

VALIDATION REPORT FOR THE BLUE SOURCE SPARTANBURG COUNTY LANDFILL GAS COMBUSTION PROJECT



Document Prepared By First Environment, Inc.

Project Title	Blue Source Spartanburg County Landfill Gas Combustion Project
Version	1.0

Report Title	Validation Report for the Blue Source Spartanburg County Landfill Gas Combustion Project
Client	Blue Source, LLC
Pages	19
Date of Issue	13 March 2012
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Summary:

The Blue Source Spartanburg County Landfill Gas Combustion Project (the Project) consists of a phased landfill gas collection and destruction project at the Wellford Landfill in Spartanburg County, South Carolina. The Project destroys landfill gas in one of three ways: in a flare, through beneficial use in offsite boilers, and by combustion for the purpose of generating electricity. The Project also displaces fossil fuels consumed for baseline thermal energy generation. These activities result in a net reduction of CO₂ equivalent emissions.

The validation process consists of the independent third-party assessment of the project design and emissions reduction assertion against the criteria stated in the Verified Carbon Standard (VCS) Standard, 1 February 2012, v3.2 and the approved Clean Development Mechanism (CDM) methodology ACM0001 (Version 11).

During the validation process, First Environment, Inc. (First Environment) issued several clarification and corrective action requests – all of which were addressed sufficiently by the project participants. In summary, First Environment is reasonably assured that the Project meets all relevant VCS requirements and correctly applies the VCS-approved CDM methodology ACM0001.

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1 INTRODUCTION

This report is provided to Blue Source LLC (Blue Source) as a deliverable of the Verified Carbon Standard (VCS) project validation process for the Blue Source Spartanburg County Landfill Gas Combustion Project (the Project). This report provides a description of the steps involved in conducting the validation and the findings of the validation performed on the basis of the VCS program requirements.

As outlined in the VCS Project Description (VCS PD), the VCS-approved methodology applied to the project activity is the Clean Development Mechanism (CDM) methodology ACM0001 – *Consolidated baseline and monitoring methodology for landfill gas project activities*, Version 11 (ACM0001). The Audit Team was provided the initial version of the VCS PD on January 5, 2011. Based on this documentation, a document review and desktop audit took place, which resulted in corrective action requests (discussed later in this report) and revisions to the VCS PD. The final version, dated March 7, 2012, serves as the basis of the final conclusions presented herewith.

During the validation process, Blue Source acted as the project advisor for the project proponents: Spartanburg County (the County), Lockhart Power (Lockhart) and Milliken & Company (Milliken). As such, the Audit Team communicated directly with Blue Source regarding most validation activities.

1.1 Objective

The purpose of validation is to have an independent third party assess the Project's design. In particular, the Project's baseline, the monitoring plan, and the Project's compliance with VCS requirements are validated. This is to ensure that the VCS PD, as documented, is sound and reasonable and meets the identified criteria. Validation objectives also include an assessment of the likelihood that the Project will achieve the emission reductions asserted by Blue Source and the project proponents. Validation is a requirement for all VCS projects and is seen as necessary to provide assurance to stakeholders of the quality of the Project and its intended generation of emission reductions.

1.2 Scope and Criteria

The validation scope is defined as an independent and objective review of the VCS PD. The VCS PD was reviewed against the following criteria:

- VCS Standard, 2 February 2012, v3.2 (VCS Standard), and
- CDM methodology ACM0001– *Consolidated baseline and monitoring methodology for landfill gas project activities*, Version 11.

The Audit Team employed a risk-based approach, focusing on the identification of significant risks for project implementation and the generation of emission reductions. The validation process was also informed by the requirements stated in the VCS Standard; the *VCS Program Guide*, 2 February 2012, v3.2; and the ISO 14064-3 standard.

1.3 Level of assurance

First Environment, Inc. (First Environment) and Blue Source have agreed that a reasonable level of assurance be applied for the Project.

1.4 Summary Description of the Project

The Project consists of the voluntary destruction of landfill gas from an expanded landfill gas collection system at the Wellford Landfill in Spartanburg County, South Carolina. The Project consists of three phases: (1) expansion of the existing landfill gas collection system and destruction of landfill gas in an existing flare; (2) implementation of a beneficial use project by which landfill gas is destroyed in off-site boilers at the Milliken Dewey Chemical plant; and (3) implementation of another beneficial use project by which landfill gas is used to generate electricity. Greenhouse gas (GHG) emission reductions are claimed

from the destruction of methane, which would have otherwise been emitted directly to the atmosphere, and also from the displacement of fossil fuels that were used for thermal energy generation at the Milliken Dewey Chemical plant prior to the project activities.

The VCS PD provides additional details regarding the project activities.

2 VALIDATION PROCESS

2.1 Method and Criteria

The following validation process was used:

- conflict of interest review;
- selection of validation team;
- initial interaction with Blue Source;
- development of the validation plan;
- site visit;
- desktop review of the project design and the baseline and monitoring methodology and other relevant project documentation;
- follow-up interaction with Blue Source and other project personnel for supplemental information and corrective action as necessary; and
- report development and issuance of final validation statement.

The validation process was utilized to evaluate whether the Project's approach, as outlined in the VCS PD, is consistent with the VCS Standard and the ACM0001 methodology. A validation conformance checklist was developed for the Project which summarizes the criteria used to evaluate the Project, the Project's conformance with each criterion, and the Audit Team's validation findings.

Conflict of Interest Review

Prior to beginning any validation project, First Environment conducts an evaluation to identify any potential conflicts of interest associated with the project. No potential conflicts were found for this project.

Audit Team

First Environment's Audit Team consisted of the following individuals who were selected based on their validation experience, as well as familiarity with landfill operations and renewable energy projects:

Iris Caldwell – Lead Auditor
 Mary Pat Campbell – Auditor
 Michael Carim – Auditor
 Natali Ganfer – Auditor
 Monica Kowalczykowski - Auditor
 James Wintergreen – Internal Reviewer

Audit Kick-off

The validation process was initiated with a kick-off meeting on February 22, 2011 between First Environment and Blue Source. The communication focused on confirming the validation scope, objectives, criteria, schedule, and the information required for the validation.

Development of the Validation Plan

The Audit Team formally documented its validation plan as well as determined the sampling plan. The validation plan was informed by the kick-off meeting where key elements of the plan for validation were discussed including project team members, project level of assurance, materiality threshold, and standards of reporting and validation. The validation plan also provided an outline of the validation process, established project deliverables, and identified a sampling plan designed to review all project elements in areas of potentially high risk of inaccuracy or non-conformance.

Site Visit

Mary Pat Campbell performed a site visit on May 11, 2011. The focus of the site visit was to interview relevant site personnel and project stakeholders; review the Project's operations, data collection procedures, and information management systems; as well as assess the Project's controls for sources of potential errors and omissions.

Desktop Review

The Audit Team performed a desktop review of the VCS PD and supporting documentation, as further described in Section 2.2 below.

Corrective Actions and Supplemental Information

The Audit Team requested clarification and supplemental information as well as corrective actions during the validation process. The corrective action and clarification requests and the responses provided by Blue Source are summarized in Section 2.5.

Validation Reporting

Validation reporting, represented by this report for Blue Source, documents the validation process and identifies its findings and results.

2.2 Document Review

The Audit Team conducted the validation using the VCS Standard and ACM0001 as the criteria. Additionality, eligibility requirements, baseline scenario(s), project emissions, the monitoring plan, and other pertinent criteria were assessed to evaluate the Project's approach as outlined in the VCS PD against the validation criteria. Discrepancies between the VCS PD and the validation criteria were considered material and identified for corrective action. Any deviations from the validation criteria required appropriate justification.

2.3 Interviews

Through the course of validation activities, First Environment interviewed the following project personnel to inform the validation process:

- Kevin Townsend – Chief Commercial Officer, Blue Source LLC
- Kelly Campbell - Project Manager, Blue Source LLC
- Will Overly – Project Manager, Blue Source LLC
- Chad Leatherwood – Engineer, SCS Engineers
- Mike Garrett – Public Works Director, Spartanburg County
- Mike Thomas – Project Engineer, Milliken & Company

2.4 Site Inspections

As described above, Mary Pat Campbell performed the site visit on May 11, 2011.

2.5 Resolution of Any Material Discrepancy

The Audit Team identified several differences between the Project's approach, as outlined in the VCS PD, and the validation criteria that would constitute non-conformities or require approval as a methodology revision. Corrective action requests were issued accordingly. Additionally, First Environment requested several clarifications in order to inform the validation assessment.

Through communications with the Audit Team, Blue Source was able to resolve all corrective action and clarification requests made by the Audit Team during the validation process. The following tables summarize the corrective action and clarifications requested, as well as Blue Source's responses.

ID	Corrective Action Request	Summary of Participant Response	Validation Conclusion
1	The PD incorrectly identifies Lockhart as the project proponent.	The PD was revised to indicate that Lockhart, Milliken, and the County are all considered project proponents.	Response is acceptable
2	The PD does not apply the most current version of the <i>Combined tool to identify the baseline scenario and demonstrate additionality</i> .	The PD was revised to be consistent with Version 3.0.1 of the <i>Combined tool to identify the baseline scenario and demonstrate additionality</i> .	Response is acceptable
3	The project activity is not accurately defined in Section 2.4 of the PD.	The project activity without carbon credits is correctly identified among the various alternatives scenarios for landfill gas management, power generation, and heat generation.	Response is acceptable
4	The eGRID factor referenced in the PD is not based on the most current eGRID data.	The PD was revised to reference the latest eGRID 2010 emission factor.	Response is acceptable
5	The average methane content applied in the LandGEM model does not match the value given in the PD.	The methane content used in the model tool has been revised to 50% to match that indicated in the PD.	Response is acceptable
6	The PD does not clearly justify the deviation associated with the parameter MD_{BL} .	Adequate justification of the methodology deviation is given in Section 2.6 of the PD.	Response is acceptable
7	Alternative scenarios for landfill gas management, electricity generation, and heat generation are not separately evaluated in the baseline and additionality assessments.	The PD was revised to separately evaluate the alternatives for each of the technologies and/or activities considered.	Response is acceptable
8	Please further explain why Lockhart did not pursue other electricity generation alternatives in lieu of the project activity.	The PD was revised to indicate that Lockhart's beneficial use project is a by-product of the County's decision to pursue the project. Therefore, Lockhart's decision is not relevant to the demonstration of additionality.	Response is acceptable

ID	Corrective Action Request	Summary of Participant Response	Validation Conclusion
9	Step 4 in the procedure for the selection of the most plausible baseline scenario is not clearly addressed per ACM0001. Similarly, the discussion of the selection of the baseline scenario (Section 2.5.4 in the PD) is incorrectly included in the additionality section.	The conclusion of the baseline selection process is more clearly described in the PD. The language in Section 2.5.4 (renamed Section 2.5.3 in the final PD version) was revised to address the selection of the project activity alternatives, instead of the baseline alternatives. This discussion is relevant to the additionality assessment.	Response is acceptable
10	It is unclear that the investment barriers identified in Section 2.5 meet the definition of acceptable barriers given in the <i>Combined tool to identify the baseline scenario and demonstrate additionality</i> . Please expand and justify.	The PD was revised to more clearly identify an investment barrier associated with the phased implementation of the project activity and the risk that no revenue (other than from carbon credits) would be achieved. Appropriate supporting documentation was provided to First Environment.	Response is acceptable
11	Please justify why the investment analysis of the “business as usual” scenario does not include the cost of additional passive vent wells or other technologies to address the DHEC letter from March 1998.	This corrective action is no longer relevant due to the restructuring of the baseline/additionality argument in the PD. An investment analysis is no longer considered. Further, it was demonstrated by Blue Source that the pre-project system had adequately addressed gas migration issues identified in 1998.	Response is acceptable
12	The essential distinctions between the project activities and other similar activities in the common practice assessment are not clearly identified or justified.	The PD was revised to more clearly describe and justify the essential distinctions. First Environment reviewed appropriate evidence for each essential distinction identified.	Response is acceptable
13	The PD does not specify how FV_{RG} or $\rho_{CH_4,n}$ are determined, nor how the operation of the heat generating equipment is monitored.	The parameters FV_{RG} and $\rho_{CH_4,n}$ were renamed $LFG_{project}$ and D_{CH_4} , respectively, and appropriately defined in the PD. The PD was revised to indicate that it is not necessary to monitor the operation of heat generation equipment, because there is a fail-safe built into the control system on each boiler gas train that automatically shuts anytime the landfill gas line is switched off or the boiler(s) goes down. First Environment identified this as an acceptable monitoring deviation.	Response is acceptable
14	Please justify why natural gas used for startup at the Milliken facility is not considered a source of project emissions.	Since the quantity of thermal energy generated by the Project is determined according to the quantity of landfill gas consumed, it is not necessary to account for natural gas as a source of project emissions.	Response is acceptable
15	The quantity of thermal energy generated at the Milliken facility is not determined in accordance with ACM0001.	The method of determining the quantity of thermal energy generated by the Project was identified and justified in the PD as a deviation. First Environment found that deviation was acceptable	Response is acceptable

ID	Corrective Action Request	Summary of Participant Response	Validation Conclusion
16	Option A in ACM0001 for the determination of the boiler efficiencies has not been properly applied.	Option B is selected for the determination of the efficiency of the boilers used in the absence of the project activity (ϵ_{boiler}). The efficiency of boilers used during the project activity is determined using Option F from the <i>Tool to determine the baseline efficiency of thermal or electric energy generation systems</i> ($\epsilon_{\text{boiler,BL}}$).	Response is acceptable

ID	Clarification Request	Summary of Participant Response	Verification Conclusion
1	Please clarify which entity is entitled to the right of use of emission reductions generated at the Milliken facility.	This finding is no longer relevant due to clarification from the VCS Association regarding the definition of project proponent. Instead, First Environment confirmed that Lockhart, Milliken, and the County share overall control and responsibility for the Project activities and, therefore, are all considered project proponents	Response is acceptable
2	Please clarify whether emission reduction credits are claimed for the displacement of fossil fuel-generated electricity and thermal energy.	Blue Source clarified that emission reduction credits are being claimed for displacement of fossil fuel generated thermal energy but not for fossil fuel generated electricity. This was also better clarified in several sections in the PD.	Response is acceptable
3	Please further describe the standard approach used to determine the radius of influence of gas wells. Specifically, please address why a radius of influence of two times the well depth is appropriate.	SCS Engineers uses a rule of thumb of two to three times the well depth for determining radius of influence. For this project, SCS determined that a less aggressive radius of influence was appropriate because of the location of the wells and the lower vacuum as a result of the engines. There are several instances where potential overlap could occur between pre-project and project wells. Blue Source provided additional explanation and supporting documentation to confirm that the risk of overlap is very minimal. First Environment reviewed supporting documentation for these arguments.	Response is acceptable
4	The model of the Rosemount flow meters observed at the site visit is inconsistent with the Project Description. Please clarify the model of the Rosemont flow meters and provide supporting documentation as necessary.	The PD was revised to indicate that the Rosemount 3051SFC model flow meter will be used to monitor gas going to each the Milliken facility and Lockhart facility. Supporting documentation of the standard conditions for these flow meters was also provided to First Environment.	Response is acceptable
5	Please clarify the shutoff temperature of the flare.	The PD was revised to indicate that the shutdown temperature is 300°F. Additionally, the flare has an ultraviolet scanner to confirm flare operation.	Response is acceptable
6	Please clarify on what frequency flow data will be aggregated.	The PD was revised to indicate that data will be aggregated monthly and yearly.	Response is acceptable

ID	Clarification Request	Summary of Participant Response	Verification Conclusion
7	The PD indicates that the gas analyzer(s) will be sent to the manufacturer for calibration if required. Please clarify under which conditions or results the instrument would be sent to the manufacturer.	The PD was revised to specify that the unit will be sent to the manufacturer if a malfunction occurs that cannot be repaired onsite.	Response is acceptable
8	Please revise the metering diagram provided in Section 3 of the PD to clearly indicate all points of methane content analysis. Please also clarify in the PD whether a single gas analyzer is employed by the project.	The metering diagram in the PD was revised as appropriate. The project intends to use only one gas analyzer, which has the capability of measuring methane content from multiple locations.	Response is acceptable
9	Please clarify the make/model of the pressure sensors used in conjunction with the Rosemount 3051 flow meters and provide evidence of the manufacturer's requirement(s) for maintenance and calibration.	The pressure sensors are considered a part of the same flow meter unit, collectively named the Rosemount 3091. The PD was revised to more clearly describe the maintenance and calibration practices; specifically that Emerson recommends inspection of the orifice plate once every 3 years as well as calibration of the differential pressure transmitters every 3 years. The PD indicates that the flow meter was "configured by a Rosemount technician" in order to address the manufacturer's requirement for initial factory calibration and a zero-trim check at installation. Appropriate supporting documentation was provided to First Environment.	Response is acceptable
10	It is unclear in the common practice assessment if the relevant geographic area under consideration is the United States or South Carolina. Please clearly identify the relevant geographic area and provide appropriate justification.	The relevant geographic area is South Carolina. There are more than 10 facilities (or projects) that provide outputs or services with comparable quality, properties and application areas as the proposed VCS project activity, so the selection of this area is consistent with the CDM Additionality Tool.	Response is acceptable
11	Please explain why a gas collection system efficiency of 77% is acceptable for the landfill and provide supporting documentation as appropriate.	This figure only impacts the ex ante estimates and will not be used to calculate actual emission reductions. The 77% collection efficiency is based on SCS' development expertise, as well as a comparison of modeled and actual LFG recovery rates.	Response is acceptable
12	Please explain the basis of the 95% capacity factor for the engines and the 10,000 BTU/kWh default value used in the ex ante emission reduction estimates.	Blue Source clarified that the 95% capacity factor for the engines and the 10,000 BTU/kWh default value do not directly affect the ex ante estimates or actual emission reductions to be calculated ex post. Rather, the factors were used to estimate the total amount of gas to be sent to each destruction device for the purpose of the additionality discussion. These references were removed from the PD; therefore, this calculation is no longer relevant.	Response is acceptable

ID	Clarification Request	Summary of Participant Response	Verification Conclusion
13	Please further describe how the project will ensure that the flare meets the other operational requirements in 40 CFR 60.18, specifically no visible emissions and continuous flare presence.	Additional language was added to Section 3.1 of the PD, which specifically addresses the four operational requirements of 40 CFR 60.18.	Response is acceptable

3 VALIDATION FINDINGS

3.1 Project Design

The project activities involve the expansion of an existing active gas collection system into Phases I through VI of the Wellford Landfill. The expanded system consists of 60 vertical wells and associated piping. The landfill gas was initially directed solely to an existing flare. Beginning on June 1, 2011, the landfill gas was also directed to a Caterpillar 3520 engine-generator unit for electricity generation. In addition, beginning on June 23, 2011, landfill gas was also transported by pipeline approximately 6.5 miles to the Milliken Dewey Chemical plant for use in its facility boilers. GHG emission reductions are claimed both for methane destruction and the displacement of fossil fuel sources of thermal energy but not for the displacement of fossil fuel sources of electricity generation.

The County owns and operates the landfill including the landfill gas collection system, gas treatment system, flare, and pipeline to the Milliken Dewey Chemical plant. Lockhart owns and operates the energy facility and also contracted with the County to maintain and operate the landfill gas monitoring equipment and pipeline activities. Milliken owns and operates the boilers and all associated equipment for thermal energy generation at their facility. Due to these shared responsibilities, all three entities, i.e., the County, Lockhart, and Milliken, are considered the project proponents. The Audit Team confirmed that the project proponents were correctly identified through interviews with site personnel and review of the agreements between Lockhart and the County and Milliken and the County.

As noted above, Blue Source serves as the project advisor for the purpose of developing, marketing, verifying, and registering GHG emission reduction credits. The Audit Team reviewed the agreement between Lockhart and Blue Source in order to confirm Blue Source's role and responsibilities.

The project start date is April 29, 2010. The Audit Team reviewed meeting minutes from the landfill's consultants indicating that all wells were operational on this date and construction of the expanded system was complete. Phase 2 and 3 of the Project were implemented on June 23, 2011 and June 1, 2011, respectively. The first crediting period is June 15, 2010 through June 14, 2020. The forecasted emission reductions during the first crediting period are 759,775 metric tonnes of carbon dioxide equivalents (CO₂e).

The Wellford Landfill is located at 595 Little Mountain Road in Wellford, South Carolina (latitude and longitude are 35.001193° and -82.13042°, respectively).

The Project complies with all relevant laws and regulations. The Audit Team reviewed relevant air and solid waste permits and interviewed project personnel in order to confirm that necessary regulatory requirements were met. Additionally, the Audit Team reviewed the U.S. Environmental Protection Agency's (EPA) Enforcement and Compliance History Online (ECHO) database to confirm the absence of regulatory non-compliances at the landfill.

The Project has neither been registered with nor rejected from another GHG program outside of VCS. Similarly, the Project does not participate in emission trading programs and is not subject to other binding limits. The Audit Team reviewed an attestation from Lockhart and similar communications from the County and Milliken indicating that the Project does not intend to register emission reductions under any

other GHG programs or registries. The Project may generate renewable energy credits; however, because the Project is not claiming GHG emissions reductions from displacement of fossil fuel sources of electricity generation, this does not represent a risk for double counting.

Commercially sensitive information related to the project design and contracts has been redacted from the public version of the VCS PD. The Audit Team reviewed all business confidential information and determined that the classification as “commercially sensitive” is appropriate.

3.2 Application of Methodology

3.2.1 Title and Reference

The VCS-approved methodology applied to the project activities is the CDM consolidated methodology ACM0001 – *Consolidated baseline and monitoring methodology for landfill gas project activities*, Version 11.

3.2.2 Applicability

The Project applies the ACM0001 methodology, which is applicable to the project activities because it falls within the scope of the approved methodology. Specifically, the project activities include the capture of landfill gas for flaring and production of electrical and thermal energy. As discussed in Section 3.2.4, the baseline scenario is the partial release of landfill gas to the atmosphere.

3.2.3 Project Boundary

The project boundary is defined as the landfill, which is the site where landfill gas is collected and destroyed in the flare and electricity genset, as well as the Milliken Dewey Chemical plant where the landfill gas is combusted for the production of thermal energy. The boundary also includes the grid from which electricity consumed by the Project is sourced. For the purpose of calculating the appropriate grid emission factor, the power generating sources within the SRVC Virginia/Carolina subregion in EPA's eGRID database are considered. The VCS PD correctly identifies sources of GHG emissions in the baseline and project scenarios.

3.2.4 Baseline Scenario

Consistent with the ACM0001 methodology, the baseline scenarios are defined as the partial atmospheric release of landfill gas from Phases I through VI of the Wellford Landfill, the continued generation of electricity from grid-connected power plants, and the continued generation of thermal energy from existing fossil fuel-fired equipment at the Milliken Dewey Chemical plant. The baseline scenarios were appropriately determined using the stepwise procedure provided in ACM0001 and the *CDM Combined tool to identify the baseline scenario and demonstrate additionality* (CDM Combined Tool), as further described below.

Step 1: Identification of Alternative Scenarios

First Environment confirmed that the alternative scenarios were identified in accordance with ACM0001 and Step 1 of the CDM Combined Tool. The VCS PD identifies the following alternative scenarios for the management of landfill gas:

- LFG1 – The project activity is undertaken without being registered with the VCS program.
- LFG2 – Atmospheric release of landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements or to address safety and odor concerns.

The VCS PD identifies the following alternative scenarios for power generation:

- P1 – Power generated from landfill gas undertaken without being registered with the VCS program.

- P2 – Existing or construction of a new on- or off-site fossil fuel fired based cogeneration plant.
- P3 – Existing or construction of a new on- or off-site renewable based cogeneration plant.
- P4 – Existing or construction of a new on- or off-site fossil fuel fired captive power plant.
- P5 – Existing or construction of a new on- or off-site renewable based captive power plant.
- P6 – Existing and/or new grid-connected power plants.

The VCS PD identifies the following alternative scenarios for thermal energy generation:

- H1 – Heat generated from landfill gas undertaken without being registered with the VCS program.
- H2 – Existing or construction of a new on- or off-site fossil fuel-fired cogeneration plant.
- H3 – Existing or construction of a new on- or off-site renewable-based cogeneration plant.
- H4 – Existing or new construction of on- or off-site fossil fuel-based boilers, air heaters or other heat generating equipment.
- H5 – Existing or new construction of on- or off-site renewable energy-based boilers, air heaters or other heat generating equipment.
- H6 – Any other source such as district heat.
- H7 – Other heat generation technologies.

All of the alternatives are currently in compliance with mandatory laws and regulations. However, Scenario LFG2 will be assessed on an annual basis in order to confirm that the landfill does not become subject to the New Source Performance Standard (NSPS) requirements to control landfill gas. Specifically, the County will be required to collect and control landfill gas if the emissions rate of non-methane organic compounds exceeds 50 megagrams (Mg) per year. The Audit Team reviewed the most recent Tier 2 test report prepared in January 2009, which indicated that the current emissions rate was 35.02 Mg per year. The VCS PD indicates that GHG emission reductions will only be claimed until the date on which the landfill gas collection and control system becomes mandatory.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable

The Milliken Dewey Chemical plant has historically used natural gas, No. 6 fuel oil, and industrial by-products to fuel their boilers. The Audit Team confirmed the historic fuel consumption pattern through interviews with site personnel and review of facility records. As allowed in ACM0001, the VCS PD identifies natural gas as the baseline fuel because it results in the lowest baseline emissions. The Audit Team concluded that natural gas was available without supply constraint in the United States.

Step 3: Application of Step 2 and/or 3 of the CDM Combined Tool to assess which alternatives should be excluded from further consideration

The VCS PD applies Step 2 from the CDM Combined Tool in order to determine which alternative scenarios are prevented by barriers. The VCS PD identifies the following barriers:

- Technical/Operational Barrier – the pre-project landfill gas collection system did not have sufficient gas flows to support either beneficial use project.
- Technical/Operational Barrier – the County's limited demand for thermal and/or electrical energy would not justify the construction of captive energy plants, nor does the County have the expertise or capital to support such projects.
- Infrastructure Barrier – the uncertainty associated with estimating the quantity and quality of landfill gas from the expanded gas collection system meant that the project proponents would not invest in the beneficial use projects without first confirming actual flow volumes and gas composition from the expanded system.

- Institutional/Investment Barrier – due to the phased implementation of the project activity, there was little to no guarantee that the County would receive revenue other than from GHG emission reductions.

The Audit Team confirmed the existence of these barriers through review of supporting documentation, such as the 2007 feasibility study commissioned by the County and industry guidance, as well as through interviews with project personnel.

Scenarios P1 and H1 were eliminated on the basis of the first barrier identified above. Scenarios P2 through P5 and H2 through H6 were eliminated on the basis of the second barrier identified above. Scenario LFG1 was eliminated on the basis of the third and fourth barriers identified above.

Step 4: Use of the alternative baseline scenario of those remaining that results in the lowest baseline emissions as the most likely baseline scenario

This step is unnecessary, since there is only one remaining baseline alternative for each the management of landfill gas, power generation, and thermal energy generation. Therefore, the baseline scenarios are correctly identified as the continuation of pre-project landfill gas management activities (LFG2), the use of existing and/or new grid-connected power plants (P6), and the continued use of existing fossil fuel-fired boilers (H4).

3.2.5 *Additionality*

The additionality of the Project is demonstrated by applying the CDM Combined Tool in conjunction with the baseline selection process described above. The VCS PD follows the stepwise procedure as further described below:

Step 1: Identification of alternatives scenarios

The VCS PD identifies realistic and credible alternatives to the project activities for the management of landfill gas, power generation, and thermal energy generation. All scenarios are consistent with mandatory laws and regulations, as described in Section 3.2.4 above.

Step 2: Barriers Analysis

A barriers analysis is applied consistent with the requirements of the CDM Combined Tool, as described in Section 3.2.4 above. The results of the barriers analysis indicate that the Project would have been prevented by infrastructure, institutional, and investment barriers. Namely, the uncertainties associated with landfill gas quantity and quality necessitated the implementation of the project activities in phases. As such, there was no guaranteed revenue for the County. The VCS PD explains that the revenue from GHG emission reductions was necessary to help overcome these risks. The Audit Team reviewed evidence that carbon revenue was considered during the planning and implementation of the Project.

Step 3: Investment Analysis

Since the outcome of the barriers analysis performed under Step 2 above identifies that the baseline scenarios are the only remaining alternatives and the barriers preventing the implementation of the Project are adequately alleviated through carbon revenue, an investment analysis is not required in the assessment of additionality.

Step 4: Common Practice Analysis

The VCS PD includes an assessment of common practice among several similar landfills in South Carolina. Specifically, landfills that have a beneficial use project (power or thermal energy generation) and are not mandated to collect and control landfill gas are considered similar. Using these criteria, only two landfills are considered similar to the Wellford Landfill. The VCS PD identifies essential distinctions

between these landfills and the Project related to the financing of the beneficial use project in one case and the availability of significantly more landfill gas in the other. The Audit Team reviewed evidence to support these essential distinctions, including appropriate justification that these represented benefits to the other landfills that were not available to the Project.

Based on the review of the barriers analysis and common practice analysis, and all supporting documentation, the Audit Team was able to confirm that the Project is additional.

3.2.6 Quantification of GHG Emission Reductions and Removals

The VCS PD presents a procedure for quantifying GHG emission reductions that is consistent with the procedures described in ACM0001 and the relevant CDM tools. The equations are correctly identified and the calculation of GHG emission reductions is presented in a transparent manner, incorporating all relevant GHG sources, sinks, and reservoirs.

Baseline emissions are calculated as the total quantity of methane destroyed by the Project ($MD_{project,y}$) multiplied by the global warming potential for methane, plus the total quantity of thermal energy generated by the Project ($ET_{LFG,y}$) multiplied by the emissions intensity of natural gas. Baseline emissions are not calculated for the electricity generation activity, because no GHG emission reductions are claimed for this activity per the VCS PD. The quantity of methane destroyed in the baseline is considered to be zero, because the flow and methane content of project gas is monitored prior to co-mingling with the existing gas collection system. This monitoring arrangement was confirmed during the site visit.

$MD_{project,y}$ is estimated ex-ante using the US EPA Landfill Gas Emissions model (LandGEM) and site-specific factors developed by SCS Engineers. The Audit Team reviewed the LandGEM model prepared by SCS Engineers as well as supporting data and assumptions in order to confirm that the estimates were realistic. Consistent with ACM0001, $MD_{project,y}$ will be determined ex-post using as the lesser of either the metered quantities of methane destroyed in the flare, engine, and boilers or the modeled methane generated values from the LandGEM model. The quantity of methane destroyed by the flare will also be adjusted to account for the destruction efficiency of the flare per the CDM *Tool to determine project emissions from flaring gases containing methane*.

The quantity of methane destroyed by the Milliken boilers is estimated ex-ante using historic fuel usage from the Milliken Dewey Chemical plant. The Audit Team reviewed facility records in order to confirm these estimates. Ex-post, the quantity of methane destroyed will be calculated using direct measurements of landfill gas flow and methane content. The total quantity of methane consumed by the boilers is multiplied by the boiler efficiency and heating value of methane in order to determine the total quantity of thermal energy generated. The emissions intensity of natural gas is determined according to ACM0001.

Project emissions are determined from the consumption of grid electricity and fossil fuels by the Project. For the purpose of ex-ante estimates, project emissions are estimated to be five percent of total baseline emissions. The Audit Team confirmed that this approach was considered conservative. In accordance with ACM0001, these emissions will be calculated ex-post using the CDM *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* and the CDM *Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion*, respectively.

As specified in ACM0001, no leakage emissions are considered. Therefore, total GHG emission reductions are calculated by subtracting total project emissions from total baseline emissions. The Audit Team reviewed the ex-ante estimates in order to confirm that they were correctly calculated.

3.2.7 Methodology Deviations

The VCS PD identifies seven methodology deviations between the monitoring or measurement requirements of the validation criteria and the Project's monitoring plan. The methodology deviations were reviewed by the Audit Team and found to be acceptable, as summarized in the table below.

Parameter	ACM0001 Requirement	Deviation from Requirement	Validation Conclusion
MD _{project, y} - Ex ante estimation of the amount of methane that would have been destroyed or combusted during the year.	Use a first order decay model per the CDM Annex 10 Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site.	Emission reductions for 2010 through 2020 are estimated using the quantity of waste disposed at the landfill and the EPA LandGEM model.	Deviation acceptable. The LFG volumes generated by LandGEM model are for illustrative purposes only, as emission reductions will be based on ex-post monitoring data of the Project performance. The LandGEM model provides a reasonable estimate of landfill gas volumes based on site-specific factors and engineering expertise.
EF _{EL,j,y} – Emission factor for electricity generation for source j in year y.	Following option A2 of the Tool to calculation baseline, project, and/or leakage emissions from electricity consumption, a conservative default value of 1.3 tCO ₂ /MWh may be used.	An emission factor for electricity generation (EF _{EL,j,y}) is assigned a value of 0.507 tonnes CO ₂ per MWh based on US EPA's eGrid 2010 for the SRVC subregion. This value will be reviewed annually upon the release of updated eGrid data.	The 1.3 tCO ₂ /MWh default value provided by the tool is not representative of the emission intensity of grid-connected electricity generation in the United States. Further, the Project does not consume a significant quantity of electricity and therefore electricity consumption does not represent a large emission source for the Project. As such, this approach is reasonable.
η _{flare,h} – Flare efficiency	A default flare efficiency of 50% for open flares and 90% for enclosed flares must be applied in cases where methane composition is measured quarterly.	The flare efficiency has been fixed ex-ante as 98%.	For projects where gas composition is measured continuously, no such default values are specified in the tool. The regulation 40 CFR §60.18 specifies requirements for flare operating variables (i.e., Btu content, exit velocity) that must be met in order to achieve a 98% or higher flare destruction efficiency. Blue Source provided evidence that the flare onsite is designed and operated in accordance with 40 CFR §60.18 and has identified mechanisms for ensuring that the flare is operated accordingly throughout the crediting period. Therefore, a 98% destruction efficiency is acceptable.

Parameter	ACM0001 Requirement	Deviation from Requirement	Validation Conclusion
MD _{BL} – Amount of methane destroyed in the absence of the project	Per ACM0001, in situations where in the baseline landfill gas captured and destroyed, for reasons other than regulation and/or contract, historic data on actual amount captured shall be used as MD _{BL} . MD _{BL} is subtracted from MD _{project,y} to determine the amount of methane destroyed above the baseline scenario.	MD _{BL} is considered zero. Landfill gas from the previously installed collection system is monitored separately, as well as the total quantity of landfill gas delivered to the flare, engine and boilers. The latter will be used as a ratio to assign the appropriate destruction efficiency to each quantity of landfill gas.	Deviation acceptable. Since the quantity of landfill gas from the project activity is directly measured, there is no need to separately account for landfill gas from the pre-existing system. The Audit Team also reviewed an analysis demonstrating that the potential for the project system to pull landfill gas that had been previously collected from the pre-project system is minimal.
ET _{LFG,y} – Quantity of thermal energy produced utilizing landfill gas	Per ACM0001, ET _{LFG,y} is monitored using a steam meter or temperature, pressure, and mass flow measurements.	ET _{LFG,y} is determined using the quantity of landfill gas, methane content, default boiler efficiency, and net calorific value (NCV) of methane. The boiler efficiency is determined using the CDM Tool to determine the baseline efficiency of thermal or electric energy generation systems.	Deviation acceptable. Direct measurement of the landfill gas used to fuel the boilers is more accurate than monitoring the total enthalpy generated by the equipment, because the boilers consume multiple fuel types. The default values applied for boiler efficiency and NCV represent conservative values and therefore should not negatively impact the conservativeness of the GHG emission reductions.
Operation of heat generating equipment	Per ACM0001, hours of operation of the heat generating equipment should be monitored in order to ensure that methane destruction is only claimed when the equipment is operational.	Hours of operation are not directly monitored, because the boilers are equipped with fail-safe values that automatically shut when the landfill gas line is switched off or the boiler(s) goes down.	Deviation acceptable. Due to the presence of the physical mechanism to ensure that landfill gas is not sent to the boilers when they are not operational, monitoring the hours of operation is not necessary.
LFG _{thermal,y} and W _{CH4,thermal,y} – Quantity of landfill gas and methane content of landfill gas sent to Milliken	Per ACM0001, methane content of the landfill gas and the landfill gas flow must be measured on the same basis (either wet or dry).	The methane content of the landfill gas sent to Milliken is measured on a wet basis prior to landfill gas treatment, while the flow is measured on a dry basis after landfill gas treatment.	Deviation acceptable. The proposed monitoring arrangement results in a conservative determination of the total quantity of methane destroyed by Milliken.

3.2.8 Monitoring Plan

The VCS PD applies the approved monitoring methodology described in ACM0001. The primary variables monitored in order to determine and account for GHG emission reductions achieved by the Project are given in the below.

Parameter	Method of Estimation	Frequency	Unit of Measurement
Total amount of LFG collected from the project system.	Flow meter	Continuous	Standard cubic feet
Total amount of landfill gas sent to flare.	Flow meter	Continuous	Standard cubic feet
Total amount of landfill gas sent to engine.	Flow meter	Continuous	Standard cubic feet
Total amount of landfill gas sent to the boilers.	Flow meter	Continuous	Standard cubic feet
Methane fraction in project gas.	Gas analyzer	Continuous	Percentage
Methane fraction in landfill gas sent to the flare, engine, and boilers.	Gas analyzer	Continuous	Percentage
Electricity consumption of project equipment.	Utility invoices and load ratings of equipment	Annual	Megawatt hours
Propane consumption by project equipment.	Supplier invoices	Annual	Gallons
Operation of the flare.	Thermocouple and ultraviolet flame detector	Continuous	Degrees Fahrenheit
Operation of the engine.	Wattmeter or similar	Continuous	Hours

The monitoring plan specified within the VCS PD includes all relevant data and parameters required to obtain a reliable result of generated emission reductions and meets the requirements of ACM0001. The details of the monitoring plan are described in Section 4.3 of the VCS PD including a complete description of the frequency of recording, monitoring, measurement, quality assurance, and reporting activities. The monitoring plan described in the VCS PD ensures the adequate measurement of emissions occurring from GHG sources through the installation of appropriate equipment and monitoring devices. Monitoring data and relevant documentation supporting emission reduction calculations will be retained for at least two years beyond the length of the VCS crediting period.

The VCS PD also identifies data and parameters that are available at validation and are expected to remain fixed throughout the VCS crediting period. The Audit Team reviewed supporting documentation for each of these parameters and also confirmed that they were appropriate in the context of the project activities.

3.3 Environmental Impact

An Environmental Impact Assessment was not performed for the project activities.

3.4 Comments by stakeholders

A stakeholder consultation was not performed for the project activities.

4 VALIDATION CONCLUSION

First Environment has performed a validation of the Project's approach, as outlined in the VCS PD, as part of the VCS validation process. The validation was performed on the basis of VCS Standard, the ISO 14064-3 standard, and the approved CDM methodology ACM0001, including all relevant methodological tools.

The review of the VCS PD and the satisfaction of corrective action and clarification requests have provided First Environment with sufficient evidence to determine the fulfilment of stated criteria.

By capturing and destroying methane that would otherwise have been released to the atmosphere and displacing fossil fuels used for thermal energy generation, the project activities result in reductions of GHG emissions that are real, measurable, and give long-term benefits to the mitigation of climate change. An analysis of the additionality test demonstrates that the proposed project activities are not likely baseline scenarios. Emission reductions attributable to the Project are hence additional to any that would occur in the absence of the Project.

The total emission reductions from the Project are estimated to be 759,775 metric tonnes of CO₂e over the selected 10-year crediting period. The emission reduction forecast has been checked, and it is deemed likely that the stated amount will be realized given that the underlying assumptions do not change.

In summary, it is First Environment's opinion that the Blue Source Spartanburg County Landfill Gas Combustion Project, as described in the VCS PD of March 7, 2012, meets all relevant VCS requirements and correctly applies the CDM methodology ACM0001.

The validation of the Project is based on the information made available to us and the engagement conditions detailed in this report. First Environment cannot guarantee the accuracy or correctness of this information. Hence, First Environment cannot be held liable by any party for decisions made or not made based on this report or opinion.

5 LEAD VALIDATOR SIGNATURE



Iris Caldwell
Senior Engineer

6 INDEPENDENT REVIEWER SIGNATURE



James Wintergreen
Senior Associate