



**Verified Carbon
Standard**

CLINTON LANDFILL



Document Prepared by 3Degrees Group, Inc.

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The Project activity is the capture and destruction of methane from the Clinton Landfill in Clinton, Illinois via combustion engines. The generated electricity is sold to the local grid. However, the displacement of fossil fuels resulting from this activity is not included in this Project and emission reductions from the offsite use of electricity are not addressed in this Project Description (PD).

The Project includes an active landfill gas collection system including wells, piping, blowers, meters and valves; a back-up open flare; two 1.6-MW Caterpillar 3520C engine generator sets; gas conditioning equipment; a building to house the generators; and associated interconnection and metering devices. Note that the gas collection system and an open flare were in place prior to the start of the Project in order to comply with regulation. This Project seeks credit for voluntary emissions reductions over and above those achieved by the gas collection system in the baseline scenario.

This renewed crediting period will include a further expansion of the existing landfill gas collection system and updates to the list of project equipment. See Section 1.10 for a detailed discussion.

The Project's first crediting period spanned from July 1, 2009 through June 30, 2019. This PD covers the second crediting period from July 1, 2019 through June 30, 2029. The estimated annual emission reductions are 130,000 metric tons of CO₂e.

1.2 Sectoral Scope and Project Type

The proposed Project activity falls into Sectoral Scope 13 – Waste Handling and Disposal under the Clean Development Mechanism (CDM). The Project meets the criteria of a landfill gas Project activity as defined in the CDM Approved Consolidated Baseline Methodology ACM0001 Version 19, "Flaring or use of landfill gas."

1.3 Project Eligibility

The Project activity involves the destruction of methane emissions via engines and flaring. This falls under the scope of the VCS Program (version 4).

1.4 Project Design

Eligibility Criteria

The Project is not a grouped Project.

1.5 Project Proponent

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Contact person	Nick Facciola
Title	Director, Carbon Projects
Address	235 Montgomery Street, Suite 320, San Francisco, CA 94104
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1.6 Other Entities Involved in the Project

Organization name	Wabash Valley Power Associations, Inc. dba Wabash Valley Alliance
Role in the Project	Project Owner
Contact person	Vicki Meyers
Title	Manager, Power Supply
Address	722 N. High School Road, Indianapolis, IN
Telephone	(317) 481-2833
Email	vickim@wvpa.com

Organization name	Clinton Landfill, Inc. (owned by GFL Environmental)
Role in the Project	Landfill Owner
Contact person	Andrew Whelpley
Title	Hydrogeologist
Address	4700 N Sterling Ave, Peoria, IL 61615
Telephone	(309) 495-1580
Email	awhelpley@gflenv.com

1.7 Ownership

The original contract was between TerraPass and DeWitt Energy, the original project owner. On October 31, 2014, DeWitt Energy transferred ownership of the power plant to Wabash Valley

Power Association (WVPA) who now owns and operates the power plant at the Clinton Landfill (see Attachments 1 and 2).

The PD for the first crediting period indicates TerraPass Inc. as the Project proponent. As indicated in Attachment 3, TerraPass changed its name to Origin Climate Inc., and in 2017 Origin Climate merged with 3Degrees Group, Inc and adopted the legal name of 3Degrees Group, Inc (“3Degrees”).

1.8 Project Start Date

The initial crediting period has been previously validated as beginning Project operations on January 24, 2007, the day on which the Project began delivering electricity to the grid.

1.9 Project Crediting Period

The initial crediting period ran from July 1, 2009 to June 30, 2019, for a total of 10 years. This will be the first renewal of the Project crediting period, allowed under VCS Standard v4.1.

The second crediting period will run for 10 years, from July 1, 2019 – June 30, 2029.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large Project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
2019 (6 mos)	45,127
2020	93,487
2021	96,696
2022	99,888
2023	103,069
2024	106,245
2025	109,421
2026	112,600
2027	115,788
2028	118,988
2029 (6 mos)	61,102
Total estimated ERs	1,062,411
Total number of crediting years	10
Average annual ERs	106,241

1.11 Description of the Project Activity

In February 2004, DeWitt Energy Associates, LLC entered into an agreement with Clinton Landfill, Inc. for rights to develop an energy Project using the landfill gas. The Project achieved financial closure on December 30, 2005, when DeWitt Energy accepted financing from a local bank. At the time of Project inception, the landfill was flaring gas to comply with regulations imposed under a Title V permit.

In April 2006, engines arrived at the landfill. The Project start date is January 24, 2007, which is the day on which the Project began delivering electricity to the grid, triggering the start of the contract term of the Power Purchase Agreement (PPA) with the local utility. Prior to the Project start, the landfill had approximately 4 million metric tons of waste in place. After the Project start date, the existing flare remained in place to serve as a back-up to the engines.

Clinton #2 was closed 2010. In 2014, DeWitt Energy transferred the ownership of the power plant to Wabash Valley Power Authority (WVPA). After the landfill's methane generation began to decline, operators at the landfill tied in a new section at the landfill in October 2015, called

Clinton #3. Section #3 shares a physical border with #2 and is part of the same Illinois Environmental Protection Agency Bureau of Air permit governing the greater landfill's emissions (Attachment 4). As such, this connection between #2 and #3 is part of routine wellfield maintenance and expansion, both of which are considered business-as-usual activities at landfills.

In April 2021, a fourth flare on the site (Flare #4) will be added to section #3 and Flare #2 (the flare historically serving as a backup to the engines) will be removed. At this point, monitoring of Flare #4 will become part of the Project activity in substitution for Flare #2, with the same baseline deduction being taken for pre-project destruction.

Major Project components are detailed below:

Blower. By replacing the existing 10-horsepower blower with a significantly more powerful 75-horsepower version, the Project has achieved higher landfill gas collection efficiency.

Generators. Two Caterpillar 3520C engines were installed for the Project. Each is capable of producing 1.6 MW of electricity at full load and requires about 550 scfm of landfill gas (depending on the methane concentration).

Meters and Recorders. A Rosemount Model 3095 Multivariable Mass Flow Transmitter is currently used to monitor flow at the flare 1 and two Rosemount Model 3051s are used to measure flow at the engines at flare 2. Either the Rosemount or a comparable piece of equipment such as the thermal mass flow meters from Sage Metering will be used to measure gas flow data. Continuous methane analyzers, such as a Siemens Ultramat 23, are used to monitor methane concentration at the flares. A handheld gas constituent analyzer, such as a Landtec GEM-5000, is used to capture methane concentration data at the engines. All data is logged electronically and consolidated weekly and monthly. Monitored data values will include methane, gas flow, temperature, pressure, kWh production, and equipment uptime. Electricity generation is tracked through monthly electricity bills from the power company's metering efforts.

Building. The building housing the generator sets is a Morton pole barn, a metal-clad structure with a poured concrete floor measuring 42 by 75 feet.

Operations and Maintenance. WVPA operates and maintains the Project. O&M requires one full-time manager to run the plant, as well as a half-time technician. Several other technicians fill in on a part-time, as-needed basis.

1.12 Project Location

The Clinton Landfill is located at 9560 Heritage Road in Clinton, Illinois 61727, in DeWitt County, about 25 miles south of Bloomington, IL. The landfill occupies approximately 157 acres of a 266-acre permitted site. The Project is conducted within the property owned by Clinton Landfill, Inc. This property's GPS coordinates are 40° 6' 51.411" N and -88° 57' 28.7994" W. The engines are housed in free-standing building along the northern edge of the waste area.

1.13 Conditions Prior to Project Initiation

Originally permitted in 1989, the Clinton Landfill received approximately 200,000 metric tons of waste per year through 2009, including municipal solid waste and non-hazardous special waste. Landfill #2 reached capacity in 2009 and Landfill #3 was opened. Landfill #3 is due to reach capacity at around 20 million metric tons of waste in 2052.

In 1998, an active methane recovery and destruction system was constructed at Clinton Landfill to maintain compliance with federal and state standards regarding the control of nonmethane organic compounds (NMOCs) and landfill gas (35 IAC, Part 220). This baseline methane capture and destruction included 40 wells and two flares (Flare #1 on Landfill #1 and Flare #2 on landfill #2) that preceded the development of the gas-to-energy Project.

The Project collects and combusts methane from an existing source (the landfill). None of the Project components create methane. Therefore, the Project's initiation does not result in an increase in greenhouse gas emissions relative to the baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The landfill operates under various permits granted by the Illinois Environmental Protection Agency (IEPA). The current IEPA Bureau of Land permit is No. 1996102-LF, issued subject to the development, operating, and reporting requirements for non-hazardous waste landfills in Title 35 Illinois Administration Code (35 IAC), Subtitle G: Land Pollution (Regulations) Parts 810, 811, 812, 813, and 814. The current Bureau of Air Permit is No. 99110013, which ensures compliance under the Title V Clean Air Act Permit Program. Biogas destruction that occurred to comply with Title V requirements in the baseline is discussed further in Section 3.4. The current National Pollutant Discharge Elimination System (NPDES) Permit is No. IL0067997.

In addition, the Project requires individual permits:

- The Dept. of Planning and Development for township of Texas, DeWitt County issued building and construction permit No. 5399 on February 23, 2005.
- The IEPA Dept. of Air issued permit No. 039808AAE on May 18, 2005 granting DeWitt Energy permission to construct emissions sources and air pollution control equipment consisting of two landfill gas-fired internal combustion engines.
- The IEPA Dept. of Air issued permit No. 039808AAC on October 28, 2010 granting Clinton Landfill permission to construct emissions sources and air pollution control equipment consisting of a MSW landfill expansion with second flare (Flare #2).
- The IEPA Dept. of Air issued permit No. 039808AAC on October 28, 2010 granting Clinton Landfill permission to construct emissions sources and air pollution control equipment consisting of a modification to the open flare (Flare #1).

- On October 7, 2020, Clinton Landfill submitted a request for a construction permit to install and operate a new candlestick flare to control landfill gas (Flare #4). It is noted that this flare will be incorporated into Clinton Landfill's Clean Air Act Permit Program Title V Operating Permit following issuance of the requested Construction Permit.

Copies of all relevant Project permits are included in Attachment 4.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The Project does not currently have registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

This Project has not been rejected by other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The Project is not eligible for crediting under any Emissions Trading program or subject to any other binding limits at the time of validation.

1.16.2 Other Forms of Environmental Credit

The reductions presented in this PD do not create another form of environmental credit. However, at the Project facility, renewable energy generation produces renewable energy certificates (RECs). The RECs are purchased by Ameren, the alternative retail energy supplier that also purchases the generated electricity. This does not pose a risk of double counting the emission reductions described in this PD as they do not relate to the displacement of grid electricity by Project generation.

1.17 Additional Information Relevant to the Project

Leakage Management

This Project does not have any leakage.

Commercially Sensitive Information

No commercially sensitive information is included in this PD.

Sustainable Development

SDG3 - Good Health and Well-Being: Approximately 7,000 people live in nearby Clinton, IL and are currently benefiting from improved health conditions as a result of the Project. In addition to methane and carbon dioxide, landfill gas contains a large number of other volatile organic compounds (VOCs), many of which are listed as hazardous air pollutants (HAPs) that pose threats to human health such as respiratory irritation and central nervous system damage. Furthermore, the California Air Resources Board has assigned cancer risk factors to the HAPs and dioxins found in landfill gas.

Combustion of LFG serves to decrease its public health impact by destroying the majority of HAPs. Using the USEPA default concentrations and California Air Resource Board cancer risk factors, Natural Resources Defense Council (NRDC) performed an analysis comparing the overall toxicity of raw LFG to that of LFG combustion exhaust. The NRDC found that the exhaust from LFG combustion has a total inhalation cancer potency of 3.17×10^{-9} lb. Toxic Equivalent Units (TEQ)/MWh-equiv. compared to 7.58×10^{-8} lb. TEQ/MWh-equiv. for raw LFG. In other words, raw landfill gas is approximately 24 times more carcinogenic to human health than landfill gas combustion exhaust.

SDG7 – Affordable and Clean Energy: Annual generation of approximately 20,000 MWh supplies renewable energy to the grid.

SDG8 – Decent Work and Economic Growth: There are 1.5 FTE permanent job positions created by the Project including the gas plant operator, wellfield monitoring technician and other support staff.

Further Information

No further information needs to be provided.

2 SAFEGUARDS

2.1 No Net Harm

We are not aware of any negative environmental or socio-economic impacts of this Project implementation.

2.2 Local Stakeholder Consultation

Prior to and after the Project start date, DeWitt Energy made a variety of efforts to reach out to both local leaders and the community at large. The purpose of this outreach was to explain the benefits of the Project to the public, to respond to questions and feedback, and to help ensure compliance with safety standards. Outreach efforts included the following activities:

- Edwin Ingalls, General Manager of DeWitt Energy, met with the county zoning board in the spring of 2005 to explain the Project and answer questions.

- DeWitt Energy twice hosted the fire chief and fire department for site visits during construction, to familiarize local emergency personnel with the design of the system.
- Ingalls presented the Project to the Rotary Club, an association of local business leaders, prior to the Project start date.
- After Project start, Ingalls presented the Project to the Central Illinois Mayor's Association.
- Ingalls has also made several local press appearances, including articles in the Clinton Daily Journal and a twenty-minute radio interview on WHOW.

Separately, the Project was subject to the extensive public consultation processes required by U.S. law. The United States has a longstanding tradition of public stakeholder consultation prior to granting environmental permits at the federal, state and municipal level. Typically, this includes measures to alert the public about the Project and ways to participate, through advertisements in relevant local media, town hall style meetings or other public hearings, an on-line option for offering comments and easy access to officials through postal mail and/or phone.

This Project's generators and flare required air quality permits pursuant to the U.S. Clean Air Act as sources of NO_x, and therefore this Project was subject to Clean Air Act permitting and notice requirements. Those requirements are described in Attachment 4.

These outreach efforts did not yield any significant feedback from the community. A landfill gas collection and flaring system was already in place at the landfill at the time that the Project was developed, and the addition of a gas-to-energy plant at the site, financed by a private developer, was generally regarded as an uncontroversial and even positive community development. No records of feedback from these consultations exist, because no formal feedback was offered.

2.3 Environmental Impact

No environmental impact assessment is required for the continuation of the Project activity.

2.4 Public Comments

The Project did not receive any public comments.

2.5 AFOLU-Specific Safeguards

This is not an AFOLU Project.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The Project's second crediting period will operate under the current version of the methodology:

ACM0001: Flaring or use of landfill gas (Version 19), provided as Attachment 5

The Project will apply the following tools:

TOOL 11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 3.0.1), provided as Attachment 6

TOOL 08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 3.0), provided as Attachment 7

TOOL 04: Emissions from solid waste disposal sites (version 8.0), provided as Attachment 8

TOOL 06: Project emissions from flaring (version 3.0), provided as Attachment 9

TOOL 05: Baseline, Project, and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 3.0), provided as Attachment 10

TOOL 03: Tool to calculate Project or leakage CO₂ emissions from fossil fuel combustion (version 3.0), provided as Attachment 11

3.2 Applicability of Methodology

The Clinton Landfill Gas Project is characterized by activities listed in the *Applicability* section of the ACM0001 methodology. The following is a list of each applicability criteria set forth in ACM0001 and referenced tools along with a demonstration of if and how the project meets each condition separately:

Applicability criteria	Project demonstration
<i>ACM0001 Large-scale Consolidated Methodology - Flaring or use of landfill gas. Version 19.0:</i>	
3(a) - Install a new LFG capture system in an existing or new (Greenfield) SWDS where no LFG capture system was or would have been installed prior to the implementation of the project activity; or	The project activity is characterized by a baseline scenario that included an existing LFG capture system, therefore criteria 3(a) is not applicable but criteria 3(b) is.
3(b) - Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:	This project activity involves investment in an existing LFG capture system to increase the recovery rate of LFG, as well

Applicability criteria	Project demonstration
i. The captured LFG was vented or flared and not used prior to the implementation of the project activity; and ii. In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available;	as the introduction of landfill gas generated electricity production. Prior to the project activity, the capture LFG was flared and historical data on the amount of LFG captured and flared in the baseline is available and used in baseline destruction emissions reductions calculations.
3(c) - Flare the LFG and/or use the captured LFG in any (combination) of the following ways: (i) Generating electricity; (ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; (iii) Supplying the LFG to consumers through a natural gas distribution network (iv) Supplying compressed/liquefied LFG to consumers using trucks (v) Supplying the LFG to consumers through a dedicated pipeline;	The project activity involves the flaring of gas in combination with electricity generation.
3(d) - Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.	The project activity does not reduce the amount of organic waste that would be recycled in the absence of the Project activity. Waste management practices at Clinton Landfill have not changed in response to the project activity.
<i>ACM0001 - The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is:</i>	
4(a) - Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and	The project's baseline scenario is the partial, but not total, atmospheric release of landfill gas.
4(b) - In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln: (i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or	For the project electricity generation, the baseline is characterized as electricity generated and supplied from the grid or from captive fossil fuel power plants.

Applicability criteria	Project demonstration
(ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary;	
4(c) - In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas.	Not applicable - LFG is not supplied to end-user(s) in the project activity.
4(d) - In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.	Not applicable - the project activity does not involve LFG from a Greenfield SWDS.
<i>ACM001 is not applicable in the following instances:</i>	
5(a) - In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace;	Not applicable - the project activity is not combined with other approved methodologies.
5(b) - If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.	Waste management practices at Clinton Landfill have not changed in response to the project activity in order to increase methane generation compared to the situation prior to the Project implementation.
<i>TOOL 11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 3.0.1)</i>	
This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 49 (a) of the modalities and procedures of the clean development mechanism.	This tool is used to assess the continued validity of the baseline at the renewal of the crediting period. Please see Section 3.4 Baseline Scenario.
<i>TOOL 08: Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 3.0)</i>	
Typical applications of this tool are methodologies where the flow and composition of residual or flared	The referenced methodology ACM0001 involves flow and composition of flared

Applicability criteria	Project demonstration
gases or exhaust gases are measured for the determination of baseline or project emissions.	gases that are measured for the determination of baseline and project emissions.
Methodologies where CO ₂ is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost effective way of monitoring flow of CO ₂ .	Not applicable – CO ₂ is not the particular and only gas of interest used in the ACM0001 methodology.
The underlying methodology should specify: (a) The gaseous stream the tool should be applied to; (b) For which greenhouse gases the mass flow should be determined; (c) In which time intervals the flow of the gaseous stream should be measured; and (d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17)) is not valid (such as the gaseous stream is predominantly composed of a gas other than N₂).	The underlying methodology, ACM0001, specifies these conditions.
TOOL 04: Emissions from solid waste disposal sites (version 8.0)	
The tool can be used to determine emissions for the following types of applications: Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. “ACM0001: Flaring or use of landfill gas”). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS); Application B: The CDM project activity avoids or involves the disposal of waste as a SWDS. An example of this application of the tool is ACM0022, in which	The project activity falls under Application A.

Applicability criteria	Project demonstration
municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS.	
In the case that: (a) different types of residual waste are disposed or prevented from disposal; or that (b) both MSW and residual waste(s) are prevented from disposal, then the tool should be applied separately to each residual waste and to the MSW.	Not applicable – the project activity does not involve avoiding or disposal of waste as a SWDS.
TOOL 06: Project emissions from flaring (version 3.0)	
This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.	The project activity involves open flares.
This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	The project activity involves the flaring of a flammable greenhouse gas for which methane is the component with the highest concentration in the flammable gaseous stream and the source of the gas is from a biogenic sources (landfill gas).
The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.	Not applicable – the project does not involve the use of auxiliary fuels to sustain combustion.
TOOL 05: Baseline, Project, and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 3.0)	
If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the	The project activity falls under Scenario A and involves the use of electricity purchased from the grid only.

Applicability criteria	Project demonstration
site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and a fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	
This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	Not applicable – this tool is only used to determine emissions from consumption of electricity due to the project activity.
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO2 emissions.	Not applicable - captive renewable power generation technologies are not used to provide electricity to the project activity, in the baseline scenario or to sources of leakage.
TOOL 03: Tool to calculate Project or leakage CO2 emissions from fossil fuel combustion (version 3.0)	
<i>This tool provides procedures to calculate project and/or leakage CO2 emissions from the combustion of fossil fuels. It can be used in cases where CO2 emissions from fossil fuel combustion are calculated</i>	<i>This tool is used to calculate project CO2 emissions from the combustion of fossil fuels.</i>

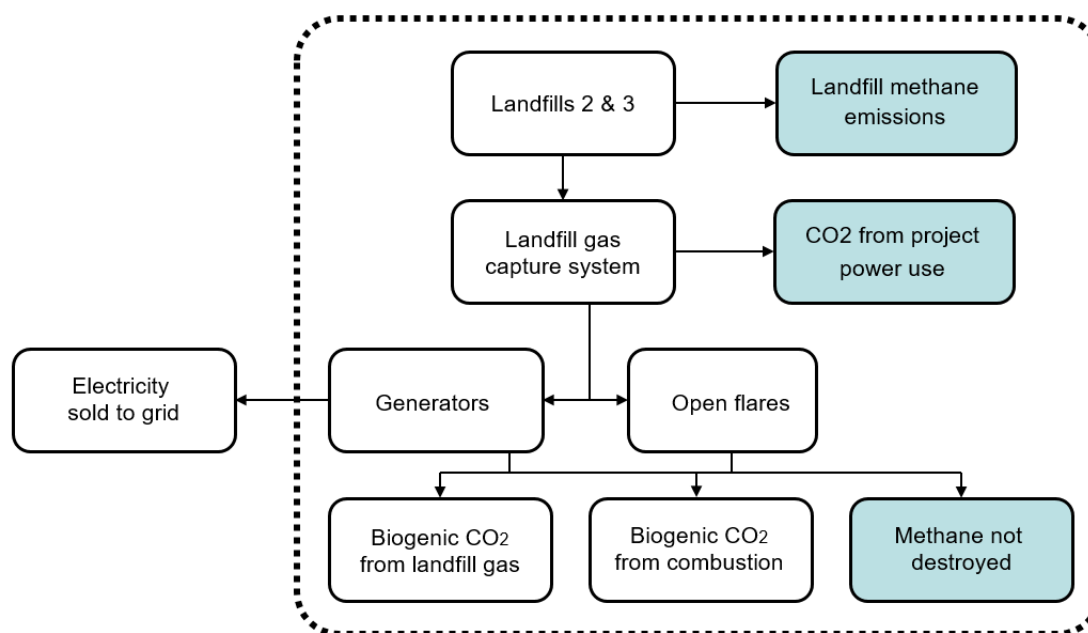
Applicability criteria	Project demonstration
<i>based on the quantity of fuel combusted and its properties.</i>	

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the landfill site	CO ₂	No	CO ₂ emissions from the decomposition of organic waste are not accounted for.
		CH ₄	Yes	The major source of emissions in the baseline.
		N ₂ O	No	N ₂ O emissions are small compared to CH ₄ emissions from landfills. Exclusion of this gas is conservative.
	Emissions from flaring in the baseline scenario	CO ₂	No	Emissions are considered biogenic.
		CH ₄	Yes	Emissions due to destruction inefficiencies are included.
		N ₂ O	No	Excluded for simplification. This is conservative.
Project	Onsite fossil fuel consumption due to the flare	CO ₂	Yes	May be an important emission source.
		CH ₄	No	Excluded for simplification. This emission source is assumed to be very small.
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small.
		Other	N/A	Not applicable
	Electricity consumption by the Project landfill gas recovery systems	CO ₂	Yes	May be an important emission source.
		CH ₄	No	Excluded for simplification. This emission source is assumed to be very small.
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small.
		Other	N/A	Not applicable
	Emissions from flaring of methane and from combustion in	CO ₂	No	Emissions are considered biogenic.
		CH ₄	Yes	Emissions due to destruction inefficiencies are included.
		N ₂ O	No	Excluded for simplification. This emission source is assumed to be very small.

Source	Gas	Included?	Justification/Explanation
electricity generators	Other	N/A	Not applicable

The following figure presents a diagram of the Project boundary.



3.4 Baseline Scenario

Per the VCS Standard v4, Section 3.8.8, for the “Renewal of Project Crediting Period”, the validity of the original baseline scenario must be assessed according to the CDM Tool: *Assessment of the validity of the original/current baseline and update of the baseline at the renewal of a crediting period (Version 3.0.1)*.

The steps for reassessment are as follows:

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess the compliance of the current baseline with the relevant mandatory national and/or sectoral policies

There have not been any updates to existing federal, state, or local laws relevant to the landfill’s regulatory standing. In other words, no laws have been put forth during the time of the initial crediting period that would require the landfill to install additional gas destruction equipment nor increase its overall gas collection. The landfill exceeded its NMOC threshold prior to the Project’s first crediting period, requiring the installation of a gas collection and control system (GCCS). As of the writing on this document, the landfill is still in compliance with its Title V permit that

required the installation of the GCCS and compliance is maintained at the level of gas collection achieved with the original 1998 system. The landfill is also in compliance with its NPDES permit.

Step 1.2: Assess the impact of circumstances

The most likely baseline scenario identified at the initial Project validation was the continued destruction of LFG in the existing flare, which was installed to meet the landfill's obligations under Title V. Since this scenario represents a continuation of current practices, it is necessary to "assess the changes to market characteristics" for the crediting period renewal.

Given that the baseline scenario was characterized by the operation of a flare that was installed to maintain compliance with a regulation, changes in market conditions would not impact the decision to continue operating the existing flare, so the original/current baseline remains valid in this respect. See Step 1.3 for further discussion. Wellhead and gas collection maintenance are ongoing costs as part of regular landfill management practices. Changes in costs related to gas collection and destruction would remain the same in the original baseline assessment and the reassessment of market conditions. The flare does not generate revenue and therefore is not affected by any changes in energy or gas sales markets. As a result, the most likely baseline scenario remains the use of the existing flare (or a similar flare) for methane destruction.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

The flare that was installed to maintain regulatory compliance was found to be destroying 32.1% of the total methane generated at the landfill in the year prior to the Project start. This rate of destruction was determined to be sufficient to maintain the landfill's good regulatory standing. To account for the baseline destruction, the Project made use of an "adjustment factor" for the duration of the first crediting period. In the baseline quantification, this adjustment factor was a ratio between 32.1% (baseline destruction efficiency) and the percentage of methane destroyed in the Project scenario (Project destruction efficiency). The adjustment factor was multiplied by metered methane destroyed in a given reporting period and subtracted from the total metered methane destruction to arrive at the methane destruction that could be attributed to the Project's expansion beyond the baseline destruction. The baseline therefore assumes a natural scaling in regulatory collection and destruction proportional to the expected landfill gas production. This scaling baseline captures the essence of the New Source Performance Standards (NSPS) requirement to size the GCCS accordingly.

While the newest version of the methodology no longer includes an adjustment factor calculation, we find that the methodology provides a path for baseline destruction quantification that functions in a similar manner to the adjustment factor. Specifically, the methodology outlines the process for handling baseline adjustments in "Case 4" in Paragraphs 52 and 53 of the methodology, which directs to the use of "Case 3" for this Project. Applying Case 3 to baseline quantification, we find that the methodology again provides a means for removing baseline methane destruction that scales based on recorded destruction. Due to the use of this scaling,

the baseline destruction is independent of the size of the flare installed for maintaining compliance. As long as the flare is able to achieve 32.1% destruction, which the replacement flare will be able to maintain, the baseline scenario holds.

Therefore, although a new flare has been installed onsite, the fundamental baseline quantification logic remains the same.

Step 1.4: Assess the validity of the data and parameters

The IPCC value for the GWP of CH₄ has been updated since the initial crediting period validation, which at the time used the IPCC Second Assessment Report. For the second crediting period, we refer to the GWP of 28 from the Fifth Assessment Report (AR5). We have also referenced the current versions of the tools used in the baseline calculations, and updated parameters to align with the new tools' values where it is possible to update and does not reference historical conditions. No other baseline parameters require adjustment.

Step 2: Update the current baseline and the data and parameters

After evaluation of the original baseline, it was determined that the existing baseline scenario should be updated to reflect the IPCC AR5 value for the GWP of methane of 28 and reference current versions of CDM tools where applicable. Additionally, parameter names have been updated in accordance with the most recent methodology, ACM001 v19.

The baseline ex-ante calculations have also been updated with new waste-in-place figures from the landfill's most recent GCCS Design Plan conducted in 2021 (Attachment 13).

3.5 Additionality

Per the VCS Standard v4, Section 3.8.9.1 – “Renewal of Project Crediting Period”, a full reassessment of the additionality is not required when renewing the Project crediting period.

See the PD for the first crediting period for a discussion on additionality of the Project (Attachment 15).

When the original PD was approved, the Project's assessment of financial additionality included 1) investment in the engines and 2) the expansion of the blower system. Since the flare installed to maintain regulatory compliance was already in place when the Project began, it was excluded from investment analysis and additionality considerations. The landfill remains above the emissions threshold that requires installation of a gas collection and control system and has since replaced its original flare with a new flare. We find that this replacement flare does not necessitate the re-assessment of additionality, as this flare is effectively a “swap” with the existing flare that was installed outside the additionality considerations of the Project.

Furthermore, as discussed in Section 3.4, the Project calculations provide a means of calculating baseline emissions that scale with the level of methane collection and destruction. Therefore, even though the new flare will have a higher rated capacity than the baseline flare, the Project

will still be taking the same proportional baseline deduction for the destruction that is occurring as a result of maintaining regulatory compliance.

Regarding regulatory surplus, the Clinton GCCS has been designed to increase the efficiency of LFG collection and destruction beyond what would be achieved by the minimum requirement to comply with NSPS. The pre-project GCCS was constructed to maintain compliance with air regulations under the U.S. Clean Air Act, specifically 40 CFR Part 60 Subparts Cc and WWW, which have been adopted in total by the State of Illinois (35 IAC, Part 220). Compliance with the 35 IAC performance metrics include 1) maintaining a negative pressure at all wellheads, 2) ensuring the system design is sized to control the maximum predicted gas generation, and 3) maintaining fewer than three monitored surface and subsurface methane exceedances within a quarter (35 IAC 220.240). The original 1998 system was sized to handle the maximum projected gas flow of Clinton Landfill #2, evidenced by the infrequency of exceedances pre-project. The landfill met the required performance criteria on the gas collection and destruction system prior to the expansion of collection activity in the project scenario.

The GCCS voluntarily expansion in 2007 went above and beyond any requirement to do so. Motivated by the prospective revenue stream of a gas-to-energy project and carbon offsets, the expansion was designed not only to collect more gas but to maximize gas collection efficiency as well. The gas collection efficiency was 32.1% in the baseline year 2006, and this level of gas collection was not violating any of the NSPS performance metric thresholds. The expansion of the system in 2007 included upgrading the blower from 10 hp to 75 hp and staffing an LFG operator to monitor and maintain the gas collection system, as well as adding a gas plant. Redundant controls were implemented that would automatically control how hard the blower pulls gas to the flare. Should either of the gensets shut down, the variable frequency drive would automatically ramp up the blower to the backup flare to maintain high levels of gas collection and destruction. Although 35 IAC requires the GCCS design to be sized to handle the maximum expected gas flow, the actual operation of the GCCS must only mitigate those three performance metrics to maintain compliance. The jump in collection efficiency from 32.1% in the baseline year to an average of 52% in project years was not mandated by federal, state, or local regulation. Finally, the last ten Annual Reports on compliance against Clean Air Act Permit Program (CAAPP) do not indicate any outright noncompliance with maintaining negative wellhead pressure or surface/subsurface methane emissions monitoring. Therefore, there was no need to increase the design capacity of the GCCS; the 2007 expansion to the GCCS was and continues to be collecting and destroying methane at a rate that is surplus to the original GCCS. Clinton Landfill also voluntarily collects and destroys gas from cells before they are required to under NSPS. For example, the 2020 CAAP report shows there is significant gas collection in Clinton #3 MSW Unit Cell 7, which is not finished grade and does not hit its 5-year +60 days date until 2023, when it would then be required under NSPS to collect gas. Even as the wellfield expands into new areas of the landfill (such as the new cells at Clinton Landfill #3), such collection is done early and with high efficiency, and always optimizing the operation of the oversized GCCS. The original GCCS was compliant with NSPS and the increased collection efficiency continues to hold regulatory surplus.

3.6 Methodology Deviations

The following deviations represent a deviation from criteria and procedures related to monitoring and measurement of GHG emission reductions set out in the methodology. The following deviations are provided because they are more appropriate than methodology defaults given the context of the Clinton Landfill Project.

Destruction Efficiencies: We use a flare efficiency of 96% for the Project flares. This number is widely used in well-established carbon protocols for flares operated under US EPA 40CFR60.18, as is the case here. This deviation is expected to provide a closer estimate to the true quantity of emission reductions. This does not impact the conservativeness of quantification, because the flaring can exceed the 96% destruction efficiency in practice. By limiting the flare flow volumes only to those periods in which the thermocouple reads hotter than 500 °F, we ensure that only adequate combustion is taking place at all times in the quantified GHG emission reductions. Thus, the accuracy is not impacted negatively. This methodology deviation has been approved throughout the first crediting period.

Use of eGRID EF for Project electricity emissions: An alternate approach to the determination of the emission factor is used here based on annual total output emission rates published by the U.S. EPA eGRID2019¹ (Attachment 12). The use of the eGRID factor is more appropriate than the tool default due to regional specificity and widespread use of these data for emission accounting purposes. The value applied will be updated to remain in agreement with the most current source value. This deviation results in increased accuracy of emission reduction quantifications.

Use of 2006 IPCC Guidelines defaults for CO₂ emissions from fossil fuels: An alternative approach to the determination of the fossil fuel emission coefficients is used here based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The emission factors in these guidelines are widely used and considered to be industry standards. The value applied will be updated to remain in agreement with the most current source value. This deviation results in increased accuracy of emission reduction quantifications.

Use of standard temperature of 68 °F rather than 32 °F: Rather than use the standard temperature of 32 °F as prescribed by the methodology and the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*, the Project elects to use 68 °F. 68 °F is more common for U.S.-based landfill Project types and thus aides in consistency with industry standards. This does not negatively impact the conservativeness of the quantification of emission reductions.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

¹ https://www.epa.gov/sites/default/files/2021-02/documents/egrid2019_summary_tables.pdf

4.1 Baseline Emissions

The baseline emissions are determined according to the following equations that are based on version 19 of ACM0001. Note that this differs from the PD in the initial crediting period, as the equations have changed substantially since version 11 of the methodology.

Baseline emissions from electricity, heat generation, and natural gas usage do not apply to this Project, therefore the methodology equation reduces to:

$$BE_y = BE_{CH_4,y}$$

Where $BE_{CH_4,y}$ is given by:

$$BE_{CH_4,y} = \left((1 - OX_{top_layer}) \times F_{CH_4,PJ,y} - F_{CH_4,BL,y} \right) \times GWP_{CH_4}$$

Where:

OX_{top_layer} = Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless), equal to 0.1

$F_{CH_4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the Project activity in year y (t CO₂e/yr)

$F_{CH_4,BL,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y (t CO₂e/yr)

GWP_{CH_4} = Global warming potential of CH₄ (t CO₂e/tCH₄), equal to 28

As required by the methodology, we set OX_{top_layer} to 0.1 to account for the effect of oxidation. Similarly, we set the GWP of methane to the default value of 28 from the IPCC Fifth Assessment Report. The value of $F_{CH_4,PJ,y}$ is quantified ex-post each year during the crediting period as well as on an ex-ante basis in order to estimate emission reductions of the proposed Project activity.

For the **ex-post** calculations, we use the following equation:

$$F_{CH_4,PJ,y} = F_{CH_4,flared,y} + F_{CH_4,EL,y}$$

Where:

$F_{CH_4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the Project activity in year y (tCH₄/yr)

$F_{CH_4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year y (tCH₄/yr).

$F_{CH_4,EL,y}$ = Amount of methane in the LFG which is used for electricity generation in year y (tCH₄/yr)

The terms $F_{CH_4,flared,y}$ and $F_{CH_4,EL,y}$ both rely on the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” to determine the methane destroyed in the baseline.

The term $F_{CH_4,EL,y}$ is determined directly using the tool and monitoring the working hours of the power plant so that no emission reductions are claimed during non-working hours. This is taken into account by monitoring the kW production of the equipment utilizing the LFG to only claim engine destruction when an engine is operating in year y ($Op_{j,m,y}$).

The term $F_{CH_4,flared,y}$ is determined using Equation 4 in the methodology, as below:

$$F_{CH_4,flared,y} = F_{CH_4,sent_flare} - \frac{PE_{flare,y}}{GWP_{CH_4}}$$

Where:

$F_{CH_4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year y (tCH₄/yr)

$F_{CH_4,sent_flare}$ = Amount of methane in the LFG which is sent to the flare in year y (tCH₄/yr), determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”

$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (tCO₂e/yr), determined using the tool “Project emission from flaring”

To determine both $F_{CH_4,EL,y}$ (the mass flow of methane to the engines) and $F_{CH_4,sent_flare,y}$ (the mass flow of methane to the flare), we will measure the flow of the LFG on a volumetric wet basis using measurement Option C. According to Paragraph 24 in the tool, if the flow cannot be demonstrated to be dry, which is the case for the Project since moisture content and temperature of the gaseous stream are not being monitored, then the gas is assumed to be wet. Therefore, we use Option C and mass flow is determined using the following equations:

$$F_{CH_4,t} = F_{CH_4,EL,y} = F_{CH_4,sent_flare,y} = V_{t,wb,n} \times v_{CH_4,t,wb} \times \rho_{CH_4,n}$$

With:

$$\rho_{CH_4,n} = \frac{P_n \times MM_{CH_4}}{R_u \times T_n}$$

Where:

$F_{CH_4,t}$ = Mass flow of methane in the LFG in time interval t (lb CH₄/h).

$V_{t,wb,n}$ = Volumetric flow of the LFG in time interval t on a wet basis at normal conditions (ft³ wet gas/h)

$v_{CH_4,t,wb}$ = Volumetric fraction of methane in the LFG in time interval t on a wet basis (ft³ CH₄/ft³ wet gas)

$\rho_{CH_4,n}$ = Density of methane in the landfill gas at normal conditions (lb CH₄/ft³ wet landfill gas)

P_n = Absolute pressure at normal conditions (1 atm or 14.70 psia)

T_n = Temperature at normal conditions (68 °F, or 527.67 °R)

MM_{CH_4} = Molecular mass of methane (lb/lbmol)

R_u = Universal ideal gas constant (psia • ft³/lbmol • R)

The volumetric flow will be converted from conditions of the internally corrected meter output to normal conditions of temperature and pressure prescribed by the Tool, as needed using the equation below:

$$V_n = V_t \times \frac{T_n}{T_t} \times \frac{P_t}{P_n}$$

$PE_{flare,y}$ is determined using the tool “Project emissions from flaring” and the equation below:

$$PE_{flare,y} = GWP_{CH_4} \times \sum_{m=1}^{525600} F_{CH_4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

Where:

$F_{CH_4,RG}$ = Mass flow of methane in the flare gas in minute m (kg)

η_{flare} = The efficiency of the flare in minute m

Note that the flare operability is monitored via thermocouple readings.

For the **ex-ante** calculations, we use the following equation:

$$F_{CH_4,PJ,y} = \eta_{PJ} \times \frac{BE_{CH_4,SWDS,y}}{GWP_{CH_4}}$$

Where:

$F_{CH_4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the Project activity in year y (tCH₄/yr)

$BE_{CH_4,SWDS,y}$ = Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y (t CO₂e/yr), as determined using Equation (1) in the methodological tool “Emissions from solid waste disposal sites”, given by:

$$BE_{CH_4,SWDS,y} = \varphi_y \times (1 - f_y) \times GWP_{CH_4} \times (1 - OX) \times \left(\frac{16}{12}\right) \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^y \sum_j (W_{j,x} \times DOC_j \times e^{-k_j \times (y-x)} \times (1 - e^{-k_j}))$$

Where:

φ_y = Model correction factor to account for model uncertainties in year y

f_y = Fraction of CH₄ captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y

GWP_{CH_4} = Global warming potential of methane (tCO₂e/tCH₄)

OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
$DOC_{f,y}$	=	Fraction of degradable organic carbon that decomposes under the specific conditions occurring in the SWDS in year y
MCF_y	=	Methane correction factor for year y
k	=	Decay rate for the waste type j (1 / yr)
j	=	Type of residual waste or types of waste in the MSW
DOC_j	=	Fraction of degradable organic carbon in the waste type j (weight fraction)
$W_{j,x}$	=	Total amount of waste disposed in SWDS in year y
x	=	Years in the time period in which waste is disposed at the SWDS, extending from $x=1$ to year y
y	=	Year of the crediting period or which methane emissions are calculated
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the Project activity

The technical specifications of the LFG capture system are not available, so the Project will use the default efficiency:

$$\eta_{PJ} = 50\%$$

The methane generation in the baseline scenario is estimated using a First Order Decay (FOD) model provided as Attachment 13.

Ex-ante estimates of $F_{CH_4,PJ,y}$ for the project's second crediting period are provided in Table 1.

Table 1. Ex-ante estimates of parameter $F_{CH_4,PJ,y}$

Year	$F_{CH_4,PJ,y}$ <i>Amount of methane in the LFG which is flared and/or used in the Project activity in year y (tCH₄/yr)</i>
2019 (6 mos)	2,786
2020	5,771
2021	5,969
2022	6,166
2023	6,363
2024	6,559

Year	$F_{CH_4,PJ,y}$ <i>Amount of methane in the LFG which is flared and/or used in the Project activity in year y (tCH₄/yr)</i>
2025	6,755
2026	6,951
2027	7,148
2028	7,345
2029 (6 mos)	3,772

For the **ex-post** and **ex-ante** determination of the amount of methane that would have been captured and destroyed in the baseline term $F_{CH_4,BL,y}$, we use Case 4 as described in ACM0001 (a requirement to destroy methane exists and a LFG capture system exists).

For Case 4, ACM0001 states that $F_{CH_4,BL,y}$ shall be determined based on information in contract or regulation requirements and data related to the existing LFG capture system, as follows:

$$F_{CH_4,BL,y} = \max\{F_{CH_4,BL,R,y}; F_{CH_4,BL,sys,y}\}$$

Where:

$F_{CH_4,BL,R,y}$ = Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (t CH₄/yr) – as determined by the procedures outlined in Case 2

$F_{CH_4,BL,sys,y}$ = Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (t CH₄/yr) - as determined by the procedures outlined in Case 3

For the Clinton Landfill, the amount of methane destroyed in the baseline scenario is not numerically defined by a regulation or a contract, therefore we follow the Case 3 steps to determine $F_{CH_4,BL,y}$:

$$F_{CH_4,BL,y} = F_{CH_4,BL,sys,y} = F_{CH_4,hist,y} = \frac{F_{CH_4,BL,x-1}}{F_{CH_4,x-1}} \times F_{CH_4,PJ,y}$$

Where:

$F_{CH_4,BL,x-1}$ = the amount of methane in the LFG which is captured and destroyed in the year prior to the Project implementation (tCH₄/yr)

$F_{CH_4,x-1}$ = the amount of methane in the LFG generated in the SWDS in the year prior to the Project, and is calculated according to the methodological tool “Emissions from solid waste disposal sites” (tCH₄/yr)

$F_{CH4,PJ,y}$ is calculated as above.

$F_{CH4,BL,x-1}$ is determined using the data from one historic year (2006) prior to the start date of the Project. This data and calculation are included as Attachments 14 and 16, and were developed as part of the Project's validation of the first crediting period. As the analysis shows, in the year prior to the Project the baseline flare destroyed 3,889 tCH₄.

$F_{CH4,x-1}$ is calculated for the same time period, 2006, based on a first-order decay model described in the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site." In the baseline year, 2006, the site generated 12,130 tCH₄.

Combining these terms, we arrive at:

$$F_{CH4,BL,y} = \frac{F_{CH4,BL,x-1}}{F_{CH4,x-1}} \times F_{CH4,PJ,y} = \frac{3,889}{12,130} \times F_{CH4,PJ,y} = 0.321 \times F_{CH4,PJ,y}$$

4.2 Project Emissions

ACM0001 requires identification of changes in fossil fuel use and non-renewable electricity consumption that occur as a result of the Project implementation.

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y}$$

Where:

PE_y = Project emissions in year y (t CO₂/yr)

$PE_{EC,y}$ = Emissions from consumption of electricity due to the Project activity in year y (t CO₂/yr)

$PE_{FC,y}$ = Emissions from consumption of fossil fuels due to the Project activity, for purposes other than electricity generation, in year y (t CO₂/yr)

$PE_{DT,y}$ = Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (t CO₂/yr)

$PE_{SP,y}$ = Emissions from the supply of LFG to consumers through a dedicated pipeline, in year y (t CO₂/yr)

$PE_{DT,y}$ and $PE_{SP,y}$ are not applicable to this Project and are both zero.

$PE_{EC,y}$ is determined according to the Methodological tool: *Baseline, Project, and/or leakage emissions from electricity consumption and monitoring of electricity generation* and applying the appropriate methodology deviation, as below

$$PE_{EC,y} = \sum_j (EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}))$$

Where:

$EC_{PJ,j,y}$ = quantity of electricity consumed by the Project in year y (MWh/yr)

$EF_{EL,j,y}$ = emission factor for electricity generation for source j in year y (tCO₂/MWh), from eGRID

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y

$PE_{FC,y}$ is determined according to the *Tool to calculate Project or leakage CO₂ emissions from fossil fuel combustion* and the appropriate methodology deviation, as below:

$$PE_{FC,y} = \sum_i (FC_{i,j,y} \times COEF_{i,y})$$

Where:

$FC_{i,j,y}$ = Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)

$COEF_{i,y}$ = The CO₂ emission coefficient of fuel type i in year y (tCO₂/mass or volume unit)

Ex-ante emissions estimates for parameters $PE_{EC,y}$ and $PE_{FC,y}$ for each year included in the project's second crediting period is provided in Table 2.

Table 2. Ex-ante estimates of parameters $PE_{EC,y}$ and $PE_{FC,y}$

Year	$PE_{EC,y}$ <i>Emissions from consumption of electricity due to the Project activity in year y (t CO₂/yr)</i>	$PE_{FC,y}$ <i>Emissions from consumption of fossil fuels due to the Project activity, for purposes other than electricity generation, in year y (t CO₂/yr)</i>
2019 (6 mos)	4	0
2020	8	0
2021	8	0
2022	8	0
2023	8	0
2024	8	0
2025	8	0
2026	8	0
2027	8	0

Year	PE _{EC,y} <i>Emissions from consumption of electricity due to the Project activity in year y (t CO₂/yr)</i>	PE _{FC,y} <i>Emissions from consumption of fossil fuels due to the Project activity, for purposes other than electricity generation, in year y (t CO₂/yr)</i>
2028	8	0
2029 (6 mos)	4	0

4.3 Leakage

ACM0001 states that leakage effects are not accounted for under the methodology.

4.4 Net GHG Emission Reductions and Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year y (t CO₂e/yr)

BE_y = Baseline emission in year y (t CO₂e/yr)

PE_y = Project emission in year y (t CO₂e/yr)

The resulting ex-ante estimate of emission reductions is shown in the table below (see Attachment 17 for calculation).

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated Project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
2019 (6 mos)	45,131	4	0	45,127
2020	93,495	8	0	93,487
2021	96,704	8	0	96,696
2022	99,896	8	0	99,888
2023	103,077	8	0	103,069
2024	106,253	8	0	106,245

2025	109,429	8	0	109,421
2026	112,608	8	0	112,600
2027	115,796	8	0	115,788
2028	118,996	8	0	118,988
2029 (6 mos)	61,106	4	0	61,102
Total	1,062,491	80	0	1,062,411

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	Regulatory requirements relating to landfill gas Projects
Data unit	--
Description	Regulatory requirements relating to landfill gas Projects
Source of data	Publicly available information of United States' and State of Illinois' regulatory requirements relating to landfill gas. In particular, the landfill is regulated under Title 35 Illinois Administrative Code (35 IAC), Subtitle G: Land Pollution (Regulations) and under the Title V Clean Air Act Permit Program. The WVPA energy plant is also regulated under Title 40 Code of Federal Regulations.
Value applied	--
Justification of choice of data or description of measurement methods and procedures applied	Landfill operates under permits as outlined in Section 1.14. As part of the validation process, necessary permits are identified so that they may be tracked during Project monitoring.
Purpose of Data	The information is used to assess the landfill's regulatory standing.
Comments	N/A

Data / Parameter	OX _{top_layer}
Data unit	Dimensionless

Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool “ <i>Emissions from solid waste disposal sites</i> ”
Value applied	0.1
Justification of choice of data or description of measurement methods and procedures applied	Specified in methodology.
Purpose of Data	Baseline and Project Emissions calculations
Comments	N/A

Data / Parameter	GWP _{CH4}
Data unit	tCO ₂ e/tCH ₄
Description	Global warming potential of CH ₄
Source of data	IPCC’s Fifth Assessment Report
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	This term will be specified in the latest version of the VCS Standard, expected to be released in March 2021, and reflects the default value from IPCC Fifth Assessment Report (AR5).
Purpose of Data	Baseline and Project Emissions calculations
Comments	N/A

Data / Parameter	F _{CH4,PJ,y} (ex-ante)
Data unit	tCH ₄ /yr
Description	Amount of methane in the LFG which is flared and/or used in the Project activity in year y
Source of data	$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4}$
Value applied	See Attachment 17

Justification of choice of data or description of measurement methods and procedures applied	Calculated in the First Order Decay (FOD) model provided as Attachment 17
Purpose of Data	Calculation of Project Emissions (ex-ante)
Comments	N/A

Data / Parameter	η_{PJ}
Data unit	Percent
Description	Efficiency of the LFG capture system installed in the Project activity
Source of data	ACM0001 Methodology
Value applied	50%
Justification of choice of data or description of measurement methods and procedures applied	This is the default value given by the methodology.
Purpose of Data	Calculation of baseline emissions (ex-ante $F_{CH_4,PJ,y}$)
Comments	N/A

Data / Parameter	η_{flare}
Data unit	Percent
Description	Efficiency of the flare installed in the Project activity
Source of data	Climate Action Reserve's U.S. Landfill Protocol (v5).
Value applied	96%
Justification of choice of data or description of measurement methods and procedures applied	Using a Methodology Deviation, the efficiency of the flare is set at 96% based on the value prescribed by the Climate Action Reserve's U.S. Landfill Protocol (v5). This value is widely accepted for U.S. landfill open flares.
Purpose of Data	Calculation of Project emissions from flaring
Comments	This Methodology Deviation has been approved in previous reporting periods under the first crediting period.

Data / Parameter	$F_{\text{CH}_4, \text{BL}, x-1}$
Data unit	tCH ₄ /yr
Description	Historical amount of methane in the LFG which is captured and destroyed in the year prior to implementation of the Project activity
Source of data	Value taken from initial validation
Value applied	3,899
Justification of choice of data or description of measurement methods and procedures applied	This value was determined at the initial validation and is maintained here. The data set and the calculations performed to determine baseline methane capture appears in Attachments 14 and 16.
Purpose of Data	Calculation of baseline methane destruction
Comments	N/A

Data / Parameter	$FCH_{4,x-1}$
Data unit	tCH ₄ /yr
Description	Amount of methane which is generated in the SWDS in the year prior to the Project activity
Source of data	Calculated in original PDD and shown in Attachments 16 and 17 (ex-ante model of landfill methane production)
Value applied	12,130
Justification of choice of data or description of measurement methods and procedures applied	This value is a result of the decay model that predicts the annual methane production of the landfill.
Purpose of Data	Calculation of baseline methane destruction
Comments	N/A

Data / Parameter	$BE_{CH_4,SWDS,y}$
Data unit	tCO ₂ e/yr
Description	Amount of methane generated in calendar year y by the landfill in absence of any collection system
Source of data	Calculated per the tool “Emissions from solid waste disposal sites” at the time of the initial validation and recalculated at the time of the second crediting period validation.
Value applied	See Attachment 17
Justification of choice of data or description of measurement methods and procedures applied	The value was determined upon the second crediting period, updated from the initial validation to account for changed values and modeled for continued decay.
Purpose of Data	Modeled value of the methane produced by the SWDS in a given year
Comments	Used for ex-ante estimation of the amount of methane that would have been generated in a given year, as well as to establish baseline scenario reductions

Data / Parameter	$F_{CH_4,BL,y} (ex-ante) = FCH_{4,hist,y}$
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Data unit	tCH ₄ /yr
Description	Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system
Source of data	$0.321 \times F_{CH_4,PJ,y}$ (ex-ante)
Value applied	Calculated
Justification of choice of data or description of measurement methods and procedures applied	This value was determined upon validation of the first crediting period.
Purpose of Data	Calculation of baseline emissions
Comments	See Attachment 17

Data / Parameter	EF _{EL,j,y}
Data unit	tCO ₂ /MWh
Description	Emission factor for electricity consumption from source j
Source of data	eGRID 2019 data (released 2/23/2021)
Value applied	0.719
Justification of choice of data or description of measurement methods and procedures applied	This is a widely used and accepted source for grid emission factors.
Purpose of Data	Calculating Project emissions from electricity use
Comments	Clinton is in SRMW region. This parameter will be reviewed and updated as necessary to remain in agreement with the latest updates of the source documentation.

Data / Parameter	TDL _{j,y}
Data unit	%
Description	Transmission and distribution losses of providing electricity to source j in year y
Source of data	eGRID 2019 data (released 2/23/2021)

Value applied	5.1%
Justification of choice of data or description of measurement methods and procedures applied	This is a widely used and accepted source for U.S. electricity grid data
Purpose of Data	Calculating Project emissions from electricity use
Comments	This parameter will be reviewed and updated as necessary to remain in agreement with the latest updates of the source documentation.

Data / Parameter	COEF _{i,y}
Data unit	tCO ₂ /gallon
Description	Emission factor for fossil fuel type i
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	Various
Justification of choice of data or description of measurement methods and procedures applied	This is a widely used and accepted source for fossil fuel emission factors.
Purpose of Data	Calculating Project emissions from fossil fuel use
Comments	This parameter will be reviewed and updated as necessary to remain in agreement with the latest updates of the source documentation.

The following parameters were used in the initial validation as part of the Tool to determine the mass flow of a greenhouse gas in a gaseous stream and are not updated in the second crediting period validation as they reference universal constants.

Data / Parameter	ρ_{CH_4}
Data unit	lbs. CH ₄ /ft ³ wet landfill gas
Description	Methane density
Source of data	US EPA conversion factor, "Basic Concepts in Environmental Science" http://www.epa.gov/apti/bces/reference/reference.htm

Value applied	0.04162 lbs/ft ³
Justification of choice of data or description of measurement methods and procedures applied	The molecular weight of methane (16.043 lb/lb mol) x $P_{\text{Reference}} / \text{Universal Gas Constant (10.73 psia} \cdot \text{ft}^3/\text{lbmol} \cdot ^\circ\text{R}) / T_{\text{Reference}}$. $P_{\text{Reference}}$ and $T_{\text{Reference}}$ are at standard temperature and pressure.
Purpose of Data	Baseline and Project Emissions Calculations
Comments	Density as measured in US units per gas industry standard temperature and pressure: 1 atmosphere and 68 °F, or 14.70 psia and 527.67 Rankine

Data / Parameter	P_n
Data unit	psia
Description	Total pressure at normal conditions
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream, Version 03.0
Value applied	14.70
Justification of choice of data or description of measurement methods and procedures applied	This is a physical value for atmospheric pressure
Purpose of Data	To determine methane density
Comments	N/A

Data / Parameter	T_n
Data unit	°R
Description	Temperature at normal conditions
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream, Version 03.0
Value applied	527.67
Justification of choice of data or description of measurement methods and procedures applied	This is a physical value for normal temperature

Purpose of Data	To determine methane density
Comments	Note that the tool sets this value at 273.15 K. However, we find the value of 527.67 °R (68 °F) to be the more appropriate value for normal conditions. As such, calculations are based on this value.

Data / Parameter	MM_{CH_4}
Data unit	lb/lbmol
Description	Molecular mass of methane
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream, Version 03.0
Value applied	16.043
Justification of choice of data or description of measurement methods and procedures applied	This is a physical value for molecular mass of methane.
Purpose of Data	To determine methane density
Comments	N/A

Data / Parameter	R_u
Data unit	psia • ft ³ /lbmol • °R
Description	Universal ideal gases constant
Source of data	Tool to determine the mass flow of a greenhouse gas in a gaseous stream, Version 03.0
Value applied	10.73
Justification of choice of data or description of measurement methods and procedures applied	--
Purpose of Data	To determine methane density
Comments	N/A

The following parameters were used in the initial crediting period as part of the tool *Emissions from solid waste disposal sites* and defaults have been updated in the second crediting period in accordance with v08.0 and ACM0001 v19.

Data / Parameter	ϕ default
Data unit	Unitless
Description	Model correction factor to account for model uncertainties
Source of data	Emissions from solid waste disposal sites v08.0
Value applied	0.75
Justification of choice of data or description of measurement methods and procedures applied	From Tool: Application A, default value
Purpose of Data	Corrects for model uncertainties in baseline calculations
Comments	N/A

Data / Parameter	f_y
Data unit	%
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
Source of data	Historic Project records and ongoing Project monitoring.
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	This value references historical conditions and requirements that were in place when the Project underwent initial validation.
Purpose of Data	Accounts for any methane that is handled outside of the Project activity.
Comments	According to ACM0001, this parameter “shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation (2) of this methodology.”

Data / Parameter	OX
Data unit	Fraction
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.1
Justification of choice of data or description of measurement methods	This term is given by the methodology.
Purpose of data	Discounts the total methane produced to account for oxidation from soil or other covering materials.
Comments	N/A

Data / Parameter	F
Data unit	Unitless
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied	0.5
Justification of choice of data or description of measurement methods	This term is given by the methodology.
Purpose of data	Reflects the methane fraction in the gas produced by the landfill.
Comments	N/A

Data / Parameter	DOC _{f,y}
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS

Data / Parameter	DOC _j			
Data unit	Fraction			
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)			
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)			
Value applied	For MSW, the following values for the different waste types j should be applied: Default values for DOC_j <table><tr><th>Waste type j</th><th>DOC_j (% wet waste)</th></tr></table>		Waste type j	DOC _j (% wet waste)
Waste type j	DOC _j (% wet waste)			

	Wood and wood products	43
	Pulp, paper and cardboard (other than sludge)	40
	Food, food waste, beverages and tobacco (other than sludge)	15
	Textiles	24
	Garden, yard and park waste	20
	Glass, plastic, metal, other inert waste	0
Justification of choice of data or description of measurement methods	Default values from IPCC 2006 Guidelines	
Purpose of data	Used to determine the fraction of organic content that is degradable	
Comments	N/A	

Data / Parameter	W_x
Data unit	t
Description	Total amount of waste disposed in a SWDS in year x
Source of data	Measurement by third-party reporting
Value applied	See Attachment 13 and Attachment 17.
Justification of choice of data or description of measurement methods	Total waste disposal is tracked and recorded historically.
Purpose of data	Used to calculate the ex-ante baseline emissions.
Comments	N/A

Data / Parameter	k_j
Data unit	1/yr
Description	Decay rate per waste type j

Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)	
Value applied	<u>Waste Type</u>	<u>k</u>
	Pulp, paper, cardboard (not sludge), textiles	0.06
	Wood, wood products, and straw	0.03
	Garden and park waste	0.1
	Food, food waste, sludge, bev & tobacco	0.185
Justification of choice of data or description of measurement methods	Default decay values used to model decay of waste in the landfill.	
Purpose of data	Calculation of baseline emissions.	
Comments	At Clinton, the climatic conditions are as follows: Mean Avg. Temp = 11.5° C (NOAA 30-year normals) Mean Avg. Precip = 90.3 cm (NOAA 30-year normals) Potential Evapotranspiration = 63.6 cm (Thornthwaite method) MAP/PET = 1.420 → Boreal/Temperate, Wet	

5.2 Data and Parameters Monitored

Data / Parameter	Management of SWDS
Data unit	--
Description	Management of SWDS
Source of data	Original design of the landfill and check-ins with Project staff on the continued operation of the facility.
Description of measurement methods and procedures to be applied	--
Frequency of monitoring/recording	Annually

Value applied	--
Monitoring equipment	--
QA/QC procedures to be applied	--
Purpose of data	Ensure that the operation of the Project does not reduce the amount of organic waste being diverted from the Clinton landfill in the absence of Project activity.
Calculation method	--
Comments	N/A

Data / Parameter	$BE_{CH4,y}$
Data unit	tCO ₂ e
Description	Baseline emissions from the SWDS in year y
Source of data	$((1 - OX_{top_layer}) * F_{CH4,PJ} - F_{CH4,BL}) * GWP_{CH4}$
Description of measurement methods and procedures to be applied	Calculated value based on other parameters
Frequency of monitoring/recording	Calculated value
Value applied	To be calculated at verification. See Attachment 17 for ex-ante values
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	The emissions in year y if the baseline scenario where chosen instead of the Project scenario by the Project owners.
Calculation method	$((1 - OX_{top_layer}) * F_{CH4,PJ} - F_{CH4,BL}) * GWP_{CH4}$
Comments	N/A

Data / Parameter	$F_{CH_4,PJ,y}$ (ex-post)
Data unit	tCH ₄ /yr
Description	Amount of methane in the LFG which is flared and/or used in the Project activity in year y
Source of data	Calculated value based on other parameters
Description of measurement methods and procedures to be applied	Calculated value based on other parameters
Frequency of monitoring/recording	Calculated value
Value applied	To be determined at verification. See Attachment 17 for ex-ante values
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	The amount of methane that was used in the Project activity in year y
Calculation method	$F_{CH_4,EL,y} + F_{CH_4,flare,y}$
Comments	N/A

Data / Parameter	$F_{CH_4,EL,y}$ (ex-post)
Data unit	tCH ₄ /yr
Description	Amount of methane in the LFG which is used for electricity generation in year y
Source of data	Determined using “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”
Description of measurement methods and procedures to be applied	Calculated value based on other parameters

Frequency of monitoring/recording	Calculated value
Value applied	To be determined at verification
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Determine methane destroyed by genset
Calculation method	Calculated using “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”(Option C)
Comments	Equal to $F_{CH_4,t}$

Data / Parameter	$F_{CH_4,flare,y}$ (ex-post)
Data unit	tCH ₄ /yr
Description	Amount of methane in the LFG which is flared in year y
Source of data	Calculated value
Description of measurement methods and procedures to be applied	Calculated value based on other parameters
Frequency of monitoring/recording	Calculated value
Value applied	To be determined at verification
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Determine methane destroyed by flare
Calculation method	Calculated using Equation 4 in the methodology
Comments	N/A

Data / Parameter	$F_{CH_4,sent flare,y}$ (ex-post)
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Data unit	tCH ₄ /yr
Description	Amount of methane in the LFG which is sent to the flares in year y
Source of data	Determined using “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”
Description of measurement methods and procedures to be applied	Calculated value based on other parameters
Frequency of monitoring/recording	Calculated value
Value applied	To be determined at verification
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Determine methane destroyed by flare
Calculation method	Calculated using “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Option C)
Comments	Equal to F _{CH₄,t} and F _{CH₄,RG}

Data / Parameter	PE _{flare,y}
Data unit	tCH ₄ /yr
Description	Project emissions from flaring in year y
Source of data	Determined using tool “Project emissions from flaring”
Description of measurement methods and procedures to be applied	Calculated value based on other parameters
Frequency of monitoring/recording	Calculated value
Value applied	To be determined at verification
Monitoring equipment	N/A

QA/QC procedures to be applied	N/A
Purpose of data	Determine methane destroyed by flare
Calculation method	Calculated using “Project emissions from flaring”
Comments	N/A

Data / Parameter	$F_{CH_4,BL,y}$ (ex-post)
Data unit	tCH ₄ /yr
Description	Amount of methane attributable to baseline destruction equipment
Source of data	$0.321 \times F_{CH_4,PJ,y}$ (ex-post)
Description of measurement methods and procedures to be applied	Calculated value based on other parameters
Frequency of monitoring/recording	Calculated value
Value applied	To be determined at verification
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Determine methane destroyed by flare in baseline scenario
Calculation method	$0.321 \times F_{CH_4,PJ,y}$ (ex-post)
Comments	N/A

Data / Parameter	Op _{j,h}
Data unit	Hours
Description	Operating hours of the energy plant
Source of data	Engine operating clock totalizer

Description of measurement methods and procedures to be applied	Operating clock hours are kept showing monthly totalizer readings, which are used to demonstrate consistent operation by comparing against monthly gas flow and monthly power generation.
Frequency of monitoring/recording	Daily
Value applied	Determined at verification
Monitoring equipment	Records of engine uptime
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of the baseline and Project emissions
Calculation method	N/A
Comments	The gensets are equipped with shutoff valves that prevent gas from passing through and entering the atmosphere while the gensets are non-operational. For any period where one or more of the destruction devices are not operational, it will be demonstrated that the remaining devices have the capacity to destroy the gas flow recorded during the period, and if relevant, it will be shown that the output corresponds to the gas flow.

Data / Parameter	Op _{flare,h}
Data unit	Hours
Description	Operation of the flares
Source of data	Flare thermocouple readings
Description of measurement methods and procedures to be applied	Any flow measured during periods when the flares' operating temperatures are less than 500° F is considered uncombusted, and ignored in the calculation of emissions reductions.
Frequency of monitoring/recording	Continuously
Value applied	Determined at verification
Monitoring equipment	Thermocouple

QA/QC procedures to be applied	N/A
Purpose of data	Calculation of the baseline and Project emissions
Calculation method	N/A
Comments	For any period where one or more of the destruction devices are not operational, it will be demonstrated that the remaining devices have the capacity to destroy the gas flow recorded during the period, and if relevant, it will be shown that the output corresponds to the gas flow.

Data / Parameter	EC _{Pj,j,y}
Data unit	kWh
Description	Quantity of electricity consumed by the Project source j in year y
Source of data	Utility invoices
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Monitored continuously, bills provided monthly
Value applied	To be calculated at verification
Monitoring equipment	Revenue meter owned by utility
QA/QC procedures to be applied	Per power company's procedures. The utility has a vested interest in maintaining conservative calibration of the meters, with legal and financial ramifications that ensure meter accuracy. As such, the meter is assumed to be accurate based on the utility's operation and dependence on the readings.
Purpose of data	Calculation of Project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$FC_{i,j,y}$
Data unit	gallons
Description	Fossil fuel of type i consumed in process j consumed by the Project Activity in year y. In this case, fuel is propane.
Source of data	Purchase invoices
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Data is recorded in the form of receipts for purchases.
Value applied	To be calculated at verification
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of Project emissions
Calculation method	N/A
Comments	N/A

The following parameters were monitored for use in the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*.

Data / Parameter	$V_{t,wb}$
Data unit	ft ³ wet gas/m
Description	Volumetric flow of the LFG in flare or engine
Source of data	Flow meters
Description of measurement methods and procedures to be applied	Data is captured by the datalogger. The Rosemount Pressure Transmitters measure differential pressure, static pressure, and process temperature continuously and converts these parameters into a compensated mass flow value at the following reference conditions:

	Engine 3051 s/n 514151: 60°F and 14.73 psia. Flare 1 3095 s/n 41863: 60°F and 14.696 psia. Flare 2 3051 s/n 514152: 60°F and 14.73 psia. Sage thermal mass flow meters measure the direct mass flow at the following reference conditions: Flare 4 Sage s/n 214832: 60°F and 29.92 Hg
Frequency of monitoring/recording	Continuously monitored, recorded on a 2-minute basis.
Value applied	To be calculated at verification.
Monitoring equipment	<u>Engine</u>: Rosemount 3051 Pressure Transmitter s/n 514151 <u>Flare 1</u>: Rosemount 3095 Pressure Transmitter s/n 41863 <u>Flare 2</u>: Rosemount 3051 Pressure Transmitter s/n 514152 <u>Flare 4</u>: Sage Mass Flow Meter s/n 214832
QA/QC procedures to be applied	The flow meters are maintained and calibrated according to manufacturer specification.
Purpose of data	Calculation of the baseline and Project emissions.
Calculation method	Integrated logic of Yokogawa data loggers. Note that the meters are calibrated to give readings for the reference conditions listed above. Thus, meter readings are corrected to standard cubic feet for 68 °F using Equation 11 of the Tool to determine the mass flow of a greenhouse gas in a gaseous stream: $V_{t,wb,n} = V_{t,wb} \times \left[\left(\frac{T_n}{T_t} \right) \times \left(\frac{P_t}{P_n} \right) \right]$
Comments	N/A

Data / Parameter	$v_{CH_4,t,wb}$
Data unit	ft ³ CH ₄ /ft ³ wet gas
Description	Volumetric fraction of methane in a time interval t on a wet basis
Source of data	Peoria Disposal Company
Description of measurement methods	Captured by data logger for the continuous measurements and landfill staff for handheld measurements

and procedures to be applied	
Frequency of monitoring/recording	Methane fraction is continuously monitored at the flares and monitored at least twice weekly at the engines via hand held readings.
Value applied	To be determined at verification.
Monitoring equipment	Siemens Ultramat 23 at each flare skid (S/Ns N1A2-146, N1A1-699) and a Landtec GEM hand held analyzer at the engine (S/N G500309)
QA/QC procedures to be applied	The continuous gas analyzer (Siemens Ultramat) is calibrated quarterly in the field. The hand held analyzers (Landtec) are calibrated to reference gases before use, as documented in the LFG Monitoring Field Reports. These meters are factory calibrated annually.
Purpose of data	Calculation of the baseline and Project emissions
Calculation method	Integrated logic of data loggers for continuous measurements at the flares.
Comments	N/A

Data / Parameter	T_t
Data unit	°F (or °R)
Description	Temperature of the gaseous stream to the power plant or flare in time interval t
Source of data	Peoria Disposal Company
Description of measurement methods and procedures to be applied	Landfill gas temperature is monitored continuously, and automatically converted by the respective flow meter/transmitter into compensated total flow value at reference condition 60 °F. Readings are corrected to 68 °F (527.67 °R) for further calculations.
Frequency of monitoring/recording	Continuously
Value applied	N/A
Monitoring equipment	Flow meters

QA/QC procedures to be applied	The flow meters are maintained and calibrated according to manufacturer specification, which is every 5 years.
Purpose of data	Calculation of the baseline and Project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	P_t
Data unit	Atmospheres (or psia)
Description	Pressure of the gaseous stream to the power plant or flare in time interval t
Source of data	Flow meters give readings for standard pressure of 1 atm (14.70 psia)
Description of measurement methods and procedures to be applied	Flow meter readings
Frequency of monitoring/recording	Continuously
Value applied	N/A
Monitoring equipment	Flow meters
QA/QC procedures to be applied	The flow meters are maintained and calibrated according to manufacturer specification, which is every 5 years.
Purpose of data	Calculation of baseline and Project emissions
Calculation method	N/A
Comments	N/A

5.3 Monitoring Plan

The purpose of monitoring is to ensure the Project accomplishes its greenhouse gas reductions as expected by WVPA, and to ensure its emission reductions are creditable pursuant to this PD and the Voluntary Carbon Standard.

The data to be reported are:

- Total landfill gas captured
- Landfill gas flow to the generators and flares
- Landfill gas constituent concentration
- Operating hours of the generators
- Quantity of electricity generated
- Quantity of grid electricity used by Project equipment
- Quantity of waste disposed at the landfill

The origin, measurement techniques, monitoring time periods, responsibilities, and data quality management systems are described in below.

Parameter	Data source	Frequency	Party	Notes
Normalized flow to generators	Continuous flow meter (Rosemount 3051 Transmitter)	Captured continuously	Wabash operations technician	Continuous flow data is submitted periodically to 3Degrees
Normalized flow to flares	Continuous flow meter (Rosemount Transmitters 3095 and 3051, and Sage Thermal Mass Flow Meter)	Captured continuously	GFL Environmental technician	Continuous flow data is submitted periodically to 3Degrees
Landfill gas temperature and pressure	Continuous flow meter	Captured continuously	Wabash operations technician/GFL technician	Flow readings are normalized to standard temperature and pressure by flow meter, thus temperature and pressure are not tracked separately
Total electricity generated	kWh meters	Hourly	Ameren	Total generated electricity is reported in Wabash monthly electricity bills, used to verify methane destruction
Engine Operating Hours	Operating hours meters	Hourly	Wabash operations technician	Cumulative engine operating hours are recorded daily

Parameter	Data source	Frequency	Party	Notes
Flare Operating Hours	Flare Thermocouples	Continuously	GFL personnel	At temperatures above 500 °F, flare is assumed to be operational
Methane fraction at flares	Siemens Ultramat 23 continuous gas analyzers	Continuously	GFL personnel	Continuous methane data is submitted periodically to 3Degrees
Methane fraction at power plant	Handheld meter (Elkins Earthworks Envision and Landtec GEM units)	At least twice weekly	GFL personnel	Methane data is aggregated in a spreadsheet manually and sent to 3Degrees periodically. Field calibration records also kept on meter
Waste Disposed	Scale readings as submitted to Illinois EPA	Annually	GFL personnel	3Degrees will collect this data annually from IEPA reports as they become available
Grid electricity used by Project	Electricity bills for WPVA/PDC	Monthly	GFL personnel	
Propane used by the Project	Propane receipts	Periodically	GFL personnel	
Operating permits	Wabash Valley Power personnel, GFL, Illinois EPA	Annually	3Degrees	3Degrees will ensure operating permits are valid and complete

The following chart provides a summary of a proposed equipment calibration plan. Actual QA/QC procedures will depend on the specific pieces of equipment used. The equipment manufacturer's recommendations and guidance are provided in Attachment 18.

Equipment	Calibration procedure	Frequency	Responsible party
Continuous flow meter	Factory calibration, as recommended by manufacturer	Per manufacturer's recommendation	Factory-authorized representative
Continuous methane analyzers	Field calibrate against reference gases, record results	Annually	GFL personnel technician

Equipment	Calibration procedure	Frequency	Responsible party
Generator kilowatt-hour meter	As recommended by manufacturer	Not responsibility of Project operators	Ameren
Handheld gas constituent analyzer	Field calibrate against reference gas cylinder, record results	Daily prior to use	GFL personnel operations technician
Handheld gas constituent analyzer	Factory calibration	At least annually	Factory-authorized representative

Non-conformances with this monitoring plan will be recorded and implemented as Project Description deviations in the relevant reporting period monitoring reports and corrective action will be taken as appropriate/possible to return to conformance with the monitoring plan.

Project Personnel and Responsibilities

GFL will be responsible for data collection and quality assurance for flare related data. Relevant staff includes Andrew Whelpley, Program Manager, and Kyle Martin, Compliance Specialist. Dedicated Yokogawa data recorders will continuously record gas flow, methane, and flare operating temperature for each flare. GFL is responsible for factory calibration of the meters related to the flares.

Wabash Valley Power has overall responsibility for operation and maintenance of the power plant. The primary data that they will retain relevant to effort is the engine hour logs. GFL will be responsible for data collection and quality assurance of the engine flow meter and collection of methane readings at the power plant and field calibration of the handheld methane analyzer.

3Degrees will be responsible for collating data, performing additional quality assurance checks, preparing Project emissions reductions calculations in accordance with the PD and ACM0001, and preparing monitoring reports and VCS documentation.

Data Generation and Storage

Project data is generated on site by Project meters, or through utility bills/propane receipts. For the engines, data from Project meters will be backed up through manual records, i.e. totaled flow, twice weekly methane readings, and engine operating hours will be entered into Excel spreadsheets for long-term storage. Utility bills will be stored on site, and also scanned for transfer to 3Degrees for analysis and storage.

Continuous flow, methane, and flare temperature data for the Project flares will be recorded to flash memory cards on the data recorders and also backed up wirelessly to an online SCADA system. Field calibration records for the flare flow meters, continuous methane analyzers, and the Landtec GEMs will be stored at GFL offices in Peoria, IL. Field calibration events for the

Landtec GEM will be recorded manually in a weekly monitoring log. Utility bills and propane receipts will be stored on site in the Landfill offices and scanned for transfer to 3Degrees.

Project data will be submitted to 3Degrees in electronic format on an approximately quarterly basis. 3Degrees will receive flow, methane, and engine operating hours in Excel format with the exception of raw flow data in proprietary Yokogawa format (3Degrees has a viewer for this type of file and converts to an excel format for data processing). Utility bills and factory calibration certificates will be transmitted to 3Degrees in PDF form. These data submittals will form the basis of the 3Degrees' calculation of credits generated during each monitoring period. 3Degrees will also collect current copies of permits and ensure that all necessary permits are valid.

All Project data, documents, permits, and calculations will be stored on 3Degrees' cloud based server. 3Degrees will ensure that all the documents and records are maintained for at least two years after the end of the Project crediting period.

Internal Auditing Procedures

Quality Assurance will be provided by 3Degrees' independent review of all Project data and calibration records on a quarterly basis. 3Degrees' handling of Project data will include the following steps:

- Integration of new data submittals into past performance data;
- Review of data for anomalies, inconsistencies, and outlying data points;
- Completeness checks of data for gas quality, gas quantity, and evidence of destruction;
- Review of electricity generation and engine operating hours in relationship to Project performance.

3Degrees will work with GFL to resolve any issues identified during the quality assurance review.