input Selection Panel

Table C.2. Input Field Instructions for Section 2 of the T1 WWS Calculator

Field Name	Description
2.1 Process Energy	Select the type(s) of process energy used at the fuel production facility.
2.2 Blended Fossil Fuels	Select the type(s) of fossil fuels blended with biomethane prior to pipeline injection, if applicable.
2.3 Finished Fuels	Select the type(s) of finished fuels

Table C.3. Input Field Instructions for Section 3 of the T1 WWS Calculator

Field Name	Description
3.1 Electricity Grid Region	If the biogas upgrading facility uses grid electricity, select the electricity mix corresponding to the region where the facility is located. The calculator includes 27 eGRID zone mixes, Brazilian average mix, Canadian average mix and User Defined Mix included in the drop-down menu. A map of eGRID zones is provide in the "CA-GREET4.0" worksheet. The eGRID region may also be determined using the eGRID Power Profiler tool.
3.2 Grid CI (gCO$_2$e/kWh)	The grid electricity CI will be displayed based on the 3.1 selection. If User-Defined is selected in Field 3.1, consult with CARB to develop an emission factor for a user-defined grid electricity mix.
3.3 Distance to CNG Station (miles)	If applying for a Bio-CNG pathway, enter the distance from the biogas upgrading facility to the CNG fueling station in California. Driving distances between the two locations may be determined using a publicly available web-based driving distance estimator. If pipeline transport serves multiple distribution routes in California, a weighted average distance may be calculated, the California centroid (Bakersfield, CA) may be used, or the distance of the farthest route may be applied.
3.4 LNG Facility ID	Enter U.S EPA Facility ID for LNG or L-CNG production. If not available, contact CARB staff.
3.5 Distance to LNG Facility (miles)	If applying for a Bio-LNG or Bio-L-CNG pathway, enter the distance from biogas processing facility to the liquefaction facility. For pipeline transport distance from a biogas processing facility to a liquefaction facility, driving distances between the two locations may be determined using a publicly available web-based driving distance estimator.

3.6 Liquefaction EF (gCO$_2$e/gallon)	If applying for a Bio-LNG or Bio-L-CNG pathway, enter the most recent validated/verified emission factor for the LNG facility, as calculated using the Tier 1 Simplified CI Calculator for Liquified Natural Gas. Data sources must be documented in the Supplemental Documentation attached with the Simplified CI Calculator.
3.7 LNG Trucking Distance (miles)	Enter distance from liquefaction facility to the intended Bio-LNG or Bio-L-CNG fueling station in California. 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 fueling stations 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, to minimize the risk of exceeding the certified CI as a result of changes in the supply chain.
3.8 LNG Truck Type	Enter the truck type used to transport Bio-LNG to dispensing station(s) in California.

Section 4: Monthly Operational Data

Operational data for all fields selected by the user in Section 2 must be entered into the Fields in Section 4 for each month of the operational data period. Fields that do not apply to the fuel pathway may either be unselected using the Pathway Input options in Section 2 or may be left blank. Any gaps in data reporting must comply with the Missing Data Provisions in LCFS Regulation section 95488.8(k).

Table C.4. Input Field Instructions for Section 4 of the T1 WWS Calculator

Field Name	Description
4.1 Reporting Month (MM/YYYY)	Enter the 24 consecutive months that reflect the most recent operational data available for the Bio-CNG production facility. For fuel production facilities that have been in operation less than 24 months, or for facilities that CARB determines have met the process change requirements of LCFS Regulation section 95488.9(c), the operational data submitted is permitted to range from 3 to 24 months.

4.2 Biogas Collected (ft^3 @ 60°F)	Enter the volume of biogas collected. Requires a dedicated flow measurement system with temperature measurement to enable reporting of gas flow at 1 atm pressure and 60°F (dry gas flow corrected for moisture) to account for monthly total raw biogas volume sourced from the digester collection system. The flow measurement system must 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.
4.3 Methane Content (%V/V CH$_4$/dry LFG)	Enter the weighted average methane content of the biogas on a volumetric, moisture-corrected basis. Methane 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.
4.4 Natural Gas (MMBtu, HHV)	Enter the quantity of natural gas used by the fuel production facility as process energy, excluding natural gas used for blending prior to injection. If dedicated metering for natural gas used for blending is not installed or not verifiable, all NG used by the facility must be reported and considered used for upgrading biogas.
4.5 Grid Electricity (kWh)	Enter the quantity of grid electricity used by the fuel production facility as process energy.
4.6 LPG or Propane (Gallons)	Enter the quantity of liquified petroleum gas (LPG) or propane used by the facility as process energy, including any quantity used for flaring and excluding any quantity used for blending prior to injection. If dedicated metering for LPG or propane used for blending is not installed or not verifiable, all LPG or propane used by the facility must be reported (and considered used for upgrading biogas)
4.7 Diesel (Gallons)	Enter the quantity of diesel fuel used by the fuel production facility as process energy.
4.8 Natural Gas Blended (MMBtu, HHV)	Enter the quantity of natural gas blended with biomethane and injected into the common carrier pipeline. Dedicated metering must be installed to substantiate quantities of NG used for this purpose.
4.9 LPG / Propane Blended (gallons)	Enter the quantity of LPG or propane blended with biomethane and injected into the common carrier pipeline. Dedicated metering must be installed to substantiate quantities of LPG or propane used for this purpose.
4.10 Total Gas Injected	Enter the total quantity of gas injected into the common carrier pipeline, including any blended gas in 4.8 and 4.9. Quantities should match financial transaction records between the injecting party and the pipeline operator.

D. Pathway Summary Worksheet

The Pathway Summary worksheet aggregates site-specific user input data to calculate the carbon intensity of each fuel pathway in the T1 WWS Calculator. This worksheet also serves as a location where a Margin of Safety may be added to each pathway CI prior to pathway certification and pathway-specific Operation Conditions may be added by CARB staff.

The top sections of this worksheet (Applicant Information, Finished Fuel Quantities) provide a summary of site-specific inputs entered by the user. In the T1 WWS Calculator, the total energy (in mmBtu) embedded in fossil fuel used as process energy (natural gas, LPG or propane, and diesel) is subtracted from the quantity of injected gas.

The Carbon Intensity (CI) Calculations Section of this worksheet provides a summary of each fuel production stage along with its calculated emissions and stage-specific CIs. The CIs are then summed to provide a CI associated with the CNG pathway. The applicant may opt to apply a conservative margin of safety to the fuel pathway CI to ensure that the pathway remains compliant with certified CIs.

The final section of this worksheet provides a space for CARB staff to publish Operating Conditions associated with the pathway.

E. CA-GREET4.0 Worksheet

The CA-GREET4.0 Worksheet contains predefined input values from several sources, including Argonne National Labs GREET 2022,[1] EPA eGRID,[2] CARB EMFAC,[3] Purdue University GTAP and Stanford OPGEE[4] models. These input values cannot be modified without written permission from CARB and will elevate the pathway application to a Tier 2 status.

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[1] https://greet.es.anl.gov/index.php
[2] https://www.epa.gov/egrid
[3] https://arb.ca.gov/emfac/
[4] https://eao.stanford.edu/research-project/opgee-oil-production-greenhouse-gas-emissions-estimator