SULPHUR CONCRETE METHODOLOGY ASSESSMENT REPORT

Document Prepared By First Environment, Inc.

Methodology Title	Quantification Methodology for the Use of Sulphur Concrete in Precast Applications	
Version	1.5	
Methodology Category	Methodology	X
	Methodology Revision	
	Module	
	Tool	
Sectoral Scope(s)	04	

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Summary:

First Environment, Inc. (First Environment) was retained to provide the second assessment in the VCS double-approval process for the proposed Methodology Element titled, "Quantification Methodology for the Use of Sulphur Concrete in Precast Applications." The Methodology Element provides procedures for monitoring and calculating emission reductions associated with the substitution of Portland cement with an alternative binder during the production of precast concrete products.

The methodology assessment process consists of an independent third-party review of the new Methodology Element. In particular, the methodology assessment shall confirm that the Methodology Element is consistent with all relevant VCS rules and procedures. The assessment of the new Methodology Element is done through a double-approval process, according to the VCS Standard, and is necessary to provide assurance to stakeholders of the quality of the new Methodology Element.

The methodology assessment was conducted using the VCS Standard, v3.4 as the criteria. Additionally, First Environment followed guidance in the VCS Methodology Approval Process, v3.5 and the VCS Program Guide, v3.5 and applied its professional judgment as informed by ISO 14064-3 in assessing the proposed methodology.

During the assessment process, First Environment issued 14 clarification requests and 14 corrective action requests – all of which were addressed sufficiently by Shell. First Environment is of the opinion that the "Quantification Methodology for the Use of Sulphur Concrete in Precast Applications," as described in Version 1.5 of the Methodology Element dated May 23, 2014 meets all relevant VCS requirements.

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1 INTRODUCTION

This report is provided to Shell Canada Limited (Shell) as a deliverable of the Verified Carbon Standard (VCS) methodology element (ME) assessment process for the proposed VCS ME titled "Quantification Methodology for the Use of Sulphur Concrete in Precast Applications." This report provides a description of the steps involved in conducting the second methodology assessment as a part of the VCS double-approval process and summarizes the findings of the second methodology assessment.

First Environment, Inc. (First Environment) was provided copies of the ME, dated June 28, 2012, and the first assessment report, dated July 4, 2012. Based on this documentation, the Audit Team performed a document review and desktop audit, which resulted in corrective action and clarification requests (discussed later in this report), and revisions to the ME. The final version of the ME, dated May 23, 2014, serves as the basis of the final conclusions presented herewith.

First Environment communicated primarily with Shell's consultant, The Prasino Group, during the course of assessment activities.

1.1 Objective

The purpose of the methodology assessment is to have an independent third party assess the conformance of the ME with VCS requirements.

1.2 Summary Description of the Methodology

The ME is applicable to projects that substitute calcium and/or magnesium carbonate-derived ("Portland") cement with an alternative binder made from modified heated sulphur. Greenhouse gas (GHG) emissions reductions are achieved through avoided production of Portland cement – specifically, avoided carbon dioxide emissions from the calcination process and GHG emissions from the combustion of fossil fuels during cement production. Alternatively, the modified heated sulphur binder is sourced as a by-product from natural gas processing and petroleum refining. As such, sulphur cement production has a much lower GHG emissions intensity compared to Portland cement. The ME provides procedures for establishing the project boundary, determining the baseline scenario, demonstrating additionality, monitoring fuel consumption and other relevant parameters, and finally, quantifying baseline and project emissions and total emission reductions.

2 ASSESSMENT APPROACH

2.1 Method and Criteria

The methodology assessment scope is defined as an independent and objective review of the proposed ME. The methodology assessment is conducted using the *VCS Standard*, 8 October 2013, v3.4 (VCS Standard) as the criteria. The *VCS Methodology Approval Process*, 8 October 2013, v3.5 (VCS Methodology Approval Process); the *VCS Program Guide*, 8 October 2013, v3.5 (VCS Program Guide); and the ISO 14064-3 standards guided First Environment's process.

The assessment process was utilized to evaluate whether the ME is consistent with the stated criteria. A methodology assessment checklist was developed which summarizes the criteria used to evaluate the ME, the conformance of the ME with each criterion, and the Audit Team's assessment findings. First Environment and Shell have agreed that a reasonable level of assurance be applied to this assessment.

The assessment process consisted of the following steps, each described in further detail below:

- conflict of interest review;
- selection of assessment team;
- kick-off meeting with Shell;

- development of the validation plan;
- desktop review of the ME and other relevant documentation;
- follow-up discussions with Shell for supplemental information, as needed, as well as the corrective action cycle; and
- report development.

Conflict of Interest Review

Prior to beginning any assessment project such as this, 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

Members of the Audit Team were selected based on their assessment experience, as further described in Section 2.4 below.

Audit Kick-off

The assessment process was initiated with a kick-off conference call on October 18, 2012 between First Environment and Shell. The communication focused on confirming the assessment scope, objectives, criteria, schedule, and the information required for the methodology assessment.

Development of the Validation Plan

Based on the information discussed during the kick-off conference call, the Audit Team formally documented its validation plan and provided the validation plan to Shell.

Desktop Review

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

Corrective Actions and Supplemental Information

The Audit Team issued requests for corrective action and clarification during the methodology assessment process, as described in Section 2.5. The corrective action and clarification requests and the responses provided by Shell are summarized in Section 4.

Assessment Reporting

This methodology assessment report documents the methodology assessment process and identifies its findings and results.

2.2 Document Review

Applicability requirements, baseline approach, additionality, project boundary, emissions quantification, leakage, monitoring, data and parameters, and other pertinent criteria were assessed to evaluate the ME against VCS program requirements. Discrepancies between the assessment criteria and the ME were considered material and identified for corrective action, as further described in Section 2.5.

During the desktop review, the Audit Team reviewed the following:

- Clean Development Mechanism (CDM) methodology, *Consolidated baseline and monitoring methodology for project activities using alternative raw materials that do not contain carbonates for clinker production in cement kilns* (ACM0015), Version 3.0;
- CDM methodology, *Consolidated Baseline Methodology for Increasing the Blend in Cement Production* (ACM0005), Version 5;
- *Draft Quantification Protocol for the Use of Sulphur Concrete in Precast Applications*, Alberta Environment, February 2010;
- *A Sulphur Concrete Retaining Wall*, University of Alberta, 2002;
- *Cement Industry Energy and CO_2 Performance: Getting the Numbers Right*, World Business Council for Sustainable Development;
- *CO_2 Accounting and Reporting Standard for the Cement Industry*, Version 2.0, World Business Council for Sustainable Development, June 2005;
- *CO_2 Emissions Profile of the U.S. Cement Industry*, U.S. Environmental Protection Agency;
- *Stakeholder Review Session: Use of Sulphur Concrete in Precast Applications*, ICF International, February 23, 2011;
- Shell Thiocrete literature;
- Various CDM tools and guidelines;
- Sample calculations that applied the quantification methodologies given in the ME.

2.3 Interviews

The Audit Team held teleconferences with the following individuals during the course of the methodology assessment:

- Timo Makinen, Shell Canada Limited – representative of the methodology developer
- Ian Kuwahara, The Prasino Group, Inc. – representative of the methodology developer's consultant
- Liz Brennan, The Prasino Group, Inc. – representative of the methodology developer's consultant.

2.4 Assessment Team

The Audit Team consisted of the following individuals who were selected based on their assessment experience:

Iris Caldwell, Lead Auditor: Ms. Caldwell is a Senior Engineer on First Environment's team providing climate change management services with a focus on GHG inventory development, offset project validation and verification, and other technical assistance. She has provided project validation and verification services for numerous energy demand projects under the Climate Action Reserve and VCS registries, including biogas-to-energy, waste energy recovery, and biomass fuel switch projects. Additionally, she has performed methodology assessments under VCS for at least two other methodologies in the energy demand sectoral scope, as well as three methodologies in other sectoral scopes.

Jeff Daley, Auditor: Mr. Daley is an Environmental Specialist on First Environment's climate change team providing climate change management services with a focus on offset project verification, inventory development, and technical assistance. Through verification and inventory development work, he has worked directly with the Climate Action Reserve's Protocols, The Climate Registry's General Reporting Protocol, and various CDM methodologies. He is an approved Lead Verifier under the CAR landfill and

livestock project protocols and an approved verifier under the California Air Resources Board (ARB) program. Mr. Daley has eight years of environmental consulting experience with a background in general air compliance and climate change issues. He holds a B.S. in Meteorology from Northern Illinois University.

Howard Kanter, Auditor: Mr. Kanter is an Environmental Specialist on First Environment's GHG team. Mr. Kanter has provided livestock, landfill, renewable energy project, and ODS validation/verification services under the Climate Action Reserve and Verified Carbon Standard registries. He has also assisted in the assessment of GHG entity inventories in accordance with The Climate Registry's General Reporting Protocol. Mr. Kanter has a background in general sustainability practices and initiatives with experience conducting energy audits and benchmarking city-wide sustainability initiatives.

James Wintergreen, Independent Internal Reviewer: Mr. Wintergreen is a Senior Associate on First Environment's team providing climate change management services with a focus on development of corporate climate change strategies and GHG management programs, technical and financial evaluations of GHG management projects, and oversight of GHG verification activities. He has developed or verified numerous GHG inventories in the oil, gas, and electricity generation sectors under The Climate Registry, California Air Resources Board, and California Climate Action Registry. He has served as an independent internal reviewer for the majority of the offset validation and verification projects conducted by First Environment under the VCS program, including many projects and methodologies in the energy demand sectoral scope.

A VCS-approved expert was not retained for the purposes of this methodology assessment. In accordance with the VCS Standard, a VCS-approved expert is not necessary for non-AFOLU ME assessments where a standardized method is not applied.

2.5 Resolution of Findings

As described in Section 2.1, the Audit Team issued formal requests for corrective action, clarification, and supplemental information during the methodology assessment process. In particular, discrepancies between the ME and the VCS Standard were identified for corrective action and required appropriate justification. Clarification and supplemental information requests served to provide the Audit Team additional context or background information in order to complete the assessment process. Shell was given the opportunity to resolve the requests through the submittal of additional evidence or justification, revisions to the ME and/or other means as appropriate.

The Audit Team raised a total of 14 corrective action requests and 14 clarification requests over several rounds of assessment and revision of the ME by Shell. The key findings raised by First Environment during the methodology assessment process included:

- lack of detail and clarity surrounding applicability conditions;
- inadequate identification and justification of sources, sinks, and reservoirs (SSRs) considered for the project boundary;
- inconsistencies and lack of detail surrounding the quantification methodologies and parameters identified in the ME; and
- lack of detail surrounding data uncertainties and appropriate procedures for project proponents to follow.

The specific corrective action and clarification requests issued by the Audit Team, as well as the responses provided by Shell, are summarized in the attached appendix. As indicated, Shell adequately resolved all of these requests.

3 ASSESSMENT FINDINGS

3.1 Relationship to Approved or Pending Methodologies

The ME draws upon elements of several approved CDM methodologies, i.e., ACM0015 and ACM0005, as well as another pending methodology under VCS developed by Shell, i.e., *Substitution of Bitumen Binder in Hot Asphalt Production and Usage*. However, the degree to which these existing methodologies would have to be revised in order to incorporate the use of sulphur concrete from alternative binders is substantial enough to warrant a new methodology. A complete listing of similar methodologies and Shell's assessment of whether the methodologies could be reasonably revised is provided as part of the ME as required by VCS.

3.2 Stakeholder Comments

No public stakeholder comments were received.

3.3 Structure and Clarity of Methodology

The Audit Team confirmed that the instructions in the VCS methodology template were followed accurately and the methodology criteria and procedures are appropriately documented throughout the ME. The terminology utilized in the ME is consistent with that of the VCS program and the language appropriately and unambiguously identifies the necessary level of adherence to the methodology requirements. The criteria and procedures are appropriately described and are readily applicable and consistent for appropriate auditing of the project activities. Based on these observations, the Audit Team concluded that the overall structure and clarity of the ME meets VCS requirements.

3.4 Definitions

The ME introduces definitions of key terms relevant to the application of the procedures and requirements given elsewhere in the ME. These definitions are given in alphabetical order and provide the necessary clarity to ensure the terms are used consistently throughout the ME and by project proponents. No acronyms are defined.

3.5 Applicability Conditions

The ME clearly identifies criteria by which to assess the eligibility of sulfur concrete projects at the time of project validation. Specifically, the ME requires that eligible projects must meet the following applicability conditions:

- The baseline scenario is the production of precast concrete products using Portland cement, as demonstrated using the methodology outlined in Section 6.
- The use of recycled concrete is not eligible in either the baseline or project scenario.
- The handling, storage, mix production temperature, and other key factors specified by the manufacturer for the proper and safe use of sulphur cement have been followed by the project proponent and appropriate evidence of such is provided to the verification body.
- The resulting sulphur concrete product meets all applicable legal and technical requirements. In the absence of technical specifications for concrete, project proponents must demonstrate that sulphur concrete produced under the project condition provides the equivalent function to concrete that would have been produced under the baseline condition.
- The pouring and forming processes should be comparable between the baseline and project conditions for an equivalent product. The quantity of aggregate used (on a mass basis) in the baseline condition should be comparable to the quantity of aggregate used in the project condition for an equivalent product.

The ME further clarifies that projects may be implemented at existing or newly constructed (i.e., Greenfield) concrete production facilities. The criteria identified provide a clear basis for determining the ME's applicability to potential project activities. Additionally, the criteria help ensure that the underlying assumptions related to project boundary, emissions quantifications, and monitoring and measurement are satisfied for any project applying the ME. The Audit Team concluded that applicability conditions given in the ME are precisely written, appropriate, adequate, and consistent with the VCS Standard.

3.6 Project Boundary

The project boundary encompasses the operation of a new or existing precast concrete facility during the incorporation of the sulphur binder technology. The ME identifies relevant sources of baseline and project emissions and indicates whether each is included or excluded from the project boundary. The SSRs included in the project boundary represent incremental increases in emissions-generating activities at the precise concrete facility due to the substitution of Portland cement with sulphur binder. Where activities are not expected to change significantly between the baseline and project scenarios, SSRs are generally excluded. Additionally, the ME includes figures to help illustrate the baseline and project process flow diagrams as well as which SSRs are included or excluded. The Audit Team determined that the ME provided sufficient criteria to establish the project boundary and that all relevant emission sources and GHGs are included.

3.7 Baseline Scenario

The ME identifies the production of precast concrete products using Portland cement as the baseline scenario. The ME requires the use of the CDM *Combined tool to identify the baseline scenario and demonstrate additionality* (Combined Additionality Tool) in order to determine this baseline scenario. Because the CDM is considered an approved GHG program under the VCS, the Audit Team considered the use of the Combined Additionality Tool an acceptable approach consistent with the VCS Standard to determine the baseline scenario.

3.8 Additionality

The ME requires the use of the Combined Additionality Tool, or the CDM *Tool for the demonstration and assessment of additionality* (Additionality Tool) in order to demonstrate project additionality. Because the CDM is considered an approved GHG program under the VCS, the Audit Team considered the use of either the Combined Additionality Tool or the Additionality Tool an acceptable approach consistent with the VCS Standard.

3.9 Quantification of GHG Emission Reductions and Removals

3.9.1 Baseline Emissions

The ME provides procedures and equations for the calculation of baseline emissions. Specifically, baseline emissions are estimated for the production of Portland cement and electricity consumption that would have occurred in the absence of the project activity. Total baseline emissions are the sum of emissions from these activities.

Baseline emissions from the production of Portland cement are quantified by multiplying the mass of finished precast sulphur-containing concrete products by the ratio of Portland cement that would have been used in the finished products under the baseline scenario. The resultant is then multiplied by the carbon dioxide emission factor for the production of Portland cement to determine the total baseline emissions that would have occurred from Portland cement production.

If it is conservative to do so, projects must also determine emissions from electricity consumption at the precast concrete facility in the baseline scenario. Emissions from electricity consumption are estimated using historical data multiplied by an appropriate emission factor.

The ME provides quantification procedures for all SSRs included the baseline scenario. The Audit Team reviewed all formulae and quantification methods for accuracy and concluded that the approach to calculate baseline emissions is appropriate, adequate, and consistent with the VCS Standard.

3.9.2 Project Emissions

The ME provides procedures and equations for the calculation of project emissions. Specifically, project emissions are quantified by summing the emissions due to sulphur degassing, heating of the aggregate, heating of the sulphur concrete, transportation and storage of the molten sulphur, production and transportation of the sulphur modifier, and electricity consumption at the precast sulphur concrete production facility. Total project emissions are the sum of emissions from these activities.

Emissions due to sulphur degassing are quantified from the amount of CO_2 emitted in the degassing vent gas as well as the combustion of fuels consumed during the degassing process. The volume of vent gas is either directly monitored or estimated from regional or sector-wide data. This volume is multiplied by the concentration of CO_2 in the vent gas and appropriate conversion factors in order to determine total process emissions from sulphur degassing. Separately, the quantities of fuels consumed during the degassing process are multiplied by appropriate emission factors.

Emissions from heating aggregate and sulphur concrete are quantified based on the fuels consumed during the concrete production process. The quantity of fuel consumed for heating is multiplied by an appropriate emission factor.

Transportation emissions for molten sulphur and sulphur modifier are quantified by multiplying the mass distance for each of these products by an appropriate emission factor. Similarly, emissions from the production of the sulphur modifier are quantified by multiplying the quantity of modifier consumed during the concrete production process by an appropriate emission factor provided by the product manufacturer.

Finally, emissions are quantified from electricity consumption at the precast concrete facility during the project scenario. The quantity of electricity consumed at the facility is multiplied by an appropriate emission factor.

The ME provides quantification procedures for all SSRs included the project scenario. The Audit Team reviewed all formulae and quantification methods for accuracy and concluded that the approach to calculate project emissions is appropriate, adequate, and consistent with the VCS Standard.

3.9.3 Leakage

There is no leakage associated with the project activity.

3.9.4 Net GHG Emission Reductions and Removals

Emission reductions are calculated as the difference between baseline and project emissions. The Audit Team determined that this approach to calculate emission reductions is appropriate, adequate, and consistent with the VCS Standard.

3.10 Monitoring

The monitoring of all data and parameters required to quantify emissions are described and appropriately defined in the ME. Specifically, the ME identifies all data and parameters as either monitored or not monitored. The descriptions include source of data, unit of measurement, measurement procedures and frequency, default values where appropriate, quality control and quality assurance procedures, and other comments necessary for project implementation or validation/verification. The ME requires that factors used in the emission reduction calculations are from reputable sources and/or representative of the emission source or activity for which they relate. Further detail on the data and parameters provided in the ME as well as the Audit Team's assessment conclusion is summarized in the tables below.

Parameters Available at Validation

Parameter	Assessment Conclusion
$EF_{Portland\ Cement\ Production}$	ME provides adequate detail for project proponents to identify the most appropriate value based on site-specific information if available, or alternatively, reference values. Additional guidance is provided in Appendix A to the ME. All information is appropriate for the intended application.
$EF\ Fuel_i$	ME identifies that regional, national, international, or IPCC reference values may be applied. These sources provide adequate accuracy for the purpose of quantifying baseline and project emissions associated with fuel combustion. All information is appropriate for the intended application.
m_{CO2}	ME identifies a default value based on the chemical properties of CO_2. All information is appropriate for the intended application.
V_{STP}	ME identifies a default value based on the chemical properties of an ideal gas. All information is appropriate for the intended application.
GWP	ME identifies IPCC reference values consistent with those cited in the VCS Standard. All information is appropriate for the intended application.
$Mass_{clinker}$ / $Mass_{Cement}$	ME provides adequate detail for project proponents to identify the most appropriate value based on site-specific information if available, or alternatively, reference values. Additional guidance is provided in Appendix A to the ME. All information is appropriate for the intended application.
$EF_{Clinker}$	ME provides adequate detail for project proponents to identify the most appropriate value based on site-specific information if available, or alternatively, reference values. Additional guidance is provided in Appendix A to the ME. All information is appropriate for the intended application.
EF_{Elec}	ME identifies that local or regional, national or international, or IPCC reference values may be applied. These sources provide adequate accuracy for the purpose of quantifying baseline and project emissions associated with electricity consumption. All information is appropriate for the intended application.
$Electricity_B$	ME identifies that project-specific historical data from the baseline precast concrete facility shall be used. All information is appropriate for the intended application.
$EF_{Transport}$	ME provides adequate detail for project proponents to identify the most appropriate value based on project-specific fleet information if available, or alternatively, reference values. All information is appropriate for the intended application.
MF_{CO2}	ME provides adequate detail for project proponents to identify the most appropriate value based on several site-specific data sources. All information is appropriate for the intended application.

Monitored Parameters

Parameter	Assessment Conclusion
$Mass_{Precast}$	ME provides adequate detail for project proponents to establish monitoring procedures for determining mass of finished precast concrete products produced using sulphur modifier. All information is appropriate for the intended application.
$\%_{PC}$	ME identifies that the parameter is determined from design criteria or historical production specifications. This value must be determined for each product type. All information is appropriate for the intended application.

Parameter	Assessment Conclusion
Vol Fuel	ME provides adequate detail for project proponents to establish monitoring procedures for determining the volume of fuels consumed by the project. All information is appropriate for the intended application.
Mass Distance	ME provides adequate detail for project proponents to establish monitoring procedures for determining the mass distance travelled by molten sulphur consumed by the project. All information is appropriate for the intended application.
$M_{Modifier}$	ME provides adequate detail for project proponents to establish monitoring procedures for determining the mass of sulphur modifer consumed by the project. All information is appropriate for the intended application.
$EF_{Modifier}$	ME identifies that the parameter is determined from manufacturer specifications and is available with each shipment of modifier product to the precast concrete facility. All information is appropriate for the intended application.
$Mass\ Distance_{Modifier}$	ME provides adequate detail for project proponents to establish monitoring procedures for determining the mass distance travelled by sulphur modifer consumed by the project. All information is appropriate for the intended application.
$Electricity_P$	ME provides adequate detail for project proponents to establish monitoring procedures for determining electricity consumption by the project. All information is appropriate for the intended application.
$Vol_{vent\ gas}$	ME provides adequate detail for project proponents to establish monitoring procedures for determining the volume of vent gas emitted at the precast concrete facility. The parameter is intended to be directly monitored, however, regional or sector-wide reference values may be used if site-specific data is unavailable and can be demonstrated to be conservative. All information is appropriate for the intended application.

The ME specifies that all data shall be retained for at least two years after the end of the last crediting period, consistent with VCS requirements. The Audit Team determined that the monitoring approach, including the identification of specific requirements for data and parameters, is appropriate and sufficient to obtain the necessary information for accurate emission reduction quantification as well as meets relevant requirements in the VCS Standard.

4 ASSESSMENT CONCLUSION

First Environment performed the methodology assessment of the ME as part of the VCS double-approval process. First Environment used the VCS Standard as the criteria for the assessment. The assessment process was further guided by the VCS Methodology Approval Process and the VCS Program Guide.

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

The ME was prepared in accordance with the VCS Standard, the VCS Methodology Approval Process, and the VCS Program Guide. The proposed methodology belongs to Sectoral Scope 4 –Manufacturing industries.

In summary, it is First Environment's opinion that the ME titled, "Quantification Methodology for the Use of Sulphur Concrete in Precast Applications," Version 1.5, dated May 23, 2014, meets all relevant VCS requirements.

5 REPORT RECONCILIATION

Not applicable.

6 EVIDENCE OF FULFILMENT OF VVB ELIGIBILITY REQUIREMENTS

The ME is classified under VCS Sectoral Scope 4 – Manufacturing industries, which falls within the Sectoral Scope Group 01 (GHG emission reductions from fuel consumption), as defined by ANSI. First Environment, Inc. holds accreditation to perform validation for projects under Group 01. First Environment has also completed more than 10 previous methodology and project validations in ANSI Group 01. First Environment, therefore, is eligible under the VCS program to perform assessments for the ME.

7 SIGNATURE

Signed for and on behalf of First Environment on 17 November 2014.

Iris Caldwell, P.E.
Senior Engineer

James Wintergreen
Senior Associate

APPENDIX A

Resolution of Corrective Action Requests and Clarification Requests

ID	Corrective Action Request	Summary of Methodology Developer Response	Assessment Conclusion
1	The ME does not apply the latest version of the VCS Methodology Template. Specifically, • Section 2 does not include the Additionality/Crediting Baseline table. • Table 4 does not include "Other" gases. • Section 9.4 does not exist in the most current template. • The template version number in the footer is out of date.	The Methodology Element was revised to incorporate the requested changes for consistency with the latest version of the Methodology Template.	Response is acceptable.
2	Section 2 and Table 4 of the ME identify several additional project requirements and underlying assumptions that are not clearly described as applicability conditions in Section 4.	Language in Table 4 was revised to more accurately justify the inclusion/exclusion of SSRs. Additionally, applicability conditions #2 and #5 were added to Section 4 of the ME.	Response is acceptable.
3	The ME does not address right of use (e.g., identification of project proponent, avoidance of double-counting, etc.).	Section 2 of the ME was revised to clearly address right of use and avoidance of double-counting of emission reductions.	Response is acceptable.
4	Please further justify the inclusion of emissions outside the project boundary as project emissions (e.g., sulphur degassing, fuel extraction and processing, etc.).	The SSR associated with fuel extraction and production emissions was removed from the included SSRs in the project and baseline scenarios. Sections 5, 8, and 9 of the ME were revised as appropriate. Sulphur degassing is included as an SSR in the project scenario, because it is assumed to occur at equal or greater rates in the project scenario compared to the baseline scenario. Section 5 was revised with further justification.	Response is acceptable.
5	The equations in Section 8 do not clearly indicate how emissions will be quantified on a CO_2e basis or converted to metric tonnes. Please also provide sample calculations to the Audit Team as further support.	Sample calculations were provided for the Audit Team's review. Additionally, the equations in Section 8 were revised to clearly indicate the conversion of emissions from kg to metric tonnes.	Response is acceptable.

ID	Corrective Action Request	Summary of Methodology Developer Response	Assessment Conclusion
6	The ME does not clearly indicate which monitored parameters should be assessed for data uncertainties and does not provide a clear procedure for estimating a 90% or 95% confidence interval in these cases.	Section 9.3 of the ME was revised to provide additional detail on which parameters are subject to greater uncertainty. Section 9 also identifies appropriate procedures for addressing such uncertainty.	Response is acceptable.
7	The ME (including Appendix A) do not provide sufficient procedures for determining the emission factor for Portland cement production and ensuring its relevance throughout the temporal and geographic scopes of project activities.	Appendix A was revised to include an equation for calculating $EF_{Clinker}$ and additional guidance for the determination of $EF_{Portland\ Cement\ Production}$.	Response is acceptable.
8	Section 9.1 of the ME does not specify which default factors may become out of date in the "Any Comment" box, in accordance with the VCS Methodology template guidance.	The ME was revised to indicate which default factors may become out of date and specify that if a parameter becomes out of date, it must be reviewed at each verification.	Response is acceptable.
9	The data units for parameters $EF_{Portland\ Cement\ Production}$, $EF\ Fuel_i$,GHG, and m_{CO2} indicated in Sections 9.1 and 9.2 of the ME are vague and inconsistent.	The data units for these parameters were clarified in Sections 9.1 and 9.2 of the ME and are now consistent with the equations in Section 8.	Response is acceptable.
10	The information provided in the "Source of data" boxes in Sections 9.1 and 9.2 of the ME is either misleading or does not provide sufficient detail regarding the actual sources of data.	The "Source of data" boxes in Sections 9.1 and 9.2 were revised to provide clear details regarding data sources and, where relevant, preferential order when multiple data sources are allowed.	Response is acceptable.
11	The following parameters are missing from Section 9 of the ME: emissions factors for sulphur degassing, $Mass_{Clinker}$ / $Mass_{Cement}$, and $EF_{Clinker}$.	The $Mass_{Clinker}$ / $Mass_{Cement}$, and $EF_{Clinker}$ parameters were added to Section 9 of the ME. Emission factors for sulphur degassing are derived from parameters already identified in Section 9.	Response is acceptable.
12	The ME does not adequately describe the measurement methods and procedures for parameter %PC.	Additional detail was added to the parameter box regarding the determination of this parameter.	Response is acceptable.

ID	Corrective Action Request	Summary of Methodology Developer Response	Assessment Conclusion
13	The ME does not adequately address procedures for managing data quality. In particular: • It is unclear how the QA/QC guidance for parameters Vol $Fuel_i$, Mass Distance, $M_{Modifier}$, $EF_{Modifier}$, and Mass $Distance_{Modifier}$ provided in Section 9.2 ensures data quality. • The ME does not address instrument calibrations on a parameter basis. • QA/QC guidance in Section 9.3 does not clearly indicate which measures are appropriate for the specific parameters in question.	The QA/QC guidance in Section 9.2 was revised for better clarity, including discussion of instrument calibrations where appropriate. Additionally, further detail was provided in Section 9.3 regarding which procedures for managing uncertainty were most appropriate for certain parameters.	Response is acceptable.
14	The recordkeeping practices described in Section 9.3 of the ME are inconsistent with the requirements of the VCS Standard.	Section 9.3 of the ME was revised and is now consistent with the records retention policy outlined in the VCS Standard.	Response is acceptable.

ID	Clarification Request	Summary of Methodology Developer Response	Assessment Conclusion
1	Please further describe what activities constitute a single project.	Section 2 and Section 5 of the ME were revised to clarify that a project is considered a set or series of precast concrete products, produced at one facility, with similar functional specifications as the precast products produced in the baseline scenario (using Portland cement).	Response is acceptable.
2	Please describe alternative management methods for the sulphur by-product in the absence of the project activity.	In the absence of such new outlets for sulphur, any sulphur surplus would likely either be “poured to block” (allowed to solidify in a designated sulphur storage facility), or formed in some fashion (e.g., made into prills or pellets) and stored for later use. Oil and gas producers sometimes elect to re-inject sulphur-containing gases into underground hydrocarbon reservoirs rather than incurring the cost of producing and shipping the sulphur.	Response is acceptable.

ID	Clarification Request	Summary of Methodology Developer Response	Assessment Conclusion
3	Please describe any regulatory or other environmental considerations that are relevant for the use or production of sulphur concrete (e.g., permitting, air pollution controls, etc.).	Health, Safety, and Environmental (HSE) requirements do exist for concrete manufacturers as well as for the transport of the sulphur material. The only significant difference stemming from the use of sulphur concrete would be the shipping and handling of molten sulphur if it is delivered to the precast plant in this form. At the manufacturing plant itself, if the sulphur is delivered in solid form, then an additional process step of melting the sulphur prior to forming the final concrete product is necessary. This would require the consideration of additional worker HSE considerations. The Audit Team concluded that these additional considerations are adequately addressed by the VCS Standard's requirement that projects demonstrate "compliance with relevant laws, statues and other regulatory frameworks."	Response is acceptable.
4	Please further elaborate on any potential process differences that may exist between Portland cement concrete production and sulphur concrete production (e.g., different equipment, different mixing ratios, etc.).	The main process difference is that sulphur concrete-based products must be molded at temperatures above the melting point of sulphur, as opposed to ambient temperature. The addition of heating equipment will likely be required, which may present an implementation barrier.	Response is acceptable.
5	Please clarify what evidence a project proponent could provide in order to demonstrate conformance with applicability condition #3, and further explain the risk that sulfur concrete is not functionally equivalent to Portland cement concrete.	Precast concrete products made with sulphur-based binder are functionally equivalent to Portland cement concrete products, except for the fact that there exists a temperature ceiling (the melting point of sulphur) above which sulphur concrete products cannot be used. Typical precast product applications do not experience elevated temperatures, so the risk of not being functionally equivalent is very minor. Project proponents could demonstrate functional equivalence of their products using evidence of product service life, or structural load or impact bearing requirements.	Response is acceptable.

ID	Clarification Request	Summary of Methodology Developer Response	Assessment Conclusion
6	Please clarify why emissions from concrete recycling or disposal are considered "likely higher" in the baseline scenario. In addition, please clarify any differences in product lifecycle between Portland cement concrete and sulphur concrete.	The ME was revised to exclude projects that involve recycling concrete. The justification provided in Table 4 for the exclusion of concrete recycling and disposal emissions was revised appropriately.	Response is acceptable.
7	Please clarify why Section 7 of the Methodology Element requires the use of both the "Combined tool to identify the baseline scenario and demonstrate additionality" and the "Tool for the demonstration and assessment of additionality."	The intention was for project proponents to refer to either tool. The ME was revised as appropriate.	Response is acceptable.
8	Please describe realistic alternatives to the project activity and the types of implementation barriers faced by the project and its alternatives. In addition, further clarify in Section 6 of the ME if any baseline alternatives should be required for consideration by project proponents as part of the determination of the baseline scenario.	Sulphur concrete is envisioned for use under this methodology only in precast applications. Therefore, the only realistic alternative to the project activity is current approaches to precast concrete manufacturing, namely the use of conventional Portland cement. The alternative to sulphur concrete usage in precast applications therefore faces no implementation barriers, given it is already widely used, and is the “business as usual” scenario. This is the only realistic baseline alternative to consider in relation to the Section 6 procedures.	Response is acceptable.
9	Please clarify if the emission factor for the production of Portland cement is intended to be a site specific factor, regional factor, or global average factor and further clarify the order of preference.	The parameter table in Section 9.1 of the ME was revised to indicate that site specific data should be used if available. If site specific data is not available, then reference values may be calculated following the procedures provided in Appendix A.	Response is acceptable.

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10	Please advise whether direct measurement of each product's mass, the volume of vent gas incinerated, and molar fraction of CO_2 in incinerated vent gas represent industry standard practices and whether this level of monitoring and/or access to data could be overly burdensome to project proponents.	Measurement of precast product mass is standard practice in the industry and these data should be readily available at a given precast manufacturing facility. It is likely that regulator-approved emissions factors would be available for determining project emissions from sulphur degassing in lieu of direct monitoring via stack testing. The parameter box for $Vol_{vent\ gas}$ was revised to indicate that direct metering is preferred but that regional or sector-wide default values may be used with appropriate justification. The parameter box for MF_{CO2} was revised to indicate that facility-specific theoretical values must be obtained through computer modeling, simulation or trial applications.	Response is acceptable.
11	Please clarify whether monthly monitoring of MF_{CO2} would be representative of operations and the extent to which this data may vary over time.	This parameter was moved to Section 9.1 and will be established at validation. The monthly monitoring option was removed.	Response is acceptable.
12	Please explain the likelihood and potential methods that project proponents could use to directly measure transportation emissions.	The source of data for $EF_{Transport}$ is fleet data based on actual fuel consumption or regional data if no fleet data is available. The parameter was moved to Section 9.1 and shall be determined at validation.	Response is acceptable.
13	Please clarify why only “local” requirements are considered (as opposed to regional or national requirements) for applicability condition #3.	The word “local” was removed from condition #3 in the Section 4 of the ME. There are not many national or regional requirements expected to be imposed on a project; however, for clarity and comprehensiveness, the text was modified to be more broad.	Response is acceptable.
14	Please clarify whether new concrete production facilities are eligible under this methodology.	New precast concrete production facilities are eligible under this methodology. For such new facilities, the business-as-usual or baseline comparator would still be the use of conventional Portland cement to manufacture precast products. Additional language was added to Section 4 of the ME for clarity.	Response is acceptable.