Life-Cycle Carbon Intensity Analysis Report: Dairy Manure Biogas to Compressed Natural Gas Pathway for Calumet-Grotegut

GREET modeling technical support document

Table of Contents

List of Tables

I. Introduction

This life-cycle carbon intensity (CI) analysis was performed to support a California LCFS Tier 2 pathway application for the compressed natural gas (CNG) produced by Calumet-Maple Leaf/Grotegut renewable natural gas (RNG) facility. This analysis is only associated with the portion of the CNG that is produced from the biogas generated by the anaerobic digester (AD) at the Grotegut Dairy Farm. Therefore, for the remainder of this report, this pathway will be referred to as the Calumet-Grotegut pathway. Based on the life-cycle modeling using a modified Tier 1 Simplified CI Calculator for Biomethane from Anaerobic Digestion of Dairy and Swine Manure [1], the CI of the CNG in this pathway is **-236.96 gCO_2e MJ^{-1}**, based off operational data from September 2019 to January 2020.

The Calumet-Grotegut pathway meets all the requirement of a typical Tier 1 dairy manure biogas to CNG pathway, except that the metered total methane quantity is less than 98% of the methane in the inlet into the upgrading system. In order to address this issue, this Tier 2 pathway application is submitted.

II. Facility Details

The Calumet-Maple Leaf/Grotegut RNG facility is a biogas upgrading facility which produces pipeline quality renewable natural gas and injects such renewable natural gas into an interstate pipeline. The injected renewable natural gas is then taken out in CA by downstream dispensing entities and used as a transportation fuel in the form of CNG via "book and claim accounting".

The facility is located at 8900 Newton Road, Newton, WI 53063. The facility receives raw biogas via pipeline from three ADs at three dairy farms- Maple Leaf East (MLE), Maple Leaf West (MLW) and Grotegut. Each of the three farms have been registered as intermediated facilities in the AFP system. Grotegut Dairy Farm is located at 7427 Newton Road, Newton, WI 53063. The Calumet-Maple Leaf/Grotegut facility also serves as a pipeline interconnect that receives trucked-in upgraded pipeline quality biomethane from two other RNG facilities- Calumet-Dairy Dreams RNG facility and Calumet-Ponderosa RNG facility, which also use dairy manure biogas feedstock.

A site visit for a 3rd party Engineering Review was performed by Paul Mordorski, PE on May 22nd, 2019. And the 3rd party Engineering Review was completed by Weaver and Tidwell, LLP. Figure 1 is a simplified process flow diagram describing the set up of the system. Figure 2 shows the metering set up of the system. Both figures can be found in the 3rd party Engineering Review document which is submitted as a supporting document. See Attachment 1- Process Description for a detailed process description. See Attachment 2- Detailed PFDs for detailed process flow diagrams. See Attachment 3- Detailed Metering Setup for the detailed locations and descriptions of the metering setup. All three attachments, and other details and related information to the facility and the pathway can also be found in the 3rd party Engineering Review.

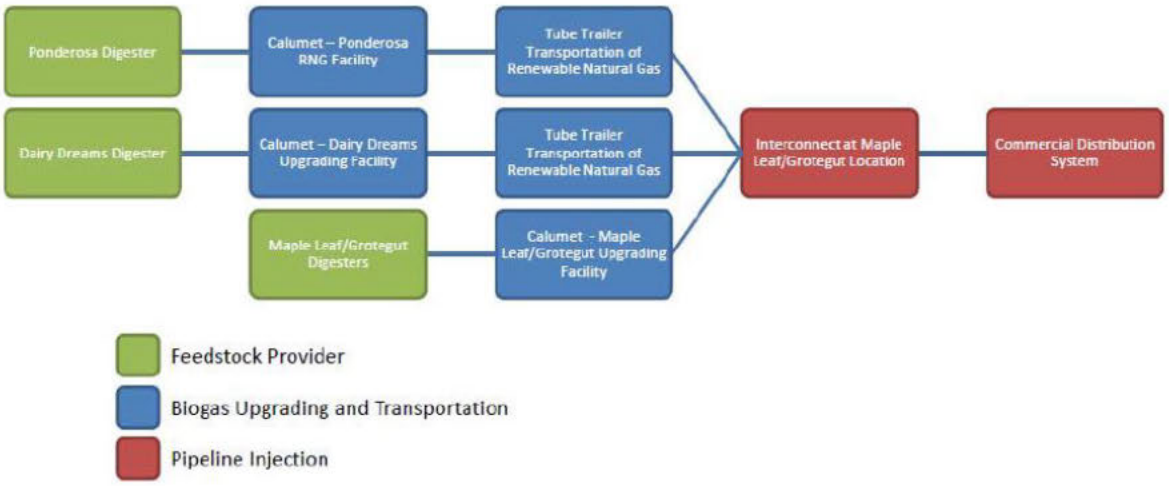


Figure 1. Simplified process flow diagram of the overall Calumet project system

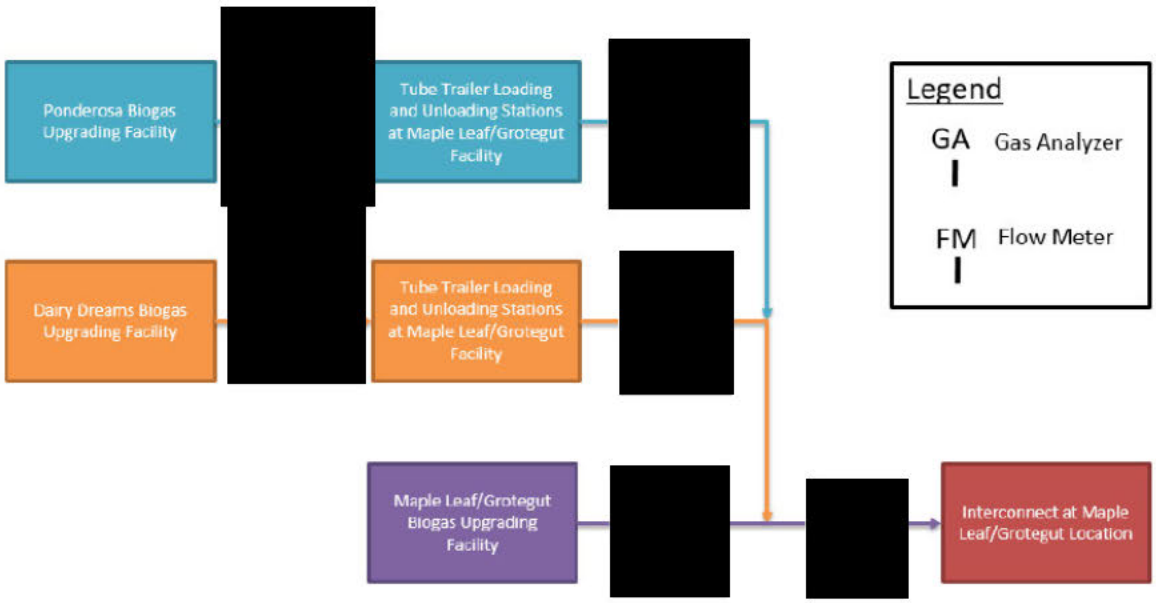


Figure 2. Metering set up diagram for the Calumet project system

Under USEPA's RFS program, the Calumet-Maple Leaf/Grotegut RNG facility is capable of producing:

- Renewable Compressed Natural Gas (Fuel Category Code 190) and Renewable Liquified Natural Gas (Fuel Category Code 200) under a D code of 3 utilizing Biogas from agricultural digesters (Feedstock Code 333) using a Renewable CNG/LNG Production Process (Process Code 851)

The facility is currently operating under an Air Permit issued by the Wisconsin Department of Natural Resources on July 25, 2018 (See 3rd Party Engineering Review). Page 9 of the Air Permit specified a maximum allowable production rate of [redacted] SCFM. The maximum allowable volume output of the Facility is [redacted] ethanol gallons equivalent per year based on the 3rd Party Engineering Review.

III. Input and the Basis of Input to the Modified Tier 1 Calculator

This section describes the input to the modified Tier 1 calculator, and the modification needed to account for the fugitive emission related CI. The general concepts and information are introduced in this section, and detailed information can be found in Attachment 4- Calumet-Grotegut Dairy Manure CNG Pathway Changes.

Manure-to-Biogas (LOP Inputs)

In the baseline scenario, 100% of the manure was sent to the anaerobic lagoons, and sludge was never removed from the lagoons in the baseline. In the project scenario, manure is scraped from barns and sent to the digesters. All manure is sent to the digesters. Solids are separated from the digester effluent by two screw presses. The solids are stacked until they are used as bedding and the remaining effluent is stored in the effluent pond. Section L4 is to determine the emissions from the VS going into the effluent pond. It started from the parameter “L4.5 Fraction of Volatile Solids Sent to BCS System", and assumes 30% of the VS sent to the BCS system will be in the digestate and sent to effluent pond. This is correct when no solid separation is applied to the digestate. However, if there is a backend solid separation applied to the digestate like the screw press in this pathway, it should be reflected in “L4.5 Fraction of Volatile Solids Sent to BCS System" because there is nowhere else to put that in. In this pathway, the digestate goes through a screw press and by default the efficiency of a screw press is 25%. This means, actually only [redacted] of the VS going into the digester actually is sent to effluent pond. The 30% is reflected in cell G82, and the [redacted] should be reflected in cell F82. L4.5’s description really should be “Fraction of the fraction of Volatile solids sent to BCS system that is sent to effluent pond”. Section L5 reflected the separated solids used as bedding. 30% of the VS entering AD ends up in the digestate per CARB default assumption. Then, 25% of this 30% is separated out, resulting in [redacted] VS used for animal bedding.

The manure treatment in both the baseline and project scenarios are in line with the 3rd party verification report under the Cap-and-Trade program.

The volatile solids (VS) carryover for the project was calculated based on assuming [redacted] VS was in the lagoons in January 2018, which is a conservative assumption as the lagoon was never cleaned out and at January 2018, there should have been VS existing in the lagoons.

Avoided Emissions

The dairy farm has a constructed anaerobic digester on site, which is considered "Enclosed Vessel" in the calculation.

Biogas-to-RNG

Production data from September 2019 to Jan 2020 was used for this pathway application.

Specifically, additional fugitive emissions beyond the 2% default value are calculated by subtracting measurable CH_4 from the amount of methane at the inlet to the upgrading system.

EF Table

Cell E86 was modified to add the additional fugitive emissions beyond the 2% default value.

Upgrading-Allocation

This tab was added to the Tier 1 Calculator to allocate the process energy, flared gas, and injected gas to three ADs that provide raw biogas to the one centralized upgrading system. See Attachment 4- Calumet-Grotegut Dairy Manure CNG Pathway Changes for details.

IV. Modified Tier 1 Calculator Output

Table 1 shows the CI results for the CNG produced by Calumet-Grotegut, which is -236.96 g CO_2e MJ^{-1}.

Table 1: Emissions (g CO_2e MJ^{-1}) from CNG produced by Calumet-Grotegut, separated by life cycle stage. Figures are rounded.

Stage of life-cycle	CI (g CO_2e MJ^{-1})
Manure handling and AD	[redacted]
Biogas upgrading	[redacted]
Biomethane flaring	[redacted]
Fugitive	[redacted]
Transmission	[redacted]
Compression	3.50
tailpipe	60.73
Avoided emissions credits	[redacted]
Total	**-236.96**

V. Production Range

This pathway should be applicable for 100% of the portion of the CNG produced at the Calumet-Maple Leaf/Grotegut facility that is associated with the biogas from the Grotegut Dairy Farm.

VI. Sustainability

The Calumet Maple Leaf/Grotegut facility was designed and constructed using established modern designs and equipment. The facility is managed by professional and qualified staff to ensure that the energy efficiency of, and emissions from, the facility do not deteriorate over time. Any deterioration in efficiency would result in a less profitable business. Therefore, the sustainability of the plant is aligned with the business objectives of the owners for a highly efficient facility.

VII. Impact on Land Use

The CNG product in this pathway has a land use change (LUC) value of 0, as it is generated from dairy manure which is classified as a waste feedstock.

VIII. Conclusion

Based on our modeling in the modified Tier 1 Calculator and available data, the CNG produced by Calumet-Grotegut has a carbon intensity of -236.96 **g CO_2e MJ^{-1}.**

IX. References

[1] California Air Resources Board. CA-GREET3.0 Model and Tier 1 Simplified Carbon Intensity Calculators. Available 03/22/2020, at https://ww2.arb.ca.gov/resources/documents/lcfs-life-cycle-analysis-models-and-documentation

Attachment 1

Process Description

Calumet-Maple Leaf/Grotegut RNG Facility Process Description for RFS and LCFS Registration

July 15, 2019

The following is a project description and engineering document for the Calumet-Maple Leaf/Grotegut RNG Facility ("Facility"). The Facility will upgrade digester gas from dairy manure into RNG that will be compressed and injected into the [redacted] pipeline located in Newton, Wisconsin.

This document was prepared for RFS and LCFS registration and should be treated as confidential business information.

I. Name and Location of Farms:

a. Grotegut Dairy Farm, Inc.
7427 Newton Road
Newton, WI 53063

b. Maple Leaf Dairy, Inc. - East
6832 County Rd X
Cleveland, WI 53015

c. Maple Leaf Dairy, Inc. - West
7920 County Trunk Highway X
Cleveland, WI 53015

II. Manure Management Process Description

a. Manure coming from the various barns is accumulated at a common collection point before being routed to the digester to extract the gas;
b. At this point the manure is high in volatile solids before it breaks down further into digestate;
c. The resulting digestate is sent through screw presses to separate the solids and liquids:
d. The liquid goes to the lagoon to be sprayed onto the crop fields, whereas the solids become a dried fiber that gets used for bedding.

III. RNG Plant Process Description

a. Digester gas from each of the farms is sent to the [redacted] by means of [redacted];
b. Then to the [redacted], where free liquids from saturated gas are returned to the digester;
c. Then to the [redacted] where up to [redacted] of [redacted] is compressed to [redacted];
d. Then to the [redacted], where the compressed gas is cooled to [redacted];
e. Then to the [redacted], where additional [redacted] are returned to the digester;
f. Then to the [redacted], to preheat the gas going into the [redacted];
g. Then to the [redacted], to remove [redacted] and [redacted], where [redacted] is sent to the [redacted];
h. Then to the [redacted], where processed gas is further stripped of [redacted] then sent to the next [redacted], to further remove residual [redacted] and [redacted] where [redacted] is sent to the [redacted];
i. Then to the [redacted], where the gas is reheated for the next stage of [redacted];
j. Then to the [redacted], to further remove [redacted] and [redacted], where [redacted] gas is sent back to the [redacted], as part of the [redacted];
k. Then to the [redacted], for final [redacted] removal, where off-spec gas is sent to the [redacted];
l. Then to the [redacted], where the gas is compressed to [redacted];
m. Then to the [redacted], to cool the gas down to pipeline spec [redacted]

n. Then to the [redacted], to remove [redacted] and [redacted] before injecting into the [redacted].
o. Engineering specifics can be found in the Process Flow Diagrams.

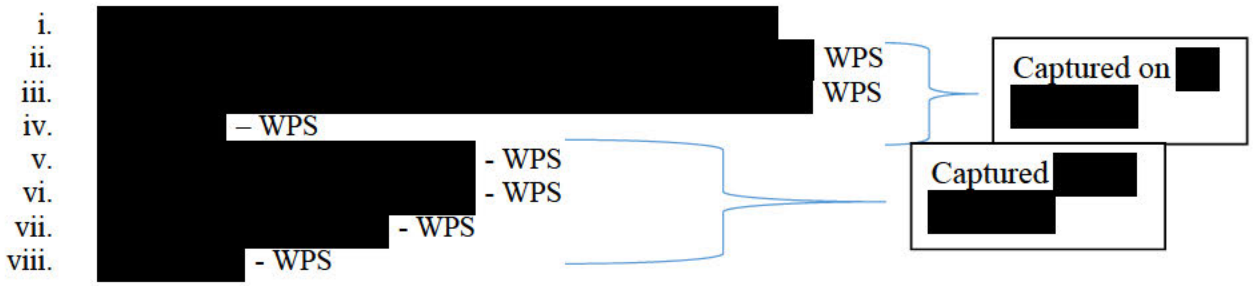
IV. Summary of Gas Collection and Injection

a. If the [redacted] are not running, the digester gas will be sent to the [redacted] for destruction. If only the [redacted] is down then the digester gas will be sent to the [redacted] for destruction, otherwise the gas will be gathered from the existing digester at a slightly positive, natural pressure, compressed and sent through [redacted] for purification.
b. The [redacted] coming from the [redacted] will be scrubbed for [redacted] that will then be sent to the [redacted] for destruction. Upon [redacted] if the purified gas does not meet [redacted] it will be sent to [redacted], otherwise it will then be compressed to [redacted] for pipeline injection in [redacted].
c. A [redacted] will be used for the process described above at the [redacted] owned and operated by the pipeline owner, [redacted]. [redacted] has specified a [redacted] for custody transfer at the [redacted]. There will also be a [redacted] or [redacted] and a [redacted] at this location.

V. Metering/Monitoring Plan

a. [redacted] will be installed at the following locations to measure [redacted] and other constituents [redacted]. The [redacted] will be converted to [redacted] for reporting purposes.
   i. [redacted]
   ii. [redacted]
   iii. [redacted]
   iv. [redacted]
b. [redacted] will be installed at the following locations to measure [redacted]. These values will then be compiled in [redacted] for reporting purposes.
   i. [redacted]
   ii. [redacted]
   iii. [redacted]
   iv. [redacted]
   v. [redacted]
   vi. [redacted]
   vii. [redacted]
c. The [redacted] and [redacted] values will be used to calculate the [redacted] at the locations in V.b above.
d. [redacted] are installed for the following locations and included on the [redacted] invoices:
   i. [redacted]
   ii. [redacted] - WPS
   iii. [redacted] - WPS
   iv. [redacted] - WPS
   v. [redacted] - WPS
   vi. [redacted] - WPS
   vii. [redacted] - WPS
   viii. [redacted]
   ix. [redacted] - WPS

   Captured on [redacted]
e. [redacted] are installed for the following locations and included on the [redacted] invoices:



VI. Downstream Production Process

i) The [redacted] produced by the Facility may be used [redacted] via contractual arrangements with no modifications to the existing facility. [redacted] and [redacted] provided affidavits affirming relevant contract information. The affidavits both state that the agreement is for the sale of [redacted]. [redacted] owns and operates the [redacted] and produces [redacted].

ii) [redacted] has the ability to allocate biogas through the [redacted]. CE owns and operates a network of [redacted] through which it purchases, sells, and dispenses biogas as a transportation fuel.

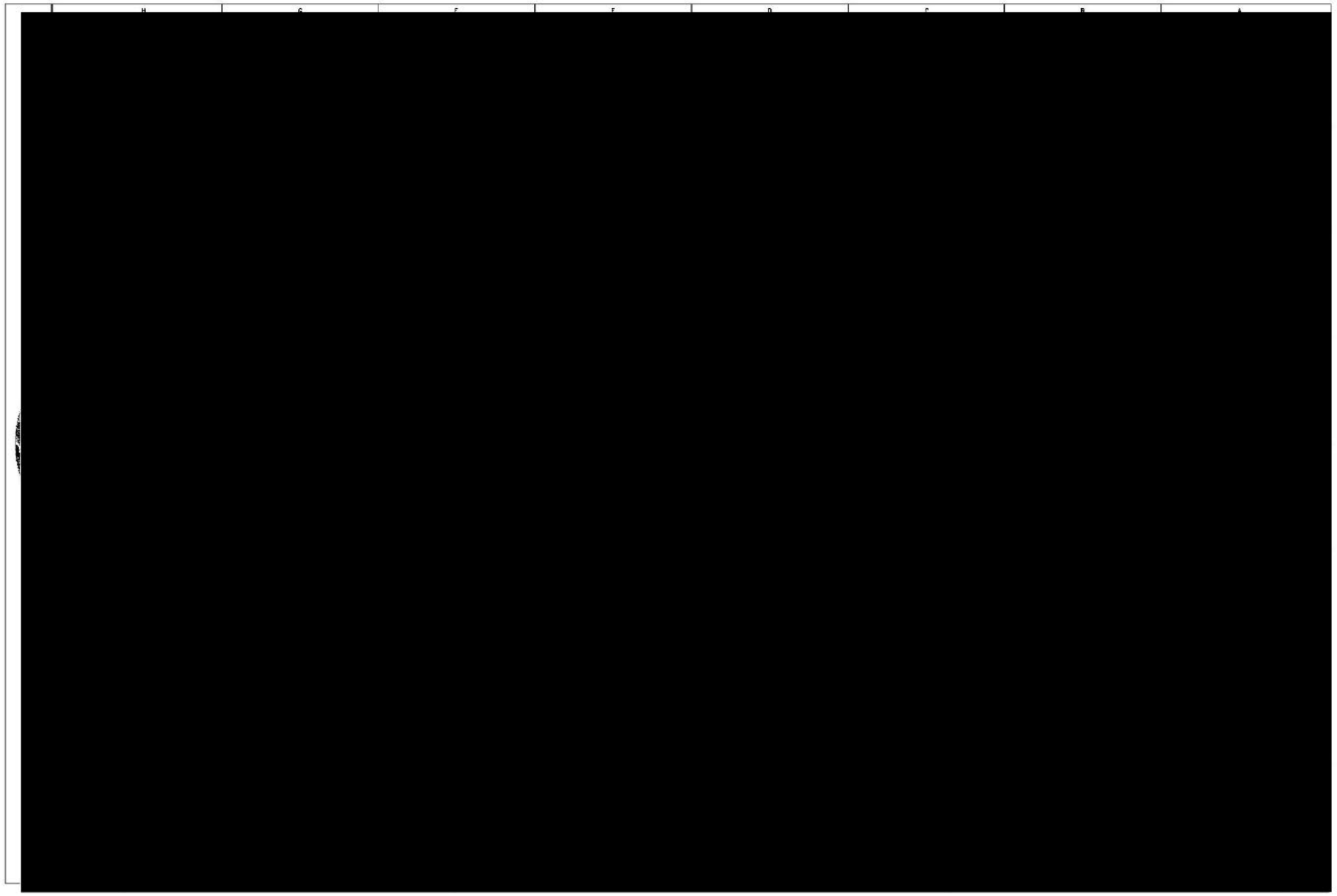
iii) [redacted] also has contracts with the following entities for the purchase and sale of biogas for use as a transportation fuel: [redacted]

iv) The physical pathway table and maps are provided in Attachment Q. These describe how the [redacted] at the [redacted] are physically connected to the qualified dispensing locations listed in the [redacted] affidavit.

Attachment 2

Detailed PFDs

Maple Leaf & Grotegut Gathering Line



Maple Leaf & Grotegut Gas Processing System

Maple Leaf & Grotegut Tox & Flare

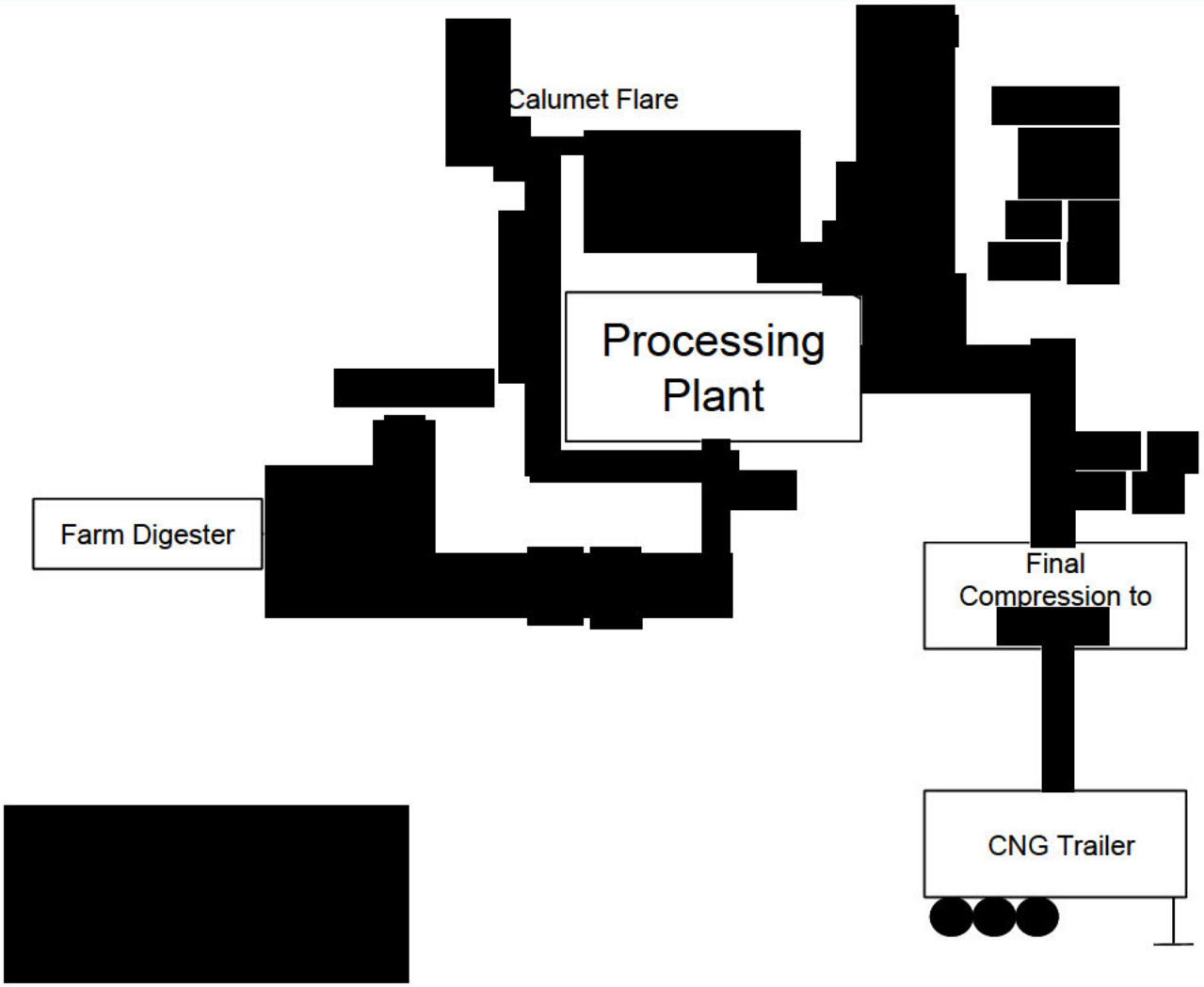
Maple Leaf & Grotegut Pipeline Injection

Attachment 3

Detailed Metering Setup

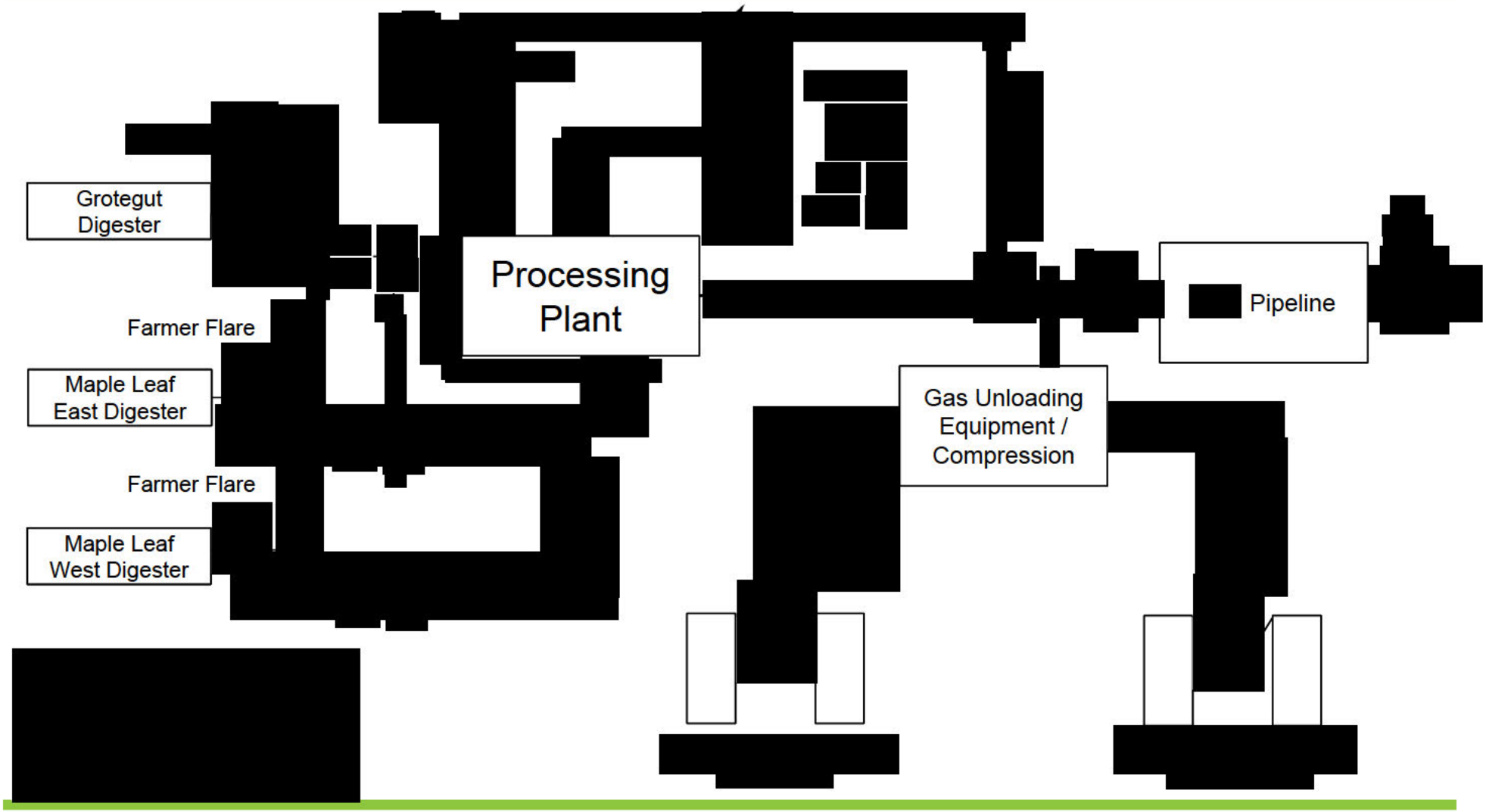
[redacted] Ponderosa/Dairy Dreams Metering Setup

DTE Biomass Energy



Maple Leaf/Grotegut Interconnect Metering Setup

DTE Biomass Energy



Attachment 4

Calumet-Grotegut Dairy Manure CNG Pathway Changes

Manure to Biogas (LOP Inputs) tab

Cells	Data input	Value	Note	Primary Data Source	Secondary Data Source	Additional Data Source
C8 to C19	L1.1.5 **Reporting Month (MM/YYYY)**	[redacted]	[redacted]			
D8 to D19	L1.1.6 **Livestock Population**	Varies	[redacted]	F le Calumet He d Count Summa y 3.21.2020	F les Da y Comp Mon to Repo ts	
G8 to G19	L1.1.9 **Average Temperature**	Varies	[redacted]	Folde Monthly Tempe atu e Data		
I8 to I19	L1.1.11 **Fraction of Volatile Solids Sent to Anaerobic Storage/Treatment System**	[redacted]	Basel ne scena o, see Cap and T ade Repo ts fo efe ence	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
K8 to K19	L1.1.13 **Retention Time and Drainage**	Varies	B l C T R t f f	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
L8	L1.1.14 **Carryover from Previous Month**	[redacted]	[redacted]	F le Copy of t e 1-dsm-calculato -co ected to calculate 2018 to 2019 Jan ca yove fo G otegut 08072020		
R8 to R19	L1.2.6 **Livestock Population**	Varies	[redacted]	F le Calumet He d Count Summa y 3.21.2020	F les Da y Comp Mon to Repo ts	
U8 to U19	L1.2.9 **Average Temperature**	Varies	[redacted]	Folde Monthly Tempe atu e Data		
W8 to W19	L1.2.11 **Fraction of Volatile Solids Sent to Anaerobic Storage/Treatment System**	[redacted]	Basel ne scena o, see Cap and T ade Repo ts fo efe ence	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
Y8 to Y19	L1.2.13 **Retention Time and Drainage**	Varies	Basel ne scena o, see Cap and T ade Repo ts fo efe ence	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
Z8	L1.2.14 **Carryover from Previous Month**	[redacted]	[redacted]	F le Copy of t e 1-dsm-calculato -co ected to calculate 2018 to 2019 Jan ca yove fo G otegut 08072020		
AF8 to AF19	L1.3.6 **Livestock Population**	Varies	[redacted]	F le Calumet He d Count Summa y 3.21.2020	F les Da y Comp Mon to Repo ts	
AI8 to AI19	L1.3.9 **Average Temperature**	Varies	[redacted]	Folde Monthly Tempe atu e Data		
AK8 to AK19	L1.3.11 **Fraction of Volatile Solids Sent to Anaerobic Storage/Treatment System**	[redacted]	Basel ne scena o, see Cap and T ade Repo ts fo efe ence	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
AM8 to AM19	L1.3.13 **Retention Time and Drainage**	Varies	B l C T R t f f	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
AN8	L1.3.14 **Carryover from Previous Month**	[redacted]	[redacted]	F le Copy of t e 1-dsm-calculato -co ected to calculate 2018 to 2019 Jan ca yove fo G otegut 08072020		
AT8 to AT19	L1.4.6 **Livestock Population**	Varies	[redacted]	F le Calumet He d Count Summa y 3.21.2020	F les Da y Comp Mon to Repo ts	
AW8 to AW19	L1.4.9 **Average Temperature**	Varies	[redacted]	Folde Monthly Tempe atu e Data		
AY8 to AY19	L1.4.11 **Fraction of Volatile Solids Sent to Anaerobic Storage/Treatment System**	[redacted]	Basel ne scena o, see Cap and T ade Repo ts fo efe ence	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
BA8 to BA19	L1.4.13 **Retention Time and Drainage**	Varies	B l C T R t f f	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
BB9	L1.4.14 **Carryover from Previous Month**	[redacted]	[redacted]	F le Copy of t e 1-dsm-calculato -co ected to calculate 2018 to 2019 Jan ca yove fo G otegut 08072020		
BS2 to BS6	L3.1 **Reporting Month(MM/YYYY)**	Varies	[redacted]			
F82 to F85	L4.5 **Fraction of Volatile Solids Sent to BCS System**	Varies	Sc ew p esses a e used to sepa ate VS out of the effluent. As a esult, a default value of 25% s appl ed, esult ng n 75% sent to BCS system effluent pond	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
B97	L5.1.b **Non-anaerobic Storage/Treatment Systems**	[redacted]	VS sepa ated out of the effluent s used fo an mal bedd ng	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	
D97 to G97	L5.3 **Manure Managed in Non-BCS (Other) Systems (MSLS, fraction)**	Varies	Sc ew p esses a e used to sepa ate VS out of the effluent. As a esult, a default value of 25% s appl ed. Th s s a conse vat ve est mate as AD tself dest oys the majo ty of the VS al eady	Folde Cap and T ade documents	F le Basel ne Manu e Management Plan	

Avoided Emissions tab

Cells	Data input		Note	Primary Data Source	Secondary Data Source	Additional Data Source
C4	P1.1 **Select Digester Type**	Enclosed Vessel	Enclosed Vessel			

Biogas-to-RNG tab

Cells	Data input		Note	Primary Data Source	Secondary Data Source	Additional Data Source
C15 to G20	**Section 1. Applicant Information**	Site specific	Fac l ty spec f c nfo mat on	F le FINAL Calumet - Maple Leaf G otegut RNG Fac l ty Eng nee ng Rev		
D24	2.1 **Select Electricity Mix for Biomethane**	11-MROE Mix	F l t W h h l t 11-MORE			
C28 to C32	2.4 **Total Raw Biogas Flow, (metered)**	Varies	[redacted]	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde P oduct on Data	
D28 to D32	2.5 **Biomethane Content (% Methane)**	Varies	Measu ed at the fa m (d geste outlet)	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde P oduct on Data	
E28 to E32	2.6 **Raw Biogas Flow to Upgrading, (metered)**	Varies	Total flow ente ng the fac l ty f om the G otegut fa m d geste	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde P oduct on Data	
F28 to F32	2.7 **Biomethane Content (% Methane)**	Varies	Same as the values measu ed at the fa m	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde P oduct on Data	
G28 to I32	**Baseline energy use**	Varies	Conse vat vely assumed at D fo all basel ne ene gy use			
J28 to J32	2.11 **Grid Electricity (for digester heating)**	Varies	G d elect c ty consumed fo the d geste at the fa m	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde Ut l ty nvo ces	F le Calumet Ut l t es Info 5.1.2020
L28 to L32	2.13 **Utility Sourced NG (digester project)**	Varies	Ut l ty sou ce NG consumed fo the d geste at the fa m	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde Ut l ty nvo ces	F le Calumet Ut l t es Info 5.1.2020
N28 to N32	2.15 **Utility Sourced NG (upgrading and compression)**	Varies	Ut l ty sou ce NG consumed at the upg ad ng fac l ty, allocated p opo t ona ly to MLE, MLW and G otegut based on the f nal p oduct on volume.	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde Ut l ty nvo ces	F le Calumet Ut l t es Info 5.1.2020
Q28 to Q32	2.18 **Grid Electricity (upgrading and compression)**	Varies	G d elect c ty consumed at the upg ad ng fac l ty, allocated p opo t onally to MLE, MLW and G otegut based on the f nal p oduct on volume.	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde Ut l ty nvo ces	F le Calumet Ut l t es Info 5.1.2020
T28 to T32	2.21 **Flared gas including tailgas from upgrading, (metered biogas)**	Varies	Include all b ogas dest uct on st eams at plant bes des njected st eams - DTE candlest ck fla e and the mal ox d ze	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020		
U28 to U32	2.22 **Biomethane Content (% Methane in Flared Gas)**	Varies	We ghted ave age value	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020		
V28 to V32	2.23 **Biomethane Injected into Pipeline for Transportation Fuel Production (metered), (subtract buyback NG and Propane if used to boost Btu)**	Varies	[redacted]	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde ANR Inject on Statements	
Z34	2.27.a **From upgrading facility to CNG station.**	[redacted]	[redacted]	F le D stance f om Newton to Bake sf eld CA		
D52	**Weighted average CH4 content of raw biogas**	=IFERROR(SUMPRODUCT(C28:C39/SUM(C28:C39) D28:D39) 0)				
F52	**Weighted average CH4 content of raw biogas at inlet of upgrading**	=IFERROR(SUMPRODUCT(E28:E39/SUM(E28:E39) F28:F39) 0)				
U52	**Weighted average CH4 content of total flared gas**	=IFERROR(SUMPRODUCT(T28:T39/SUM(T28:T39) U28:U39) 0)				

EF Table tab

Cells	Data input		Note	Primary Data Source	Secondary Data Source	Additional Data Source
E86	**Fugitive methane from upgrading (%)**	**=1-('Biogas-to-RNG'!V55 'Biogas-to-RNG'!U55)/'Biogas-to-RNG'!F55**	Cons de ed the total losses between the fac l ty nlet and [redacted] tatement value. Th s ncludes all the fug t ve em ss ons nclud ng upg ad ng and t ansm ss on to the n ect on po nt. Anyth ng beyond the 2% defau t value s added on top of the 2%.	Calculated		

Upgrading-A location tab- Added as provided by CARB staff

Cells	Data input	Value	Note	Primary Data Source	Secondary Data Source	Additional Data Source
A1-M11	**Table 1. Determination of Monthly Allocation of Total Upgrading Energy to Multiple Digesters**					
	Mete ed B ogas (SCF) at Inlet to Upg ad ng	Va es	Sum of fa m fla e and flow to the upg ad ng fac l ty	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde P oduct on Data	
	Mete ed % Methane Concent at on at Inlet to Upg ad ng	Va es	Measu ed at the fa m (d geste outlet)	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde P oduct on Data	
	(B ogas-to-RNG f eld 2.6 x 2 7)	Va es	Total flow ente ng the fac l ty f om the G otegut fa m d geste	Calculated	Folde P oduct on Data	
	% Allocated to each D geste	Va es	Same as the values measu ed at the fa m	Calculated	Folde P oduct on Data	
A14-J27	**Table 2. Upgrading Facility - Total (pre-allocat on)**					
	2.15 **Utility Sourced NG (upgrading and compression)**	Varies	Total fo the upg ad ng system	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde Ut l ty nvo ces	F le Calumet Ut l t es Info 5.1.2020
	2.18 **Grid Electricity (upgrading and compression)**	Varies	Total fo the upg ad ng system	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde Ut l ty nvo ces	F le Calumet Ut l t es Info 5.1.2020
	2.21 **Flared gas including tailgas from upgrading, (metered biogas)**	Varies	Total fo the upg ad ng system	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020		
	2.22 **Biomethane Content (% Methane in Flared Gas)**	Varies	Total fo the upg ad ng system	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020		
	2.23 **Biomethane Injected into Pipeline for Transportation Fuel Production (metered), (subtract buyback NG and Propane if used to boost Btu)**	Varies	Total fo the upg ad ng system	F le Maste Data Repo t - RINs & LCFS.v2 ZW 03212020	Folde ANR Inject on Statements	

A29-J41	**Table 3. Upgrading and compression energy use (Project) - Allocated to Grotegut**					
	2.15 Utility Sourced NG (upgrading and compression)	Varies	Allocated to nd v dual AD	Calculated		
	2.18 Grid Electricity (upgrading and compression)	Varies	Allocated to nd v dual AD	Calculated		
	2.21 Flared gas including tailgas from upgrading, (metered biogas)	Varies	Allocated to nd v dual AD	Calculated		
	2.22 Biomethane Content (% Methane in Flared Gas)	Varies	Allocated to nd v dual AD	Calculated		
	2.23 Biomethane Injected into Pipeline for Transportation Fuel Production (metered), (subtract buyback NG and Propane if used to boost Btu)	Varies	Allocated to nd v dual AD	Calculated		
O15-W23	**Table 4. %Allocation used for injected fuel**	Varies	Allocat on of n ected gas f om [redacted] statements to nd v dual AD:	F om da ly data n Summa y_P vot tab of monthly nte connect data f le		

Attachment 5

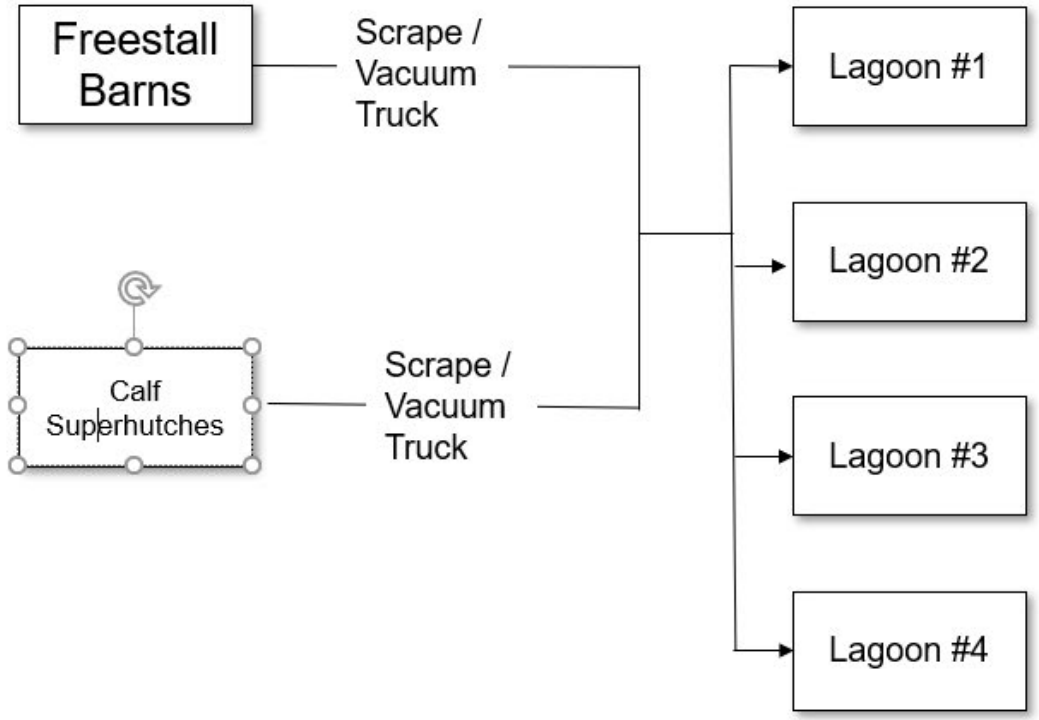
Description of Manure Handling System Pre- and Post-BCS

Grotegut

1) How the manure was collected (e.g., scrape, flush, vacuum) - pre and post-BCS?
    a. In both the pre and post BCS scenarios, manure is conveyed via [redacted] and deposited in the lagoon (pre BCS) or digester (post-BCS)
2) Number of lagoons per dairy farm - pre and post-BCS?
    a. The project has [redacted] lagoons in the baseline and [redacted] lagoons in the project scenario
3) Movement of manure from freestalls/open corrals to anaerobic lagoon - pre and post-BCS
    a. In both the pre and post BCS scenarios, manure is conveyed via [redacted] and deposited in the lagoon (pre BCS) or digester (post-BCS)?
4) Which farm sends manure to this digester?
    a. The Grotegut digester only receives manure from the Grotegut dairy farm.

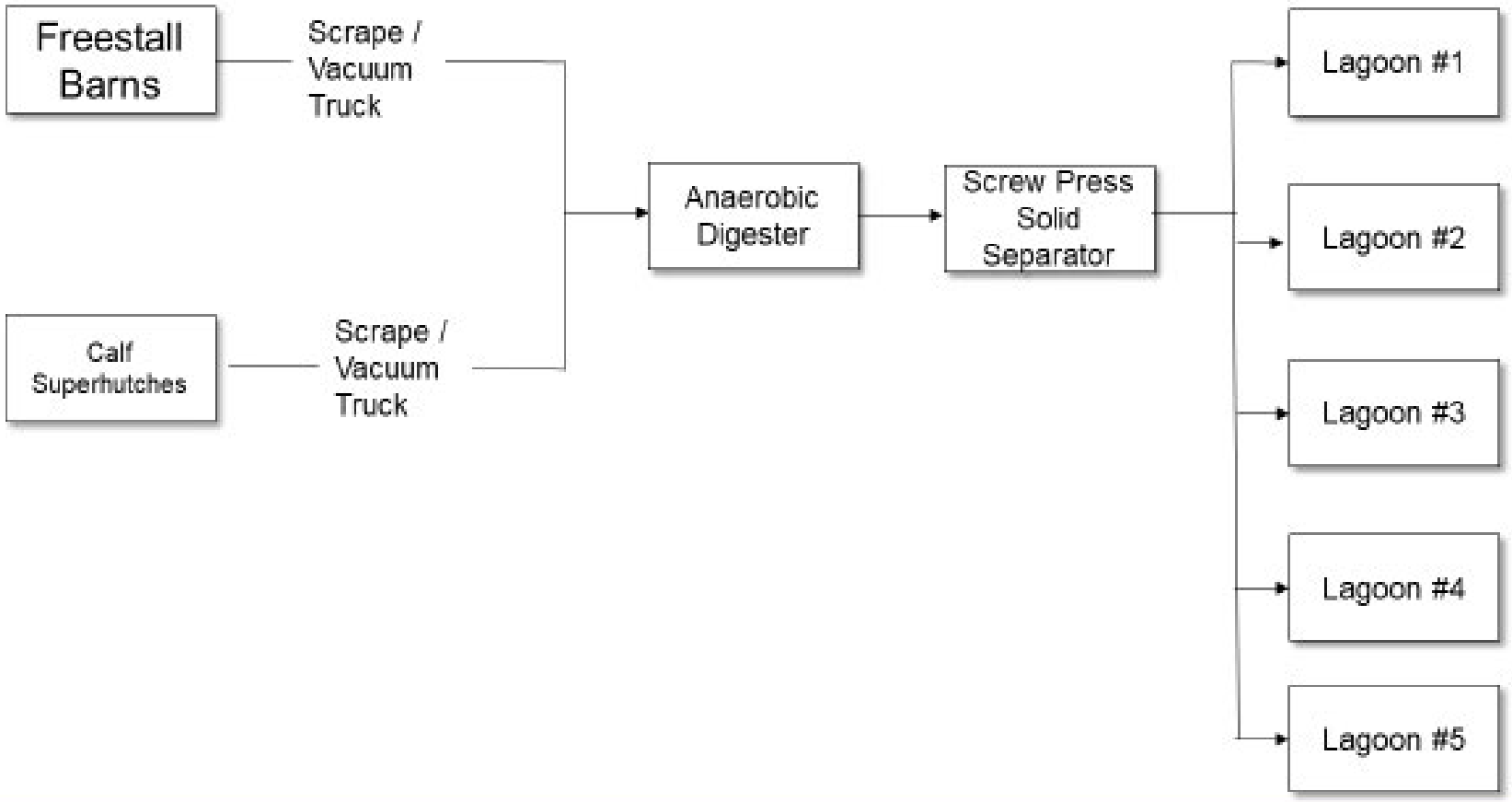
Grotegut Pre-BCS Manure Conveyance

DTE Biomass Energy



Grotegut Post-BCS Manure Conveyance

DTE Biomass Energy



Grotegut Farm Manure Storage Summary

Lagoon #	Date Constructed	Lining	Total Volume (gallons)	Waste Storage Uses
[redacted]