

Surface Coal Mine Methane Offset Protocol

Capturing and Destroying Methane from Active Surface Coal Mines

DRAFT

March 11, 2013

Prepared by:

Ruby Canyon Engineering, Inc.

Table of Contents

Abbreviations and Acronyms	3
1 Project Definition	4
2 Eligibility	5
2.1 Location.....	5
2.2 Offset Project Commencement	5
2.3 Project Crediting Period.....	5
2.4 Additionality.....	5
2.4.1 The Legal Requirement Test	5
2.4.2 The Performance Standard Test	5
2.5 Regulatory Compliance	6
3 Offset Project Boundary – Quantification Methodology.....	6
4 Quantifying GHG Emission Reductions	9
4.1 Quantifying Baseline Emissions	9
4.1.1 Calculating Methane Destruction in the Baseline.....	10
4.1.2 Calculating Methane Released into the Atmosphere	10
4.2 Quantifying Project Emissions	13
4.2.1 Project Emissions from Energy Required for Methane Collection, Transport, and Combustion.....	14
4.2.2 Project Emissions from Destruction of Captured Methane	14
4.2.3 Project Emissions from Uncombusted Methane	16
5 Offset Project Documentation and Monitoring Requirements	16
5.1 Monitoring Requirements.....	16
5.1.1 Arrangement of Gas Metering Equipment	17
5.2 Instrument QA/QC	17
5.3 Missing Data.....	19
5.4 Monitoring Parameters.....	20
6 Reporting Parameters.....	22
6.1 Document Retention.....	22
Appendix A Emission Factors	23
Appendix B Data Substitution Guidelines	24

Abbreviations and Acronyms

CBM	Coal bed methane
CH ₄	Methane
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
GHG	Greenhouse gas
MSHA	Mine Safety and Health Administration
NMHC	Non-methane hydrocarbon
QA/QC	Quality assurance/quality control
SMM	Surface mine methane
SSR	Sources, sinks, reservoirs

1 Project Definition

For the purpose of this protocol, offset project is defined as the installation and operation of any device, or set of devices, that result in the capture and destruction of methane gas that would otherwise have been vented to the atmosphere from an active surface coal mine operation. This methane gas will be referred to as “surface mine methane” (SMM) throughout the protocol. Eligible mines include coal mines that are permitted by the Mine Safety and Health Administration (MSHA) under the Federal Mine Safety and Health Act of 1977.

A project must consist of one or a combination of the following:

1. Installation and operation of new methane capture wells
2. Continued operation of existing coal bed methane (CBM) wells that otherwise would be shut-in and abandoned
3. The re-activation of previously abandoned wells

In addition, the following conditions apply to projects:

1. The mine where the project is located must have had a working mining concession or lease for at least three years prior to the start of project
2. Only SMM wells completed no more than 130 feet below the base of the lowest mined coal seam are eligible
3. Only SMM wells placed within areas shown on mine plans to be mined within twenty years are eligible
4. SMM well life may be credited up to but no more than ten years prior to actual mining activities or the date of issuance of mining concession, whichever is later
5. Emission reductions resulting from SMM projects should only be credited beginning in the year in which the well is demonstrated to be in the zone of influence of the mine face or be shut-in because of encroachment of mining activities
6. Existing CBM wells included in a project must have been acquired in order to extend the life of the well operation and otherwise qualify as eligible SMM wells under this protocol

Captured methane can be destroyed on-site or transported for off-site use (e.g. through gas distribution or transmission pipeline). Regardless of how the methane is utilized, the ultimate fate must be destruction. In addition, project developers may register multiple projects at a single coal mine, e.g. if separate gathering systems or destruction devices are installed at different locations and time periods.

The protocol does not apply to projects that:

- Recover methane from abandoned coal mines
- Recover methane from virgin CBM wells outside of a mine plan
- Use CO₂ or any other fluid/gas to enhance SMM drainage before mining takes place
- Occur at a surface mine that employs mountaintop removal mining (MTM) methods

2 Eligibility

2.1 Location

Only projects located at a single mine in the United States, its territories or on U.S. tribal lands are eligible under this protocol.

2.2 Offset Project Commencement

Offset Project Commencement is defined as the date on which SMM is first destroyed by the project.

2.3 Project Crediting Period

The crediting period for this protocol is ten years.

2.4 Additionality

Projects must satisfy the following tests to be considered additional:

1. The Legal Requirement Test
2. The Performance Standard Test

2.4.1 The Legal Requirement Test

All projects are subject to a Legal Requirement Test to ensure that the GHG reductions achieved by a project would not otherwise have occurred due to federal, state, tribal or local regulations, or other legally binding mandates. A project passes the Legal Requirement Test when there are no laws, statutes, regulations, court orders, environmental mitigation agreements, permitting conditions, or other legally binding mandates requiring the destruction of coal mine methane at the project site.

Currently, there are no existing federal, state, tribal or local regulations that require mines to destroy surface mine methane. If an eligible project begins operation at a mine that later becomes subject to a regulation, ordinance or permitting condition that calls for the destruction of surface mine methane, emission reductions may be reported up until the date that the surface mine methane is legally required to be destroyed.

2.4.2 The Performance Standard Test

Projects pass the Performance Standard Test by meeting a performance threshold established on an ex-ante basis by this protocol.

There are numerous possible management options and end uses for SMM, ranging from venting, to destruction by flares, to injection of the methane into natural gas pipelines. The Performance Standard Test employed by this protocol is based on a national assessment of “common practice” for managing SMM.

The performance threshold for the management of SMM has been demonstrated through low levels of activity penetration as well as the lack of financial viability in the absence of GHG emission reduction credits. Please refer to the document “SMM Background on Performance Standard-Additionality” for details of this assessment.

SMM projects pass the Performance Standard Test if they destroy gas through any end-use management option (e.g. flare, power generation, heat generation, injection into a natural gas pipeline, etc.).

The Performance Standard Test is applied at the time a project applies for registration. Once a project is registered, it does not need to be evaluated against future versions of the protocol or the Performance Standard Test for the duration of its first crediting period.

2.5 Regulatory Compliance

Offset projects must also demonstrate that the project is in material compliance with all federal, state, local, and tribal regulatory requirements that apply based on the offset project location. The project developers are required to disclose in writing to the verifier any and all instances of non-compliance of the project with any law. Offset projects are not eligible for GHG reductions or GHG removal enhancements that are found to be in non-compliance with regulatory requirements due to negligence or intent.

3 Offset Project Boundary – Quantification Methodology

The Offset Project Boundary delineates the GHG sources, GHG sinks, and GHG reservoirs (SSRs) that shall be assessed to determine the net change in emissions associated with a surface mine methane project. This protocol does not account for carbon dioxide emission reductions associated with displacing grid-delivered electricity or fossil fuel use.

Figure 3.1 provides a general illustration of the Offset Project Boundary, indicating which SSRs are included or excluded from the Offset Project Boundary. All SSRs within the dashed line are accounted for under this protocol.

Table 3.1 provides greater detail on each SSR and information for the SSRs and gases from the Offset Project Boundary.

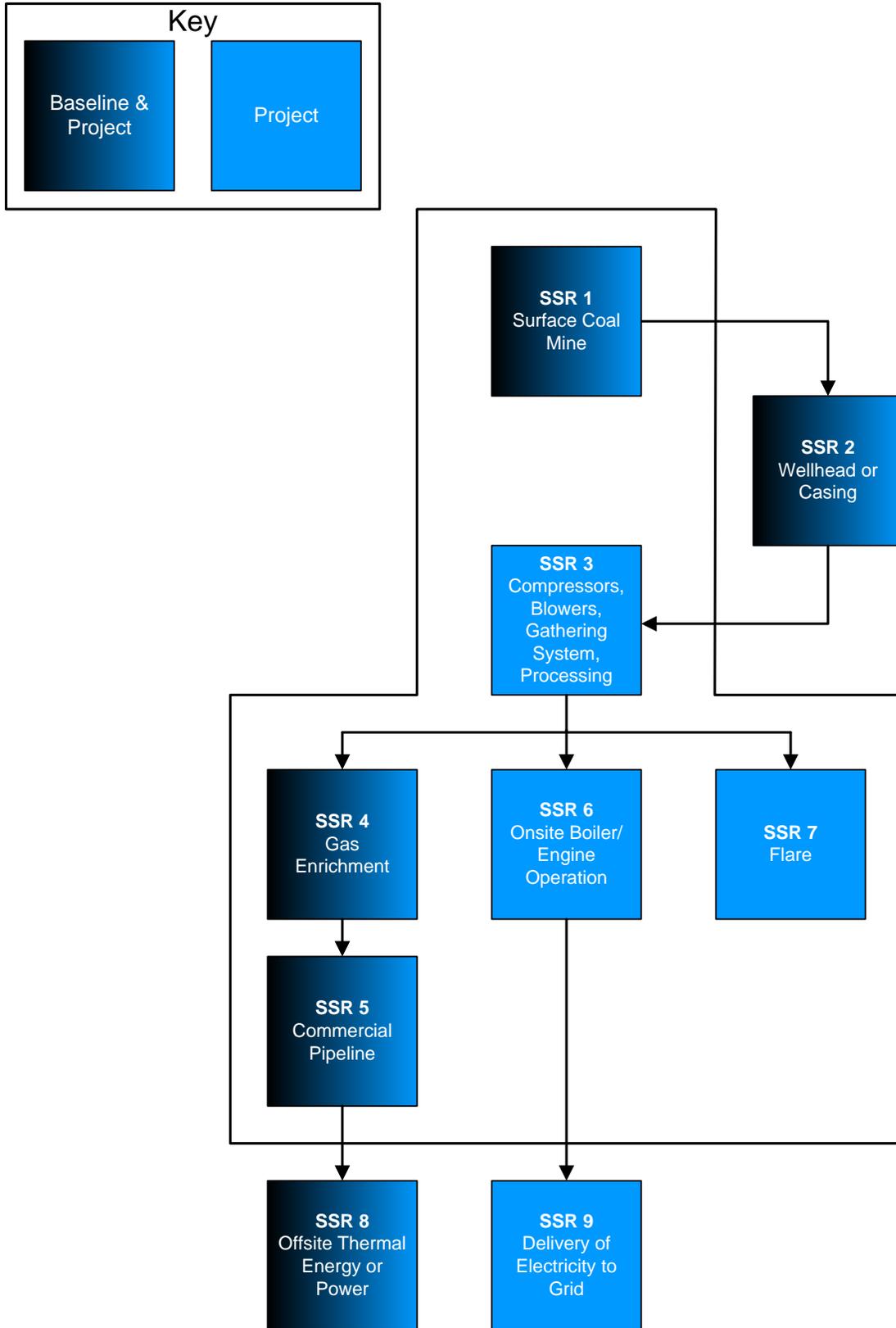


Figure 3.1 General Illustration of the Offset Project Boundary

Table 3.1 Summary of Identified GHG Sources, GHG Sinks, and GHG Reservoirs

SSR	Description	GHG	Relevant to Project Baseline (B) or Offset Project (P)	Included/Excluded
1	Emissions of methane as a result of venting	CH ₄	B, P	Included
2	Fugitive emissions resulting from casing or wellhead	CH ₄	N/A	Excluded
3	Emissions resulting from energy used by compressors, blowers, gathering systems, processors	CO ₂	P	Included
		CH ₄		Excluded
		N ₂ O		Excluded
	Fugitive emissions resulting from energy used by compressors, blowers, and/or gathering systems	CH ₄	N/A	Excluded
4	Emission resulting from energy used by gas enrichment system	CO ₂	P	Included
		CH ₄		Excluded
		N ₂ O		Excluded
	Fugitive emissions from gas enrichment system	CH ₄	N/A	Excluded
5	Emissions from combustion of gas by end user of pipeline	CO ₂	B, P	Included
		N ₂ O		Excluded
	Emissions resulting from the incomplete combustion during end use destruction	CH ₄	P	Included
	Emissions from NMHC destruction	CO ₂	P	Included if NMHC accounts for more than 1% by volume of extracted coal mine gas
6	Emissions resulting from combustion during on-site electricity generation	CO ₂	P	Included
		N ₂ O		Excluded
	Emissions resulting from incomplete combustion during on-site electricity generation	CH ₄	P	Included
	Emissions from NMHC destruction	CO ₂	P	Included if NMHC accounts for more than 1% by volume of extracted coal mine gas
7	Emissions resulting from combustion during flaring	CO ₂	P	Included
		N ₂ O		Excluded
	Emissions resulting from incomplete combustion during flaring	CH ₄	P	Included
	Emissions from NMHC destruction	CO ₂	P	Included if NMHC accounts for more than 1% by volume

				of extracted coal mine gas
8	Emissions resulting from offsite thermal or power generation	CO ₂	N/A	Excluded
		CH ₄		
		N ₂ O		
9	Delivery and use of project electricity to grid	CO ₂	N/A	Excluded
		CH ₄		
		N ₂ O		

4 Quantifying GHG Emission Reductions

The emission reduction ER_t by the project activity during a given year y is the difference between the baseline emissions (BE_t) and project emissions (PE_t), as follows:

$$ER_t = BE_t - PE_t \quad (1)$$

Where,

ER_t = Emissions reductions by the project activity during the reporting period (tCO₂e)

BE_t = Baseline emissions during the reporting period (tCO₂e)

PE_t = Project emissions during the reporting period (tCO₂e)

Note: Due to the fact that emissions reductions from SMM are only credited when a drainage well is shut-in because of mining activities, there could be cases where SMM drainage commenced before the start of the crediting period.

4.1 Quantifying Baseline Emissions

$$BE_t = BE_{MD,t} + BE_{MR,t} \quad (2)$$

Where,

BE_t = Baseline emissions during the reporting period (tCO₂e)

$BE_{MD,t}$ = Baseline emissions from destruction of methane during the reporting period (tCO₂e)

$BE_{MR,t}$ = Baseline emissions from release of methane into the atmosphere during the reporting period (tCO₂e)

4.1.1 Calculating Methane Destruction in the Baseline

Depending on the baseline scenario, methane may be destroyed in the baseline scenario through flaring, flameless oxidation, power generation, heat generation, supply gas to various combustion end uses. Baseline emissions should account for the CO₂ emissions resulting from the destruction of that methane.

$$BE_{MDt} = (CEF_{CH_4} + r \times CEF_{NMHC}) \times \sum_i SMM_{BLi,t} \quad (3)$$

Where,

- BE_{MDt} = Baseline emissions from destruction of methane in the reporting period (tCO₂e)
- i = Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
- $SMM_{BLi,t}$ = SMM that would have been captured, sent to and destroyed by use i in the baseline scenario in the reporting period (tCH₄)
- CEF_{CH_4} = Carbon emission factor for combusted methane (2.75 tCO₂e/tCH₄)
- CEF_{NMHC} = Carbon emission factor for combusted non methane hydrocarbons. This parameter should be obtained through periodical analysis of captured methane (tCO₂eq/tNMHC)
- r = Relative proportion of NMHC compared to methane

With:

$$r = \frac{PC_{NMHC}}{PC_{CH_4}} \quad (4)$$

Where,

- PC_{NMHC} = NMHC concentration (in mass) of methane in extracted gas, to be measured on wet basis (lb/ft³)
- PC_{CH_4} = Concentration (in mass) of methane in extracted gas, to be measured on wet basis (lb/ft³)

4.1.2 Calculating Methane Released into the Atmosphere

Baseline emission must include the methane that would have been emitted to the atmosphere in the absence of the project activity.

$$BE_{MRt} = GWP_{CH_4} \times \sum_i (SMM_{e,t} - SMM_{BLi,t}) \quad (5)$$

Where:

BE_{MRt}	=	Baseline emissions from release of methane into the atmosphere avoided by the project activity during the reporting period (tCO ₂ e)
i	=	Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
$SMM_{e_{i,t}}$	=	Eligible SMM captured, sent to and destroyed by use i during the reporting period (tCH ₄)
$SMM_{BL_{i,t}}$	=	SMM that would have been captured, sent to and destroyed by use i in the baseline scenario during the reporting period (tCH ₄)
GWP_{CH_4}	=	Global warming potential of methane (21 tCO ₂ e/tCH ₄)

The methane that is still vented in the project scenario is not accounted for in the project emissions or in the baseline emissions, since it is vented in both scenarios.

For SMM captured, the avoided emissions should only be credited in the year in which a drainage well is shut-in because of mining activities, as explained in Section 4.1.2.1.

4.1.2.1 Determining Eligible SMM

The approach to quantify the eligible SMM is to identify the zone of influence of SMM wells, and when these are impacted by mining activities.

Step 1: Identify relevant wells

The first step is to identify the drilling plan and the wells that will be intersected by mining or are likely to extract methane from an area that will overlap with future coal extraction. The location of SMM wells in relation to the mine concession area and mining plan during the initial crediting period is estimated using the latest mine plan information.

Wells that extract virgin coal bed methane, i.e. from areas that would not be mined and would not influence eventual SMM emissions in mined areas, are out of the GHG project boundary and are not eligible for emission reductions.

Step 2: Estimation of the zone of influence of a SMM well and eligible methane

This methodology estimates the overlap between a gas drainage zone around a SMM well with the zone of disturbance around a surface mine from which methane is emitted to the atmosphere. A SMM well is considered to be in the zone of influence of the surface mine under the following conditions:

- SMM well produces elevated amounts of atmospheric gases (nitrogen concentrations that are greater than five percent above baseline levels). Standard well operating procedures must ensure that the elevated amounts of atmospheric gases are not due to leakage around the well bores.

- SMM well is physically bisected by surface mining activities, such as excavation of overburden, drilling and blasting, removal of the coal).

To estimate the portion of SMM that would have been released from mining activities, the following approach to determine the horizontal plane and the vertical plane is used.

Horizontal Plane

The area of overlap is considered to be 100% when either of the two above conditions is met.

Therefore:

The eligible share for the horizontal plane is defined as follows:

$$ES_h = 100\% \text{ (if the well is eligible based on zone of influence)} \quad (6)$$

Vertical Plane

For an underground mine, the de-stressing zone typically extends upwards 460 feet and downwards 130 feet. For a surface mine all strata above the mined seams are considered within the de-stressing zone and the strata 130 feet below the lowest mined seam is considered within the de-stressing zone. For boreholes within the de-stressing zone all the gas entering the SMM well is gas that would have been emitted as methane emissions during and after mining. Based on Section 1.0 of the protocol, wells completed and producing from zones below the de-stressed zone (greater than 130 feet below the base of the mined coal) are not eligible for inclusion as pre-mine drainage wells. If a well is acquired from another operator in order to pre-mine drain the methane and it has been completed below the 130 feet limit, it must be plugged back to the 130 feet limit and only methane produced from that point will qualify as emission reductions.

A geologic cross section should be included in project documents showing the coal seams from the surface to 130 feet below the lowest mined seam. The well depth of completion relative to the lowermost mined seam should also be documented.

The eligible share for the vertical plane is defined as follows:

Therefore:

$$ES_v = 100\% \text{ (if the well is eligible based on depth of completion)} \quad (7)$$

Eligible SMM

Summarising the eligible contribution of SMM in the horizontal and vertical planes gives the final eligible SMM:

$$ES_t = 100\% \quad (8)$$

Step 3: Temporal adjustments for baseline emissions within a defined crediting period

No emission reductions from SMM utilization and or destruction can be claimed until the mining activity enters the zone of influence of the well. At that time the emission reductions from the share of eligible pre-drainage and subsequent post-drainage methane can be claimed. This is calculated as follows:

$$SMM_{e,t} = \left[ES_t \cdot \sum_w \sum_{m=1}^{t-b} V_{w,t-m} \right] + \left[ES_t \cdot \sum_w V_{w,t} \right] \quad (9)$$

Where,

$SMM_{e,t}$ = Eligible SMM captured by the project for the reporting period (tCH₄)

ES_t = Total eligible share of SMM (100%)

$V_{w,t-m}$ = Volume of methane captured from well w in the reporting period $t-m$ (tCH₄)

$V_{w,t}$ = Volume of methane captured from well w in reporting period t (tCH₄)

w = Number of wells where mining reached the zone of influence in reporting period t

b = Initial year of crediting period

Note that the first term covers the sum of all the methane drained from each new well for which mining has actually entered the zone of influence during a given reporting period t , from the start of the crediting period to the end of the previous reporting period (i.e. end of reporting period $t-1$). The second term covers the sum of all methane drained from each well for which mining has entered the zone of influence for reporting period t .

For example, at a mine in which five SMM wells had been drilled, if mining entered the zone of influence of all five wells in reporting period four, then in reporting periods one through three the eligible SMM would be zero. Reporting period four would then be equal to the cumulative volume for the previous three reporting periods plus the volume extracted in reporting period four. In reporting period five it would only be the volume extracted in reporting period five.

4.2 Quantifying Project Emissions

Project emissions are defined by the following equation:

$$PE_t = PE_{ME} + PE_{MD} + PE_{UM} \quad (10)$$

Where,

PE_t = Project emissions in year y (tCO₂e)

PE_{ME}	=	Project emissions from energy use to capture and use methane (tCO ₂ e)
PE_{MD}	=	Project emissions from methane destroyed (tCO ₂ e)
PE_{UM}	=	Project emissions from un-combusted methane (tCO ₂ e)

4.2.1 Project Emissions from Energy Required for Methane Collection, Transport, and Combustion

Included in the GHG Assessment Boundary are carbon dioxide emissions resulting from fossil fuel combustion and/or use of grid-delivered electricity for on-site equipment that is used for:

- Compressors, blowers and/or SMM gathering systems
- Transporting SMM to on-site combustion
- Transporting SMM to a pipeline
- Transporting SMM to boilers/engines for power generation
- Transporting SMM to a flare

$$PE_{ME} = (CONS_{ELEC,PJ} \times CEF_{ELEC}) + \frac{(CONS_{HEAT,PJ} \times CEF_{HEAT} + CONS_{FossFuel,PJ} \times CEF_{FossFuel})}{2204.62} \quad (11)$$

Where,

PE_{ME}	=	Project emissions from energy use to capture and use or destroy methane during the reporting period (tCO ₂ e)
$CONS_{ELEC,PJ}$	=	Additional electricity consumption for capture and use or destruction of methane during the reporting period, if any (MWh)
CEF_{ELEC}	=	Carbon emissions factor of electricity used by coal mine (tCO ₂ /MWh)
$CONS_{HEAT,PJ}$	=	Additional heat consumption for capture and use or destruction of methane during the reporting period, if any (volume)
CEF_{HEAT}	=	Carbon emissions factor of heat used by coal mine during the reporting period (lbs CO ₂ e/volume); see Appendix A
$CONS_{FossFuel,PJ}$	=	Additional fossil fuel consumption for capture and use or destruction of methane during the reporting period, if any (volume)
$CEF_{FossFuel}$	=	Carbon emissions factor of fossil fuel used by coal mine (lbs CO ₂ /volume)
$1/2204.62$	=	Conversion of lbs to metric tons

4.2.2 Project Emissions from Destruction of Captured Methane

When SMM is sent to a pipeline for eventual combustion, burned in a flare, or heat or power plant, carbon dioxide emissions are released and must be accounted for. In addition, if non-methane hydrocarbons (NMHC) comprise more than 1% of the volume of extracted SMM, carbon dioxide emissions from combustion of NMHC must also be accounted for.

$$PE_{MD} = MD_i + (CEF_{CH_4} + r \times CEF_{NMHC}) \quad (12)$$

With:

$$r = \frac{PC_{NMHC}}{PC_{CH_4}}$$

PE_{MD} = Project emissions from methane destroyed during the reporting period (tCO₂e)
 MD_i = Methane destroyed by all qualifying and non-qualifying devices during the reporting period (tCH₄)

CEF_{CH_4} = Carbon emission factor for combusted methane (2.75 tCO₂/tCH₄)
 CEF_{NMHC} = Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO₂/tNMHC)

r = Relative proportion of NMHC compared to methane

PC_{NMHC} = NMHC concentration (in mass) of methane in extracted gas, to be measured on wet basis (lb/ft³)

PC_{CH_4} = Concentration (in mass) of methane in extracted gas, measured on wet basis (lb/ft³)

$$MD_i = \sum_i MM_i \times Eff_i \quad (13)$$

Where,

MD_i = Methane destroyed by all qualifying and non-qualifying devices during the reporting period (tCH₄)

MM_i = Methane measured sent to use i (tCH₄)

Eff_i = Efficiency of methane destruction for device i (%)

Apply the following equation only if the SMM flow metering equipment does not internally correct for temperature and pressure.

$$MD_{adjusted} = MM_{unadjusted} \times \frac{520}{T} \times \frac{P}{1} \quad (14)$$

Where,

$MD_{adjusted,i}$ = Adjusted volume of SMM collected for the given time interval at utilization type i, adjusted to 60° F and 1 atm (scf/unit time)

$MM_{unadjusted,i}$ = Unadjusted volume of SMM collected for the given time interval at utilization type i (scf/unit time)

T = Measured temperature of the SMM for the given time period, °R = °F + 460 (°R)

P = Measured pressure of the SMM for the given time interval (atm)

4.2.3 Project Emissions from Uncombusted Methane

Not all of the methane sent to the flare, pipeline, or to generate heat and power will be combusted; a small amount will escape to the atmosphere. These emissions are calculated using the equation below.

$$PE_{UM} = GWP_{CH_4} \times \sum_i MM_i \times (1 - Eff_i) \quad (15)$$

PE_{UM} = Project emissions from uncombusted methane during the reporting period (tCO₂e)

GWP_{CH_4} = Global warming potential of methane (21) (tCO₂e/tCH₄)

i = The set of qualifying and non-qualifying destruction devices

MM_i = Methane measured sent to use i (tCH₄)

Eff_i = Efficiency of methane destruction for device i (%)

5 Offset Project Documentation and Monitoring Requirements

Project developers are responsible for monitoring the performance of the project and ensuring that the operation of SMM destruction devices is consistent with the manufacturer's recommendations for each piece of equipment.

5.1 Monitoring Requirements

Methane destruction devices must be monitored with measurement equipment that directly meters:

- The flow of gas delivered to each destruction device (unless otherwise allowed by Section 5.1.1), measured continuously and recorded every 15 minutes or totalized and recorded at least daily, adjusted for temperature and pressure
- The fraction of methane in the gas from measured continuously and recorded every 15 minutes and averaged at least daily

All flow data collected must be corrected for temperature and pressure at standard conditions (60°F and 1 atm). Equation 14 must be applied if flow metering equipment does not make this correction automatically. Depending on the methane analyzer technology used, methane concentration data may or may not need to be corrected for temperature and pressure. If the methane analyzer technology used requires adjustment for temperature and pressure, then concentration data must also be corrected to 60°F and 1 atm.

NMHC content of the gas shall be determined on an annual basis by a full gas analysis using a gas chromatograph at an ISO 17025 accredited lab or a lab that has been certified by an accreditation body conformant with ISO 170252 to perform test methods appropriate for NMHC content analysis. Separate

gas samples shall be collected by a third-party technician prior to each destruction device within the project definition.

Operational activity of the SMM systems and the destruction devices shall be monitored and documented at least hourly to ensure actual methane destruction. GHG reductions will not be accounted for during periods in which the destruction device is not operational. For flares, operation is defined as thermocouple readings above 500°F. For all other destruction devices, the means of demonstration shall be determined by the project developer and subject to verifier review and professional judgment.

5.1.1 Arrangement of Gas Metering Equipment

The flow of gas to each destruction device must be monitored separately for each destruction device, except under certain conditions. Specifically, if all destruction devices are of identical efficiency and verified to be operational throughout the reporting period, a single flow meter may be used to monitor gas flow to all destruction devices. Otherwise, the destruction efficiency of the least efficient destruction device shall be used as the destruction efficiency for all destruction devices monitored by this meter.

If a project using a single meter to monitor gas flow to multiple destruction devices has any periods when not all destruction devices downstream of a single flow meter are operational, methane destruction from the set of downstream devices during these periods will only be eligible provided that the verifier can confirm all of the following requirements and conditions are met:

- a. The destruction efficiency of the least efficient downstream destruction device in operation shall be used as the destruction efficiency for all destruction devices downstream of the single meter; and
- b. All devices are either equipped with valves on the input gas line that close automatically if the device becomes non-operational (requiring no manual intervention), or designed in such a manner that it is physically impossible for gas to pass through while the device is non-operational; and
- c. For any period during which one or more downstream destruction devices are not operational, it must be documented that the remaining operational devices have the capacity to destroy the maximum gas flow recorded during the period.

5.2 Instrument QA/QC

Monitoring instruments shall be inspected, cleaned, and calibrated according to the following schedule.

All gas flow meters and continuous methane analyzers must be:

- Cleaned and inspected on a regular basis, as specified in the project's monitoring plan, with the activities and results documented by site personnel. Cleaning and inspection frequency must, at a minimum, follow the manufacturer's recommendations.
- Field checked for calibration accuracy by an appropriately trained individual or a third party technician with the percent drift documented, using either a portable instrument or manufacturer specified guidance, at the end of – but no more than two months prior to or after

– the end date of the reporting period. If a portable calibration instrument is used for field checks, the portable instrument shall be maintained and calibrated per the manufacturer’s specifications, and calibrated at least annually by the manufacturer or at an ISO 17025 accredited laboratory. For portable methane analyzers, the portable instrument must be field calibrated to a known sample gas prior to each use.

- Calibrated by the manufacturer or a third-party calibration service at the frequency recommended by the manufacturer. If the manufacturer does not specify a recommended calibration schedule, then no calibrations are required, unless a field check reveals a difference of +/- 5% or more.
 - Flow meter calibrations shall be documented to show that the meter was calibrated to a range of flow rates corresponding to the flow rates expected at the mine.
 - Methane analyzer calibrations shall be documented to show that the calibration was carried out to the range of conditions (temperature and pressure) corresponding to the range of conditions as measured at the mine.

If the field check on a piece of equipment reveals a difference of +/- 5% or more between the value measured by the portable calibration instrument and the value measured by the monitoring instrument, calibration by the manufacturer or a third-party calibration service is required for that piece of equipment.

For the interval between the last successful field check/calibration and any field check/calibration event revealing accuracy outside the +/- 5% threshold, all data from that meter or analyzer must be scaled according to the following procedure based on the results of the calibration report from the manufacturer or third-party service provider. These adjustments must be made for the entire period from the last successful field check/calibration until such time as the meter is properly calibrated and in place.

- For calibrations that indicate an underestimation of emission reductions, the metered values must be used without correction.
- For calibrations that indicate an overestimation of emission reductions, the metered values must be adjusted based on the greatest calibration drift recorded at the time of calibration.

For example, if a project conducts field checks quarterly during a year-long reporting period, then only three months of data will be subject at any one time to the penalties above. However, if the project developer feels confident that the meter does not require field checks or calibration more than annually, then failed events will accordingly require the adjustments above to be applied to the entire year’s data. Further, frequent calibration may minimize the total accrued drift (by zeroing out any error identified), and result in smaller overall deductions.

In order to provide flexibility in verification, data monitored up to two months after a field check may be verified. As such, the end date of the reporting period must be no more than two months after the latest successful field check. A field check conducted up to two months after the end date of a reporting period is also acceptable to confirm the accuracy of the equipment during the reporting period.

Project developers have the option to use either the default methane destruction efficiencies provided in the protocol, or the site-specific methane destruction efficiencies as provided by a state- or local agency-accredited source test service provider, for any of the destruction devices used in the project, performed on an annual basis. Device-specific source testing shall include at least three test runs, with the accepted final value being one standard deviation below the mean of the measured efficiencies.

5.3 Missing Data

In situations where the flow rate or methane concentration monitoring equipment is missing data, the project developer shall apply the data substitution methodology provided in Appendix B. If for any reason the destruction device monitoring equipment is inoperable (for example, the thermocouple on the flare), then no emission reductions can be credited for the period of inoperability.

5.4 Monitoring Parameters

Prescribed monitoring parameters necessary to calculate baseline and project emissions are provided in Table 6.1.

Table 5.1 Surface Mine Methane Project Monitoring Parameters

Parameter	Description	Data Unit	Calculated (c) Measured (m) Reference (r) Operating records (o)	Measurement Frequency
$SMM_{BL,i,t}$	SMM that would have been captured, sent to and destroyed by use i in the baseline scenario in the reporting period	tCH ₄	c,m	Estimated at start of project and calculated annually, if non-qualifying destruction device is still in place
CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons. This parameter should be obtained through periodical analysis of captured methane	tCO ₂ eq/tNMHC	m	Annually
PC_{NMHC}	NMHC concentration (in mass) of methane in extracted gas, to be measured on wet basis (mg/m ³)	lbs/ft ³	m	Annually
PC_{CH4}	Concentration (in mass) of methane in extracted gas, to be measured on wet basis (mg/m ³)	lbs/ft ³	m	Continuous
$SMM_{e,t}$	Eligible SMM captured, sent to and destroyed by use i during the reporting period	tCH ₄	c,m	Every reporting period
GWP_{CH4}	Global warming of methane	tCO ₂ e/tCH ₄	r	21
ES_t	Total eligible share of SMM	%	c	Every reporting period
ES_h	Eligible share of SMM based on the horizontal plane overlap	%	c	Every reporting period
ES_v	Eligible share of SMM based on the vertical plane overlap	%	c	Every reporting period

w	SMM wells with zones of influence that overlap with mining activity		o	Every reporting period
V_w	Volume of methane captured from well w	tCH ₄	m	Every reporting period
$CONS_{ELEC,PJ}$	Additional electricity consumption for capture and use or destruction of methane, if any	MWh	o	Every reporting period
CEF_{ELEC}	Carbon emissions factor of electricity used by coal mine	tCO ₂ /MWh	r	Every reporting period
$CONS_{HEAT,PJ}$	Additional heat consumption for capture and use or destruction of methane, if any	volume	o	Every reporting period
CEF_{HEAT}	Carbon emissions factor of heat used by coal mine	lbs CO ₂ e/volume	c	Every reporting period
$CONS_{FossFuel,PJ}$	Additional fossil fuel consumption for capture and use or destruction of methane, if any	volume	o	Every reporting period
$CEF_{FossFuel}$	Carbon emissions factor of fossil fuel used by coal mine	lbs CO ₂ /volume	R	Every reporting period
MD_i	Methane destroyed by all qualifying and non-qualifying devices	tCH ₄	c	Every reporting period
MM_i	Methane measured sent to use i	tCH ₄	m	Continuous
Eff_i	Efficiency of methane destruction for device i	%	m,r	Annually
$MD_{adjusted,i}$	Adjusted volume of SMM collected for the given time interval at utilization type i , adjusted to 60° F and 1 atm	scf/unit time	c	Every reporting period
$MM_{unadjusted,i}$	Unadjusted volume of SMM collected for the given time interval at utilization type i	scf/unit time	c	Every reporting period
T	Measured temperature of the SMM for the given time period, °R = °F + 460	°R	m	Continuously
P	Measured pressure of the SMM for the given time interval	atm	M	Continuously

6 Reporting Parameters

This section provides requirements and guidance on reporting rules and procedures.

6.1 Document Retention

System information to be retained shall include, but is not limited to:

- All data inputs for the calculation of GHG reductions, including all required sampled data
- Copies of mine operating permits, air, water, and land use permits; Notices of Violations (NOVs); and any administrative or legal consent orders related to project activities dating back at least three years prior to the project start date; and for each subsequent year of project operation
- Copies of mine plans and mine ventilation plans submitted to MSHA throughout the crediting period
- Flow meter information (model number, serial number, manufacturer's calibration procedures)
- Methane monitor information (model number, serial number, calibration procedures)
- Destruction device monitor information (model number, serial number, calibration procedures)
- Field checks and calibration results for all meters
- Corrective measures taken if meter does not meet performance specifications
- Destruction device monitoring data (for each destruction device)
- Project flow and methane concentration data
- Emission reduction calculations
- Verification records and results from each verification
- All maintenance records relevant to the project monitoring equipment and destruction devices

Appendix A Emission Factors

PLACEHOLDER - [eGRID Table]

PLACEHOLDER - [Destruction Efficiencies]

Calculating Heat Generation Emission Factor

$$CEF_{HEAT,t} = \frac{EF_{CO_2,i}}{Eff_{heat}} \times \frac{44}{12} \quad (16)$$

Where,

$CEF_{HEAT,t}$ = Emission factor for heat generation (lbs CO₂/volume)

$EF_{CO_2,i}$ = CO₂ emission factor of fuel used in heat generation (lbs C/volume)

Eff_{heat} = Boiler efficiency of the heat generation; either measured efficiency, manufacturer nameplate data, or 100% (%)

44/12 = Carbon to carbon dioxide conversion factor

Appendix B Data Substitution Guidelines

This appendix provides guidance on calculating emission reductions when data integrity has been compromised due to missing data points. No data substitution is permissible for equipment such as thermocouples which monitor the proper functioning of destruction devices. Rather, the methodologies presented below are to be used only for the methane concentration and flow metering parameters, including temperature and pressure data.

The following data substitution methodology may be used only for flow and methane concentration data gaps that are discrete, limited, non-chronic, and due to unforeseen circumstances. Data substitution can only be applied to methane concentration or flow readings, but not both simultaneously. If data is missing for both parameters, no reductions can be credited. The methodology may also be used for missing temperature and pressure data (which is used to adjust flow rate). However, the methodology must be applied to both parameters simultaneously, regardless of if data is available for one or the other. Thus, if either temperature or pressure data is missing, the following methodology to substitute data for both parameters over the same time interval must be used.

Further, substitution may only occur when two other monitored parameters corroborate proper functioning of the destruction device and system operation within normal ranges. These two parameters must be demonstrated as follows:

1. Proper functioning can be evidenced by thermocouple readings for flares, energy output for engines, etc.
2. For methane concentration substitution, flow rates during the data gap must be consistent with normal operation.
3. For flow substitution, methane concentration rates during the data gap must be consistent with normal operations.

If corroborating parameters fail to demonstrate any of these requirements, no substitution may be employed. If the requirements above can be met, the following substitution methodology maybe applied:

Duration of Missing Data	Substitution Methodology
Less than six hours	Use the average of the four hours of normal operations immediately before and following the outage
Six to 24 hours	Use the 90% lower or upper confidence limit of the 24 hours of normal operations prior to and after the outage, whichever results in greater conservativeness
One to seven days	Use the 95% lower or upper confidence limit of the 72 hours of normal operations prior to and after the outage, whichever results in greater conservativeness
Greater than one week	No data may be substituted and no credits may be generated

The lower confidence limit should be used for both methane concentration and flow readings, as this will provide the greatest conservativeness.