

# VERIFICATION REPORT FOR GREATER LEBANON REFUSE AUTHORITY LANDFILL GAS COLLECTION AND COMBUSTION PROJECT



Document Prepared By: SCS Global Services

Contact Information: [www.scsglobalservices.com](http://www.scsglobalservices.com)

<b>Project Title</b>	Greater Lebanon Refuse Authority Landfill Gas Collection And Combustion Project
<b>Version</b>	1
<b>Report ID</b>	VCS Verification Report_GLRA_V1-0_041718

<b>Report Title</b>	Verification Report for the Greater Lebanon Refuse Authority Landfill Gas Collection and Combustion Project
<b>Client</b>	3Degrees, Inc.
<b>Pages</b>	23
<b>Date of Issue</b>	17 April 2018
<b>Prepared By</b>	SCS Global Services
<b>Contact</b>	2000 Powell Street, Ste. 600, Emeryville, CA 94608 USA
<b>Approved By</b>	Christie Pollet-Young - Director, Greenhouse Gas Verification
<b>Work Carried Out By</b>	Tina Sentner - Lead Verifier Tiffany Mayville - Verifier Mark Lutz - Internal Reviewer

**Summary:**

SCS Global Services (SCS) conducted a periodic verification of the Greater Lebanon Refuse Authority Landfill Gas Collection and Combustion Project located in Lebanon, Pennsylvania (“the Project”). In this project, methane gas is collected from active and inactive portions of the Greater Lebanon Refuse Authority landfill and sold to a local utility who uses it to generate electricity from twin Caterpillar internal combustion engines that are coupled to electricity generators (“generator sets”).

3Degrees Group Inc. (previously known as Origin Climate Inc.) engaged SCS to verify its emission reductions from 1 January 2017 to 31 March 2018. SCS verified the asserted emission reductions against criteria found in CDM Approved Consolidated Baseline Methodology ACM0001, Version 8, “Consolidated Baseline and Monitoring Methodology for Landfill Gas Project Activities.”

The objective of the engagement with 3Degrees was to determine, with reasonable assurance, that the calculated emission reductions for this project were, in all material respects, accurately stated. The SCS verification team conducted its verification in accordance with Verified Carbon Standard Version 3.7 (21 June 2017), Verified Carbon Standard Program Guidelines Version 3.7 (21 June 2017) and ISO 14064, Part 3, Greenhouse gases – Specification with guidance for the validation and verification of greenhouse gas assertions. SCS raised seven (7) findings during the verification and all issues were satisfactory closed.

On the basis of work conducted, SCS was able to conclude with reasonable assurance that 3Degrees asserted vintage 2017 methane emission reductions were accurately stated. More detail concerning this conclusion is provided in Section VI of this report.

**Table of Contents**

1 Introduction ..... 4

    1.1 Objective ..... 4

    1.2 Scope and Criteria ..... 4

    1.3 Level of Assurance ..... 4

    1.4 Summary Description of the Project ..... 4

2 Verification Process ..... 5

    2.1 Method and Criteria ..... 5

    2.2 Document Review ..... 7

    2.3 Interviews ..... 7

    2.4 Site Inspections ..... 7

    2.5 Resolution of Findings ..... 9

        2.5.1 Forward Action Requests ..... 9

    2.6 Eligibility for Validation Activities ..... 9

3 Validation Findings ..... 9

    3.1 Participation under Other GHG Programs ..... 9

    3.2 Methodology Deviations ..... 9

    3.3 Project Description Deviations ..... 9

    3.4 Grouped Project ..... 11

4 Verification Findings ..... 11

    4.1 Project Implementation Status ..... 11

    4.2 Accuracy of GHG Emission Reduction and Removal Calculations ..... 14

    4.3 Quality of Evidence to Determine GHG Emission Reductions and Removals ..... 16

    4.4 Non-Permanence Risk Analysis ..... 17

5 Safeguards ..... 17

    5.1 No Net Harm ..... 17

    5.2 Local Stakeholder Consultation ..... 17

6 Verification conclusion ..... 17

APPENDIX A: List of Findings ..... 19

## 1 INTRODUCTION

### 1.1 Objective

The objective of this verification audit was to determine, with reasonable assurance that:

- Methods and monitoring procedures were implemented in accordance with the validated project description. This includes ensuring conformance with the monitoring plan.
- GHG emissions reductions quantified, monitored, and reported in the monitoring report were materially accurate.

### 1.2 Scope and Criteria

The scope of the engagement included quantification, monitoring and reporting of greenhouse gas project emissions reductions associated with the operation of internal combustion engines operating electricity generator sets at the Greater Lebanon Refuse Authority Landfill located in Lebanon County, Pennsylvania, USA. The scope also included an enclosed flare, which was installed and available for use as a backup combustion device for when the engines were down. The temporal scope included 1 January 2017 to 31 March 2018.

3Degrees Group Inc. (3 Degrees) and the Greater Lebanon Refuse Authority implemented its methane emission reduction project in accordance with the requirements of the CDM methodology ACM0001, version 8, and the Verified Carbon Standard 2007.1. SCS conducted its verification of the reported emission reductions in accordance with:

- the Verified Carbon Standard Version 3.7, (21 June 2017),
- the Verified Carbon Standard Program Guidelines Version 3.7 (21 June 2017),
- the Verified Carbon Standard Validation and Verification Manual
- ISO 14064:2006 Part 3, Greenhouse gases – Specification with guidance for the validation and verification of greenhouse gas assertions. SCS is a GHG validation and verification body accredited by the American National Standards Institute in the project scope of waste management.

### 1.3 Level of Assurance

This engagement was performed at the reasonable level of assurance. Emission reduction reports were considered accurately stated if they varied by no more than 5% from a complete statement of the project's emission reductions.

### 1.4 Summary Description of the Project

The Greater Lebanon Refuse Authority Landfill Gas Collection and Combustion Project (the "Project") was implemented at a site containing both active and inactive landfill areas operated by the Greater Lebanon Refuse Authority (GLRA) in Lebanon County, Pennsylvania. The project sells landfill gas to EPP Energy Services (formerly PPL Energy Services), which operates two internal combustion engines and electricity generators ("generator sets"). The carbon credit originator, purchaser, and preparer of the monitoring reports was 3Degrees Group Inc.

The existing gas collection system draws landfill gas from both the currently active landfill area and a previously closed landfill area. The gas collection system has been optimized for the currently active landfill site, and feeds the generator sets installed at the southwest side of the active landfill. An enclosed flare is installed at the north side of the landfill gas collection system

near the site where a former operator, Lebanon Methane Recovery (LMR), generated electricity from GLRA landfill gas. The collection system is constructed such that the enclosed flare can be used as a backup combustion device when the generator sets are not operational for extended periods of time.

The project baseline is reduced by the amount of methane formerly destroyed by LMR at the generator sets that are now decommissioned and at the enclosed flare that was installed in 2002 and was used by LMR until June 2007. The Project start date of 13 September 2007, was verified by reference to the project validation report and through review of the first in a series of records of gas payments to GLRA from EPP Energy Services. From this date well field gas collection was expanded and optimized and methane was routed to the new generator sets.

## 2 VERIFICATION PROCESS

### 2.1 Method and Criteria

SCS conducted its verification of the reported emission reductions in accordance with ISO 14064:2006 Part 3. The following is a summary of the verification process implemented by SCS:

- Conflict of Interest Review and Appointment of Team
- Kick-off meeting with 3Degrees Group Inc.;
- Conduct a Document Review including the Project Description (PD) and supporting data;
- Development of the verification and sampling plan;
- Interviews and execution of the sampling plan;
- Review and evaluation of raw data and emission reduction calculations for the period under review;
- Follow-up of Non-conformities and Clarification Requests as needed; and
- Final statement and report development.

#### **Conflict of Interest Review**

Conflict of Interest inquiries were completed for SCS and for the verification team and a finding of low COI risk was confirmed by SCS's internal COI process. The COI assessment was conducted to identify any potential conflict of interests with the verification/project.

#### **Appointment of Verification Team**

This verification was performed by Tina Sentner, SCS Lead Verifier, and reviewed by Mark Lutz, SCS Senior Internal Reviewer. Tina Sentner and Mark Lutz are lead verifiers approved by SCS to conduct landfill gas project verifications.

#### **Project Kick off Meeting**

A kick off meeting was conducted on 9 January 2018 between the verification team and 3Degrees. The purpose of the kick off meeting was to review the timeline of verification; confirm verification criteria; determine any changes in the site, sources, GHG management systems or personnel, and to begin gathering information.

#### **Desk Review**

SCS reviewed the Project Description Document, Project monitoring report, the Validation Report and supporting documentation. A detailed discussion is provided below. A risk assessment was

conducted to identify key factors that impact the reported emission reductions and removals. A Verification Plan was created to focus on the critical elements presenting potential risk for errors with the project. A separate sampling plan was designed to review all project elements in areas of high risk of inaccuracy or non-conformance. The verification plan was submitted prior to the verification activities.

### **Site Visit**

There was no site visit conducted for this reporting period. A site visit was previously conducted by the lead verifier on 2 March 2017. The purpose of the site visit is to verify the project equipment, location and eligibility, to review and evaluate the project GHG management systems, data collection and handling, and emission reduction calculations and procedures in place, and to finalize the risk assessment and sampling plan. During the kick off call, the Project confirmed there were no changes to the GHG Management system, data collection and handling or procedures since the previous site visit and SCS concluded a site visit was not necessary this reporting period.

### **Quantitative Review**

An assessment of the emission reduction calculation inputs and procedures was performed to review the quantitative analyses undertaken by the Project Proponent, of converting the raw inventory data into emission reduction estimates.

### **Findings**

Throughout the verification, there is an iterative exchange between SCS and the Project Proponent to gather additional information for review and examination. This exchange includes Findings—New Information Requests (NIR), and Non-Conformity Reports (NCR)—that are issued by SCS to the Project Proponent. The Project Proponent must respond to NIRs and NCRs in order for SCS to render a verification opinion. At this time all Findings have been appropriately addressed by 3Degrees and subsequently closed by SCS.

### **Final Report and Opinion**

The last step in the verification process included a final review of the submitted data, completion of the Verification Report, and drafting of the Deed of Representation. The draft report was presented to an internal SCS Senior Technical Reviewer who determines the Verification Opinion to be justified given the evidence presented. Once completed, the Verification Report and Deed of Representation are presented to the project proponent for approval and subsequent submittal to the VCS.

### **Exit meeting with client**

The exit meeting entails a review of the verification process, summary of the verification findings and to initiate scheduling for the next verification period.

**2.2 Document Review**

The verification team conducted a document review to inform the planning process in advance of performing verification activities. Documents reviewed included the GLRA VCS Monitoring Report version 1 2017 and final version 3 against the project developer’s Validated Project Design Document, version 6 (11 November 2008) and against ACM0001, ver. 8. Discrepancies between project documentation and the verification criteria were considered material and identified for corrective action. Project deviations were reviewed and justification from 3Degrees was assessed. In addition, SCS assessed the GHG emission reduction assertion and underlying monitoring data to determine if either contained material or immaterial misstatements. The results of these reviews are discussed in greater detail below.

SCS’s verification approach is risk-based. It draws upon our understanding of risks to fair statement of reported emissions and the operation of controls to reduce such risks. As a result of the document review and correspondence with project management personnel, a verification plan and a sampling plan were developed for this engagement.

**2.3 Interviews**

Throughout the course of verification activities and during the site visit, SCS interviewed the following project personnel:

Person	Title	Organization
Julie Kelleher	Associate	3Degrees Group Inc.

The purpose of the interviews were to assess and confirm information and data provided in the Project Description and monitoring report, identify relevant competencies to assigned roles and responsibilities, and to assess the GHG management systems implemented onsite.

**2.4 Site Inspections**

A site visit was previously conducted on 2 March 2017. During the site visit, SCS conducted an inspection of the project well field, flare skid, and engine facility operated by EPP. SCS conducted interviews of key personnel to assess if the management control environment of the Project. This review included the following:

- Assess if changes to the implementation of the landfill gas project to report emission reductions in accordance with the ACM 0001, Version 8, “Consolidated baseline and monitoring methodology for landfill gas project activities” and the Project Description Document;
- Review the Project Proponents knowledge of and assertion of compliance with applicable air and water regulations;
- Assess if any changes in applicable methane and carbon dioxide emission sources within the project boundary and their quantification as defined by the ACM 0001, Version 8, “Consolidated baseline and monitoring methodology for landfill gas project activities”;
- Assessment of the Project’s compliance with monitoring of key operational parameters of its landfill gas collection and destruction project as noted in the project description;
- Assessment of the capability of the Project’s management system and procedures to produce accurate, reliable, and reproducible data and information;

- Review of the Project's conformity in all material respects with the requirements of the ACM 0001, Version 8, "Consolidated baseline and monitoring methodology for landfill gas project activities";
- Reviewing the basis for and results achieved from the calculated methane emission reductions from its landfill gas collection and destruction project.

SCS conducted an interview and risk assessment with the Project developer prior to verification activities and determined that a site visit was not necessary.



## 2.5 Resolution of Findings

SCS issued four (4) corrective action requests, three (3) requests for clarification, and no opportunity for improvement during the verification process. 3Degrees' responses were sufficient to resolve all clarification requests. The clarification requests with the responses provided are summarized in the Appendix

### 2.5.1 Forward Action Requests

There were no Forward Action Requests outstanding or raised during the verification.

## 2.6 Eligibility for Validation Activities

SCS maintains the ANSI accreditation of Validation Body under ISO 14065 for sectorial scope 06. Waste Handling and Disposal and is therefore eligible to review the project description deviation noted below.

## 3 VALIDATION FINDINGS

The scope of this verification does not include a gap validation, or validation of methodology deviations. However, SCS did review previous project descriptions and two new project description deviations.

### 3.1 Participation under Other GHG Programs

This project does not seek registration under Other GHG Programs.

### 3.2 Methodology Deviations

There were no new methodology deviations noted for this verification period.

### 3.3 Project Description Deviations

There were six project description deviations applied during this verification. SCS reviewed the project description deviations against the CDM *Guidelines on assessment of different types of changes from the project activity as described in the registered PDD*. The following is a review of the deviations:

The project determined that the flare was seldom used as back up for the engines and therefore elected to not seek credit for the gas it destroyed. As such, a couple of the ongoing QA/QC procedures associated with the monitoring equipment at the flare were omitted during this reporting period. These included the following:

1. The Thermal instrument Company flow meter model 62-9 at the flare was not field-checked for flow accuracy on a quarterly basis against handheld flow meters
2. The annual calibration of the thermocouple was not conducted.

The project proponent documented that the omission of the flare flow data would not have an impact on the applicability of the methodology, appropriateness of the baseline scenario or additionality of the project. SCS reviewed the flare flow data and confirmed that the flare flow was not significant and was less than 1% of the total landfill gas destruction. In addition, SCS verified that a third party calibrated the flare flow meter during the verification period. Lastly the flare thermocouple was observed to be operational in the monitoring data indicating its operational status. Based on this review, SCS concluded the omission of the flare data and subsequent monitoring of the flare flow meter and thermocouple were appropriately described and justified in the monitoring report.

The third deviation was applied to the annual calibration of the Rosemont pressure transmitter that monitors the amount of landfill gas combusted in the power plant. The Project did not conduct the annual calibration during the verification period. The project proponent documented that the omission of the calibration of the flow meter would not have an impact on the applicability of the methodology, appropriateness of the baseline scenario or additionality of the project. SCS verified the Project received correspondence from Rosemont indicating the calibration of the instrument could be extended to up to five years based on this type of installation. In addition, the Rosemont representative provided a field calibration check method to the Project to ensure accuracy of the instrument. SCS confirmed the meter was field checked by a third party on a monthly basis according to the field check procedure and was observed to be operating within accuracy.

The fourth deviation resulted from Missing data from Siemens methane analyzer.

The Siemens Ultramat 23 is set up to continuously monitor methane concentration of the landfill gas delivered to the power plant and record every minute, while the data acquisition system aggregates weekly into operational logs. For the period of 10 August 2016 to 26 August 2016, the Siemens Ultramat 23 was out of service due to overheating and failure. To account for methane concentration during the 16-day period, the Project substituted data based on the 95% lower confidence limit of all valid 1-minute data throughout the month of August. The data substitution was applied to the weekly methane readings in the operational logs. SCS reviewed the data substitution procedure and calculations and determined that taking the valid 1 minute data from the month of August resulted in a representative data set to apply the 95% lower confidence limit to substitute methane concentration. In addition, ACM0001 does allow for periodical measurements with a 95% confidence level, but GLRA's project description says they will only use continuous readings. As such SCS agrees the substitution is a deviation from the project description. Lastly, SCS concluded the deviation does not affect the applicability of the methodology, nor does it impact the Additionality or the appropriateness of the baseline scenario. The project remains in compliance with the applied methodology.

The fifth deviation resulted from Missing data from Siemens methane analyzer.

For the period of 15 April 2017 to 01 May 2017, the Siemens Ultramat 23 was out of service due to an unknown failure. To account for methane concentration during the 15-day period, the Project substituted data based on the 95% lower confidence limit of all valid 1-minute data throughout the month of April and May. The data substitution was applied to the weekly methane readings in the operational logs. SCS reviewed the data substitution procedure and calculations and determined that taking the valid 1 minute data resulted in a representative data set to apply the 95% lower confidence limit to substitute methane concentration. In addition, ACM0001 does allow for periodical measurements with a 95% confidence level, but GLRA's project description says they will only use continuous readings. As such SCS agrees the substitution is a deviation

from the project description. Lastly, SCS concluded the deviation does not affect the applicability of the methodology, nor does it impact the Additionality or the appropriateness of the baseline scenario. The project remains in compliance with the applied methodology.

The sixth deviation applied to the Project is a result of using an updated GWP for Methane. In accordance with VCS Standard v3.7, released in June 2017, the Project transitioned the source of global warming potential from IPCC's Second Assessment Report to the IPCC's Fourth Assessment Report (AR4). For methane this results in a change from GWP of 21 to a GWP of 25. The Project justified the use of the above referenced destruction efficiency as more appropriate as it is a value approved in the VCS Standard. Accordingly, the wide adoption of this value suggests overarching acknowledgement of its relevancy, accurateness, and appropriateness in the U.S. SCS concluded the deviation does not affect the applicability of the methodology, nor does it impact the Additionality or the appropriateness of the baseline scenario. The project remains in compliance with the applied methodology.

Based on the above review, SCS determined that the project deviations noted above were valid, appropriately described and justified, and concluded that the Project remained in compliance with VCS rules.

### **3.4 Grouped Project**

This section does not apply.

## **4 VERIFICATION FINDINGS**

### **4.1 Project Implementation Status**

The Greater Lebanon Refuse Authority Landfill Gas Collection and Combustion Project (the "Project") was implemented as indicated in the validated project description on a site containing both active and inactive landfill areas operated by the Greater Lebanon Refuse Authority (GLRA) in Lebanon County, Pennsylvania. The project sells landfill gas to EPP Energy Services, which operates the internal combustion engines and electricity generators ("generator sets"). The carbon credit originator, purchaser, and preparer of the monitoring reports was 3Degrees Group Inc.

SCS confirmed through interviews that the existing gas collection system continues to draw landfill gas from both the currently active landfill area and a previously closed landfill area. The well field and gas collection system has been optimized for the currently active landfill site, and feeds the generator sets installed at the southwest side of the active landfill. An enclosed flare is installed at the north side of the landfill gas collection system near the site where a former operator, Lebanon Methane Recovery (LMR), generated electricity from GLRA landfill gas. The collection system is constructed such that the enclosed flare can be used as a backup combustion device when the generator sets are not operational for extended periods of time. Except for periodic testing and during events when one or both generator sets were down, the enclosed flare did not operate. No emission reductions were claimed for methane destruction in the flare during these brief operating periods.

The Project start date of September 13, 2007, was verified by reference to the project validation report and through review of the first in a series of records of gas payments to GLRA from EPP Energy Services. From this date well field gas collection was expanded and optimized and methane was routed to the new generator sets.

**Project Monitoring**

SCS assessed the implementation status of the monitoring plan and the completeness of monitoring, including the suitability of the implemented monitoring system as defined in the Project Description Document and Project Monitoring Report. Project monitoring was performed by GLRA for the landfill and enclosed flare and by EPP Energy Services technicians for the electricity generator sets and reported to 3Degrees. SCS confirmed that measurement equipment installed just prior to combustion at the generator sets included a gas flow meter and methane concentration analyzer. Methane concentration and flow meter data were logged continuously approximately every 84 seconds on a Supervisory Control and Data Acquisition (SCADA) software system developed by EPP Energy Systems. The SCADA system also controls the Caterpillar internal combustion engines and the generators.

Engine Landfill gas flow was measured using a Veris Veribar flow sensor and a Rosemount 1151 Smart Pressure Transmitter. The Veris Veribar does not require periodic calibration. According to the manufacturer, a periodic inspection and cleaning of the Rosemont Transmitter unit could be done on a frequency of once every five years (see project deviation noted above). EPP inspected, cleaned and calibration checked the unit on a monthly basis. The Rosemount differential pressure transmitter was installed new in September 2007. Product data sheets delivered with the instrument at the time claimed a  $\pm 0.075\%$  reference accuracy and a two year stability of  $\pm 0.1\%$ . OEM documentation suggested a factory calibration on a two year interval. 3Degrees provided evidence that the instrument was last calibrated on June 2014 and field checked monthly as noted above. SCS has concluded from the evidence presented that the pressure differential transmitter remained reliable during the reporting period. Temperature and pressure were not separately monitored because the project used flow meters that automatically measured temperature and pressure; expressing LFG volumes in normalized SCF (68 deg. F and 1 atmosphere).

Methane concentration for the engine was measured using an in-line Siemens Ultramat 23 continuous gas analyzer. The gas analyzer was observed to be field calibrated to span gas on an at least quarterly basis. There is no manufacturer requirement for factory calibration; only calibration to known gases on an annual basis. SCS reviewed the calibration record for a calibration of the Ultramat by a third party quarterly during the reporting period, which indicated the meter was operating accurately. The gas analyser experienced a malfunction and was removed for repair and 15 April 2017 and an identical like spare was put in its place on May 1, 2017. During this time, the project implemented substituted data during the period the Siemens was down (see section above regarding deviations).

Flare landfill gas flow was measured continuously using a Thermal Instrument thermal mass flow meter. The flow meter was calibrated on an annual basis by the manufacturer but quarterly inspection and cleanings were not conducted; nor was the thermocouple calibrated annually (see section 3.3 for this deviation). Flow was recorded on a Honeywell Truline circular chart recorder. Methane concentration for the flare was measured using an Elkins Earthworks Envision portable methane analyzer. SCS verified records related to the maintenance and operation of the enclosed flare even though the flare did not operate significantly during the reporting period covered by this verification report except for periodic testing and the few days the generator sets were not operating. Emission reductions were not claimed for landfill gas destroyed through the flare.

The operation hours of the engines were monitored to ensure that methane was only flowing to the engines when they are operating. The operation of the flare was monitored through the flare’s thermocouple temperature readings.

SCS confirmed the GHG emission reductions or removals generated by the Project were not intended to be included in an emissions trading program or any other mechanism that includes GHG allowance trading by interview of 3Degrees Offset project team and by review of the project monitoring plan that indicated no such activities were considered. The Offset Project manager confirmed the project has not received or sought any other form of environmental credit, or become eligible to do so since validation or previous verification. Lastly, the project has not participated or been rejected under any other GHG programs since validation or previous verification.

SCS also confirmed via interviews with 3Degrees that the project has not participated or been rejected under any other GHG programs since validation or previous verification. SCS reviewed various registry websites such as the Climate Action Reserve and did not find the Project listed on this website.

During the verification process, it was noted there were no remaining issues from the previous validation. The validation process for the Project identified one methodology deviation from ACM0001. Ver 8 methodology as follows:

Parameter	Monitoring	Deviation	Validator conclusion
MD LFG <sub>total y</sub> MD <sub>electricity y</sub> :	Alternative calculation method for LFG total y	Total Landfill gas is not monitored separately. The Protocol requires three flow meters when two destruction methods are used (i.e., generators plus flare): one meter at each destruction location and one meter for total flow. At GLRA, the flare and generator blowers are physically distant and pull gas in opposite directions, so there is no possible location for a total flow measurement.	The deviation from the ACM 0001 methodology was accepted by the Project Validator because an alternative method of crosschecking the amount of methane at the generator sets exists using the total kilowatt-hours generated by the power plant. The alternative MD <sub>Electricity</sub> calculations substitute for a third measurement device because they are based on an independently measured parameter. Does not impact eligibility, conformance, or performance of Project against ACM0001

Based on the above review, SCS concluded that the project was implemented as described in the project description and the project monitoring remained effective during the verification period.

#### 4.2 Accuracy of GHG Emission Reduction and Removal Calculations

The emission reduction calculation assessment included the review of project assumptions, raw data inputs and accuracy of calculations. The formulas and raw data inputs used to determine emission reduction calculations as described in the emission reduction calculation spreadsheets were first reviewed for compliance with ACM 0001, version 08 methodology and the validated Project Description document.

SCS reviewed emission reduction calculations for the reporting period, using the following specific tests and checks:

- Samples of raw data were tested for continuity and consistency of flow rates, methane content and for handling of outliers.
- Methane fraction readings were compared to the data used in the calculations.
- Excel formulas that transposed data from one worksheet to another were checked for errors.
- All formulas used were tested to ACM 0001 v08 and to the validated PDD.
- Samples of raw data were examined and followed through to final calculations.
- Confirmation of operation and calculation of the flare and electricity generator to the required parameters (temperatures, flow rates, efficiency factors, etc....) defined in the validated PDD were conducted.
- Samples of spreadsheet aggregation formulas were checked for accuracy.
- Default factors were verified to the validated PDD.
- Independent calculations, using aggregated spreadsheet data, were used to compare final results from the Project spreadsheets.

SCS verified the project monitoring data for the following parameters and values:

Data Unit / Parameter:	Description	Value Monitored as verified
LFGelectricity,y	Amount of landfill gas combusted in power plant at normal temperature and pressure in a year y	2017= 349,325,056 ft3 2018= 48,828,416 ft3
WCH4, power plant	Methane fraction in landfill gas at power plant (average for year)	2017= 52.7% 2018= 52.9% ft3 CH4 / ft3 LFG
Operation of the Energy Plant	Hours	2017= 17,137 2018= 2,753 .
Electricity produced	Quantity of electricity delivered to the grid from each generator	2017= 16,779,236 kWh 2018= 2,330,188 kWh

LFG <sub>flare,y</sub>	Amount of landfill gas flared at normal temperature and pressure	0 ft <sup>3</sup> No emission reductions claimed this period
WCH <sub>4, flare</sub>	Methane fraction in landfill gas at flare	0 % ft <sup>3</sup> CH <sub>4</sub> / ft <sup>3</sup> LFG No emission reductions claimed this period
T <sub>flare</sub>	Flare temperature for evidence of combustion	Not used for emission reductions
D <sub>ch4</sub>	Methane density	0.04166 lbs CH <sub>4</sub> /ft <sup>3</sup>
AF	Adjustment Factor (ε <sub>BL</sub> /ε <sub>PR</sub> )	0.7472
ε <sub>BL</sub>	Methane destruction efficiency of the collection system in the baseline scenario	0.61
ε <sub>PR</sub>	Destruction efficiency of the system used in the Project Scenario	0.82

Landfill gas collected and destroyed along with Methane fraction (W<sub>CH<sub>4</sub></sub>) were used to calculate the amount of methane destroyed by the project. Flow was first calculated by taking the flow difference between the aggregated monitoring periods from the raw data provided by EPP. Methane destroyed from each destruction device was aggregated on a monthly basis and the annual monthly summaries were brought forward to the emission reduction calculation spreadsheet for further calculation. The methane destroyed by the Project (MD<sub>project,y</sub>) was calculated based on the quantity used to generate electricity as no emission reductions were taken by the flare due to its limited use. The calculations were as follows and have been total for the whole period for simplicity:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y}$$

Where:

$$MD_{electricity,y} = LFG_{electricity,y} * W_{CH_4,y} * D_{CH_4} / 2204.6$$

$$MD_{flared,y} = LFG_{Project\ total,y} * W_{CH_4,y} * D_{CH_4} * \left( 1 - \frac{PE_{flare,y}}{GWP_{CH_4}} \right)$$

Therefore:

$$MD_{project,y} = (0) + (398,153,472 \text{ t}^3 * 52.8\% * 0.04166 / 2204.62)$$

$$MD_{project,y} = 3,967 \text{ tCH}_4$$

For conservativeness, the equations above were compared to Methane Generated to LFG destroyed. The lesser of two values was used to calculate methane destroyed.

Baseline emissions were then further correctly calculated using the formula:



$$BE_y = (MD_{\text{project}, y} - MD_{\text{BL}, y}) * GWP_{\text{CH}_4}$$

Where:  $MD_{\text{BL}, y} = MD_{\text{project}, y} * \text{Adjustment Factor}$

Adjustment factor= 0.7472 - as verified in first verification

Consistent with ACM0001, an adjustment factor is calculated and applied to account for methane generated in the baseline that may have been captured and destroyed to comply with regulations or contractual requirements. SCS confirmed that the adjustment factor was calculated correctly as .7472, in conformance with the validated Project Description.

Therefore:

$$BE_y = [3,967 \text{ t}_{\text{CH}_4} - (3,967 \text{ t}_{\text{CH}_4} * (0.7472))] * 25$$

$$BE_y = 47,376 \text{ tCO}_2\text{e}$$

Project emissions from electricity use and propane consumption were not calculated or deducted from the overall emission reductions created by the Project in conformance with the validated Project Description using equation:

$$ER_y = BE_y - PE_y$$

$$ER_y = 25,071 - 0$$

$$ER_y = 25,071 \text{ tCO}_2\text{e}$$

Through examination of the calculations in the Excel spreadsheet provided by the Project Proponent, and through an independent recalculation of the emission reductions from the verification period using the available raw flow, and methane data, SCS concluded the emission reduction calculations were calculated accurately and in conformance with ACM 0001 ver. 08 and the validated Project Description.

#### 4.3 Quality of Evidence to Determine GHG Emission Reductions and Removals

3Degrees provided documentation for emissions data, the data collection process and the quality systems associated with this project. Additional supplementary evidence was provided by EPP Power, and Greater Lebanon Landfill regarding details of the landfill itself, monitoring equipment history, and maintenance and calibration details of the equipment on the gas collection system, the flare skid and the operation of the electricity generator

SCS interviewed key personnel during the previous site visit to the Greater Lebanon Refuse Authority and assessed the management control environment of GLRA, EPP Energy Services, and 3Degrees. Controls include staffing key positions with competent personnel, exercising supervisory and management oversight, and managing data. GLRA, the landfill operator, provided personnel for maintaining the gas collection system, and inspecting and maintaining the monitoring devices at the flare. EPP Energy Services is responsible for maintaining and calibrating the flow meter and methane analyzer located just outside the generator set facility. EPP Energy Services is also responsible for managing the operations of the generator sets and monitoring operational data that feeds into its SCADA system. SCS concluded that the project participants were qualified for the functions that they performed.



Monitored data was available directly from the SCADA system in real time and a monthly operating report spreadsheet was provided to GLRA and 3Degrees. Weekly Operating reports are internally checked within EPP Energy Services and monthly by GLRA for any irregularities. 3Degrees cross checks the reported gas flow to the generator sets against engine operating hours to identify irregularities in reporting.

Data permanence was assured through redundancy of personal computers running in separate buildings with separate power connections. On-site operators maintain six months of SCADA data using preprogrammed queries. Database managers can retrieve stored information for longer periods and 3Degrees independently archives spreadsheets and other data on a permanent basis.

3Degrees aggregated the all the data generated from the Project including monitoring data from EPP and GLRA to develop the calculations for the emission reductions and to develop the Project Monitoring Report. Project monitoring was documented in the Project Design Document (version 6, 11 November 2008), and in "VCS Monitoring Report." For this project period, SCS reviewed version GLRA VCS Monitoring Report 2017 v3.

The evidence provided was sufficient for verification of the project and consistent with the requirements of the VCS Standard, v3.7 (21 June 2017), ACM0001 (Version 08), the validated PDD. SCS concluded the Project Monitoring Report and supplement data were appropriate and met accepted evidentiary standards for best practice in GHG accounting.

#### **4.4 Non-Permanence Risk Analysis**

This section is not applicable to the project.

### **5 SAFEGUARDS**

#### **5.1 No Net Harm**

There are no negative environmental or socio-economic impacts identified by the Project.

#### **5.2 Local Stakeholder Consultation**

There was no stakeholder input received during with local stakeholders during the reporting period.



### **6 VERIFICATION CONCLUSION**

Based on review of the Project Monitoring report, Validated Project Design Document and the necessary evidence requested during the verification process, SCS has concluded that the emission reductions generated from the capture and destruction of landfill gas methane have been compiled in a transparent manner, the data was found to be accurate within the uncertainty limits of the measurement equipment and emission reduction calculations were found to include all the required sources. SCS has determined that the Greater Lebanon Refuse Authority Landfill Gas Collection and Combustion Project, developed by 3Degrees Group Inc., remains implemented in accordance with the project description with the exception of the deviations noted above in section 3.2 and is in conformance with the Consolidated Baseline Methodology ACM001, version 8 and the VCS Standard 3.7 (21 June 2017). Furthermore, the Project Plans and data are considered accurate, complete, transparent, and free of material misstatements. The GHG emission reductions are considered verified to a reasonable level of assurance.

Verification period: From 01 January 2017 to 31 March 2018

Verified GHG emission reductions and removals in the above verification period:

Report period	Baseline emissions or removals (tCO <sub>2</sub> e)	Pre-Project emissions or removals (tCO <sub>2</sub> e)	Leakage emissions (tCO <sub>2</sub> e)	Net GHG emission reductions or removals (tCO <sub>2</sub> e)
<b>Vintage 2017: 1 January to 31 December 2017</b>	41,549	19,562	0	21,987
<b>Vintage 2018: 1 January to 31 March 2018</b>	5,828	2,744	0	3,084

Project Developer	3Degrees Group Inc., as credit originator for the Greater Lebanon Refuse Authority
Project Location	Lebanon, PA, USA
Project Type	Landfill gas destruction
Project Period:	1 January – 31 March 2018
Nature of Data Verified	Historical
Protocol/Methodology	CDM ACM0001, version 8 Verified Carbon Standard Version 3.7 (21 June 2017) Verified Carbon Standard Program Guidelines Version 3.7 (21 June 2017)
Emissions/Removals Verified	Vintage 2017: 21,987 metric tons of CO <sub>2</sub> -equivalent Vintage 2018: 3,084 metric tons of CO <sub>2</sub> -equivalent
Verification Conclusion, with Reasonable Assurance	Based upon the verification activities described above, SCS has concluded that the 3Degrees Group Inc. /Greater Lebanon Refuse Authority's reported 2017/2018 vintage methane emission reductions of 25, 071 metric tons are, in all material respects, fairly stated.
Lead Verifier	 Tina Sentner, 07 April 2018
Internal Reviewer	 Mark Lutz, 17 April 2018

**APPENDIX A: LIST OF FINDINGS****Project: Greater Lebanon Refuse Authority Landfill Gas Collection and Combustion Project****Reporting Period: January 1, 2017 to February 28, 2018****NCR 1 Dated 27 Feb 2018****Standard Reference:** ACM 0001/ Ver 8**Document Reference:** GLRA Monitoring Report 2016\_v1

EPP Gas Analyzer Down

**Finding:** The file: EPP Gas Analyzer Down notes the Siemens Ultramat was down from 4/16/2017 thru 5/1/2017. The Title V Semi annual report for notes that the motherboard failed and a spare instrument was installed. In addition, the EPP Gas Tech Calibration Record notes a calibration done on 5/1/2017 shows the instrument over reporting still. Please clarify the details of the Siemens analyzer downtime issues in the project monitoring report implementation status section as necessary and respond specifically:

1. When the instrument failed,
2. If a new instrument was installed or the instrument repaired (Please provide any new instrumentation calibration data records as applicable or repair orders),
3. When the continuous monitoring of methane for the engines resumed.

**Project Personnel Response:** 1. Instrument failed on 4/15/2017.

2. A new instrument was installed on May 1, 2017 (s/n E6-091). This instrument was factory calibrated before installation on 3/28/2017. Client is currently waiting on the calibration record, but a photo of the sticker on the device proving the calibration date of the new meter is included.

3. The continuous monitoring of the methane at the engines resumed on May 1, 2015.

**Auditor Response:** Thank you for the clarification. I have received the 03/28/2017 factory calibration record for the spare gas analyzer.

In addition, section 3.2 of the monitoring report v2 was observed updated with the change of like-kind instrumentation and the calibration data. Issue closed.

**Bearing on Material Misstatement or Conformance (M/C/NA):**

**NCR 2 Dated 27 Feb 2018**

**Standard Reference:** ACM0001 Ver. 8, Monitoring section  
VCS Standard 3.7, sec. 3.6.2

**Document Reference:** EPP Gas Analyzer Down  
GLRA VCS calcs 2017-2018

**Finding:** ACM001, ver 8, monitoring methodology states: The fraction of methane in the landfill gas ( $w_{CH_4,y}$ ) should be measured with a continuous analyzer or, alternatively, with periodical measurements, at a 95% confidence level, using calibrated portable gas meters and taking a statistically valid number of samples and accordingly the amount of land fill gas from  $LFG_{total,y}$ ,  $LFG_{flare,y}$ ,  $LFG_{electricity,y}$ ,  $LFPL,y$  and  $LFG_{thermal,y}$  shall be monitored in the same frequency. The continuous methane analyzer should be the preferred option because the methane content of landfill gas captured can vary by more than 20% during a single day due to gas capture network conditions (dilution with air at wellheads, leakage on pipes, etc.)." The file: EPP Gas Analyzer Down note when the Siemens analyzer was down, the plant used an average engine heat rate to calculate the methane content of the gas during the missing period.

Please explain how this deviation is in line with ACM 008 Monitoring requirement and update the monitoring report with necessary justification according to VCS Standard 3.7

**Project Personnel Response:** For the period of April 16, 2017 to May 1, 2017 the Siemens Ultramat 23 was out of service due to erroneous data. To account for the methane concentration during the 15-day period, we substitute data based on the 95% lower confidence limit of all valid 1-minute data through the month of April & May 2017. The data substitution has been applied to the weekly methane readings in the operational logs (see GLRA VCS calcs 2017-2018v2.xlsx & GLRA LFG Data April & May 2017.xlsx). A project description deviation has been added to the Monitoring Reportv2 as well.

**Auditor Response:** The Monitoring Report v2 was observed to be updated with the deviation for the data substitution and appropriately justified. The auditor concurs that the deviation does not affect the applicability of the methodology, the additionality or the baseline scenario of the project. Issue closed. Reviewed the calculation of lower confidence level applied and was observed to be correctly used in the emission reduction sheets. Issue closed.

**Bearing on Material Misstatement or Conformance (M/C/NA):**

**NCR 3 Dated 27 Feb 2018**

**Standard Reference:** ACM0001 Ver. 8, Monitoring section  
VCS Standard 3.7, sec. 3.6.3

**Document Reference:** GLRA VCS calcs 2017-2018

**Finding:** The field check tab for the GLRA VCS calcs references 2016 data. Please update this tab for the reporting period.

**Project Personnel Response:** Updated in GLRA VCS calcs v2

**Auditor Response:** Received the updated field checks tab in the revised calcs. Issue closed

**Bearing on Material Misstatement or Conformance (M/C/NA):**

**NIR 4 Dated 27 Feb 2018****Standard Reference:** VCS Standard 3.7**Document Reference:** Verifier Pack**Finding:** Please provide the following records:

1. generator event records for the 1st half of the year for 2017,
2. one week of raw data for January and February 2018,
3. The Monitoring plan states the Engine Siemens Ultramat was calibrated on 07/27/2017. Please provide the calibration record for the instrument.

**Project Personnel Response:** Obtained from GLRA. The calibration on 7/27/2017 was a mistype. At the time the replacement meter would have been in use.

- Auditor Response:**
1. received generator events record. No further issues noted. Closed.
  2. received raw data files : glrawdata2018jan, and glrawdata2018feb. Issue closed.
  3. response accepted. Issue closed.

**Bearing on Material Misstatement or Conformance (M/C/NA):****NCR 5 Dated 27 Feb 2018****Standard Reference:** VCS Standard 3.7 sec 3.12.1**Document Reference:** GLRA Monitoring Report 2016\_v1**Finding:** Section 2.1 of the report should note any changes to the Project Proponent as noted in the monitoring report template. Please note the change of Origin Climate to 3 degrees. In addition, please provide evidence that credit ownership resides with 3 Degrees as previously it was Origin Climate.**Project Personnel Response:** Monitoring Report v2 corrected to denote the merger between Origin Climate and 3Degrees. Documentation of the merger is also provided.**Auditor Response:** The report in section 1.3 was updated (as opposed to 2.1) to note the merger of 3 Degrees with Origin Climate. The merger documentation was provided dated April 4, 2017. Issue closed.**Bearing on Material Misstatement or Conformance (M/C/NA):****NIR 6 Dated 27 Feb 2018****Standard Reference:** VCS Standard 3.7 sec 3.17.5**Document Reference:** EPP\_LFG Flow Meter Calibration Record**Finding:** The file EPP\_LFG Flow Meter Calibration Record was provided, however there is no indication of the instrument that was calibrated or the serial number of the instrument . Please clarify the instrument and serial number on the calibration record and resubmit.**Project Personnel Response:** Corrected in v2 of EPP\_LFG Flow Meter Calibration Record.**Auditor Response:** The revised calibration log was provided with the instrument serial numbers identified. These match the project documentation. Issue closed.**Bearing on Material Misstatement or Conformance (M/C/NA):**

**NIR 7 Dated 27 Feb 2018****Standard Reference:** VCS Standard 3.7 sec 3.17.5**Document Reference:** EPP Gas Tech Calibration Record with as found/as left 2017**Finding:** The file EPP Gas Tech Calibration Record with as found/as left 2017 was provided, however there is no indication of the instrument that was calibrated or serial number. Please clarify the instrument and serial number on the calibration record and resubmit (especially if the instrument changed due to issue with the analyzer noted above).**Project Personnel Response:** Corrected in EPP Calibration records v2.**Auditor Response:** The revised weekly calibration log was provided and notes the instrumentation calibrated. Issue closed.**Bearing on Material Misstatement or Conformance (M/C/NA):**