California Environmental Protection Agency
Air Resources Board

Proposed Regulation to Implement the California Cap-and-Trade Program

APPENDIX A

STAFF REPORT AND PROPOSED COMPLIANCE OFFSET PROTOCOL

MINE METHANE CAPTURE PROJECTS

Release Date: September 4, 2013

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State of California
California Environmental Protection Agency
AIR RESOURCES BOARD
Stationary Sources Division

STAFF REPORT: INITIAL STATEMENT OF REASONS
PROPOSED REGULATION TO IMPLEMENT
THE CALIFORNIA CAP-AND-TRADE PROGRAM

APPENDIX A

STAFF REPORT AND COMPLIANCE OFFSET PROTOCOL

MINE METHANE CAPTURE PROJECTS

Public Hearing to Consider the Proposed Regulation
to Implement the California Cap-and-Trade Program

Date of Release: September 4, 2013
Scheduled for Consideration: October 24-25, 2013

Location:

California Air Resources Board

Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

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Staff Report

I. Introduction and Background on Compliance Offset Protocols

A. Staff Proposal

Staff is recommending the Board adopt a new Compliance Offset Protocol for Mine Methane Capture projects to augment the existing ARB-approved Compliance Offset Protocols and to support the Cap-and-Trade program. This part discusses the development of a Compliance Offset Protocol for Mine Methane Capture (MMC) projects.

B. Rationale for Compliance Offset Protocols

The Air Resources Board's (ARB or Board) Cap-and-Trade program allows the use of offsets, which are greenhouse gas (GHG) emission reductions or removal enhancements from uncapped sectors, to comply with reporting entities' emission reduction compliance obligations. Offset credits are issued from projects developed using ARB-adopted Compliance Offset Protocols. Compliance Offset Protocols contain the basic methods and procedures to conduct the offset project and determine its greenhouse gas reduction benefits, including project eligibility criteria, quantification methodologies, procedures for project monitoring, reporting, and verification, and regulatory enforcement requirements established to meet the requirements of the Cap-and-Trade Regulation and of the Global Warming Solutions Act of 2006 (Assembly Bill 32, stats. 2006, ch. 488) (AB 32), such that any ARB-issued offset credits are "real, permanent, quantifiable, verifiable, enforceable, and additional."

C. Board Adoption of Compliance Offset Protocols

At its October 2011 meeting, the Board adopted four Compliance Offset Protocols, including protocols for Livestock Manure (digester) Projects, Ozone Depleting Substances Destruction Projects, Urban Forest Projects, and U.S. Forest Projects. Offset protocols must be adopted by the Board before they can be used to generate ARB offset credits. The final Regulation Order of October 2011 directed the Executive Officer "to develop implementation documents laying out the process for review and consideration of new offset protocols, including a description of how staff will evaluate "additionality," signaling the Board's intention to adopt additional Compliance Offset Protocols in the future. This process has since been developed (CARB 2013) and is publicly available at: http://www.arb.ca.gov/cc/capandtrade/compliance-offset-protocol-process.pdf.

D. Compliance Offset Protocol Structure and Regulatory Requirements

Compliance Offset Protocols consist of two main structural elements: project requirements and project quantification. Project requirements include items such as eligibility, monitoring and reporting, and verification and enforcement provisions. AB 32 requires ARB to adopt regulatory requirements for verification and enforcement of any offset reductions used for compliance purposes. Project quantification identifies the quantification methodologies and equations used in project accounting such as baseline determination and calculation of emissions and emission reductions.

The Cap-and-Trade Regulation itself includes offset program regulatory requirements, including but not limited to, eligibility criteria for start dates, project locations, offset project reporting periods, project document retention, project listing information, project reporting information, verification requirements, and enforcement provisions. Staff has developed the Compliance Offset Protocol for Mine Methane Capture Projects to be consistent with regulatory requirements in the Cap-and-Trade Regulation. Since Compliance Offset Protocols are used in the context of a compliance program, staff has included language in the proposed Compliance Offset Protocol for Mine Methane Capture Projects to refer to the regulatory requirements in the Cap-and-Trade Regulation where needed rather than splitting the offset protocols into separate documents based on regulatory requirements and quantification methodologies. In sections that relate directly to a requirement in the Cap-and-Trade Regulation, text refers readers to the appropriate section(s) of the Regulation.

New Compliance Offset Protocols, including the proposed Compliance Offset Protocol for Mine Methane Capture Projects, will be incorporated by reference into proposed amendments to the Cap-and-Trade Regulation. This incorporation makes the offset protocol document an enforceable regulation. AB 32 exempts quantification methodologies from the Administrative Procedure Act (Government Code, section 11340 *et seq.*) (APA), however those elements of the Compliance Offset Protocol are still regulatory. The exemption allows future updates to the quantification methodologies to be made through a public review and Board adoption process but without the need for rulemaking documents. Each Compliance Offset Protocol identifies sections that are considered quantification methodologies and exempt from APA requirements. Any changes to the non-quantification elements of the Compliance Offset Protocols would be considered a regulatory update subject to the full regulatory development process.

E. Environmental Impacts

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine any potentially adverse environmental impacts of any potential projects under the compliance offset program. When adopting the first four Compliance Offset Protocols in 2011, ARB determined that adoption and implementation of the Compliance Offset Protocols constitute “projects” as defined by Public Resources Code §21000 et seq. The CEQA Guidelines provides the definition of a project (Title 14, California Code of Regulations, §15378). As was done in 2011, ARB has included a tiered environmental review of the proposed amendments to the Cap-and-Trade Regulation and the proposed Compliance Offset Protocol for Mine Methane Capture Projects. The specific environmental analysis for the MMC Protocol is contained in Part B of this Appendix.

II. Compliance Offset Protocol for Mine Methane Capture (MMC) Projects

A. Role of Mining and Mine Methane Capture in Climate Change Mitigation

The uncontrolled venting of methane occurs at various categories of mines, including active underground mines, active surface mines, and abandoned underground mines. Methane is emitted from active underground and surface mines when a coal or trona seam is disturbed by the advancement of mining activities and, to a lesser degree, when coal is handled post-mining. At the time of closure and abandonment, methane liberation from underground coal mines decreases but does not stop and, after the initial decline, can continue at a near-steady rate for decades (U.S. EPA CMOP 2004).

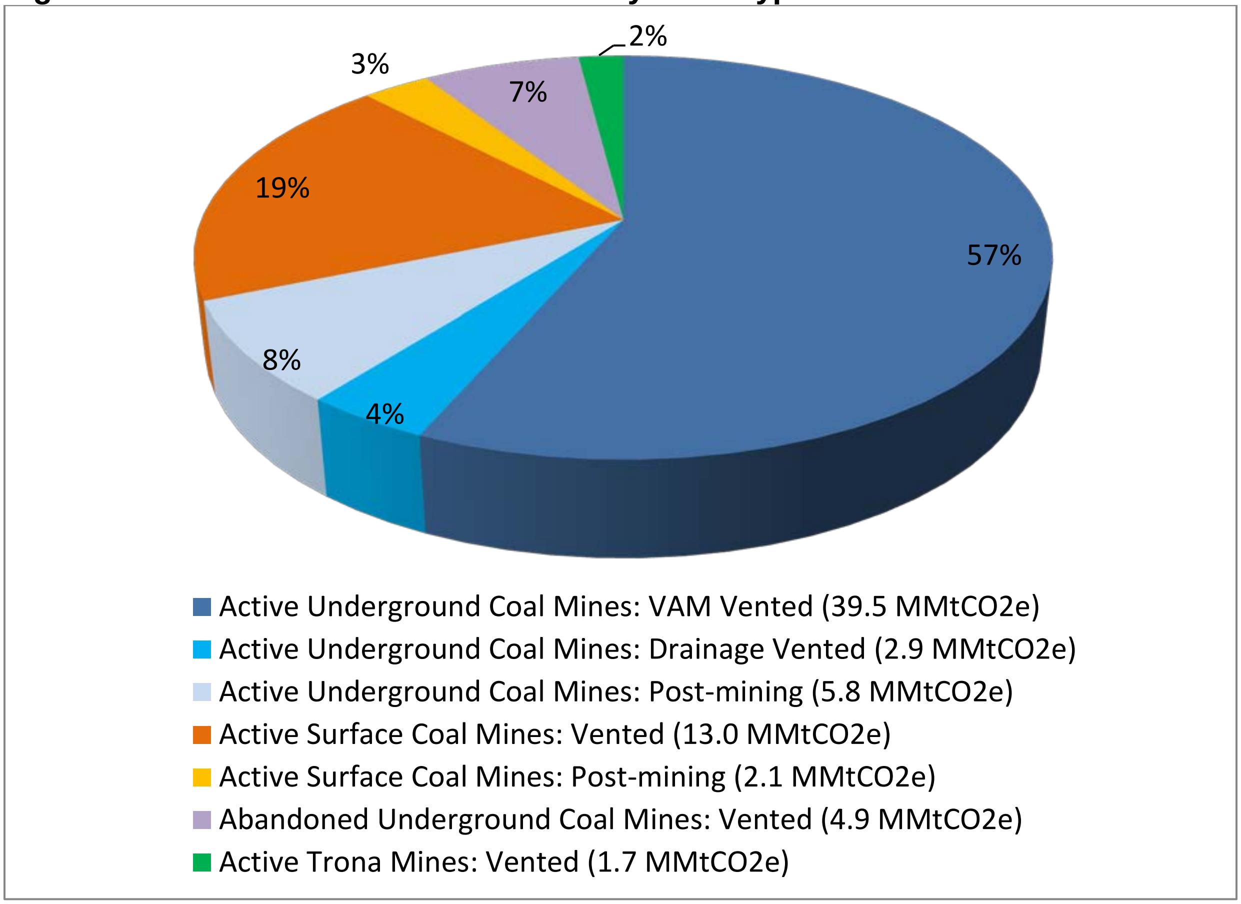
The United States is home to the world's largest reserves of recoverable coal, which is largely used in the generation of electricity (U.S. EIA 2013). Because of the unique adsorptive capacity of coal, the mining of this mineral results in significant methane emissions. Methane is produced during the creation of coal from peat, or "coalification," and is stored within the coal and the natural fractures in the coalbeds known as cleats. Similarly, the mining of trona, a water-bearing sodium carbonate compound that is mined and processed into soda ash or bicarbonate of soda, also releases methane stored in the carboniferous shales above and below the trona seam.

Methane is explosive in concentrations of 5-15% volume in air (U.S. EPA CMOP 2009) and can pose a safety hazard to miners, particularly those at active underground mines. Federal regulations require mines to maintain safe methane levels. To comply with these safety regulations, all underground mines utilize ventilation systems to dilute and remove methane from the mine. At particularly "gassy" mines (i.e., ones which release methane at higher rates), where ventilation systems may not be sufficient to meet safety requirements, drainage systems are employed to extract methane from the seam prior to mining. Despite the requirements to keep methane concentration levels below 1% in mine working places and intake air courses (Title 30, Code of Federal Regulation, 75.323, 2006), no regulations currently exist prohibiting the venting of mine gas from drainage systems or ventilation air methane from ventilation systems or requiring the destruction of this methane.

While methane does not pose the same safety risk at active surface mines and abandoned underground mines, drainage system technology can be employed in those settings for the purpose of mine methane capture.

Mining activities in the United States liberated 89.3 million metric tons of carbon dioxide equivalent (MMtCO_2e) in 2011. Just over one fifth of this methane was captured and destroyed, while 69.9 MMtCO_2e was vented into the atmosphere. The resulting mining related emissions accounted for nearly 12% of U.S. anthropogenic methane emissions and 1% of total U.S. GHG emissions that year (U.S. EPA 2013). The graph below (Figure 1) shows a breakdown of the emissions from 2011 by mine type and mining stage.

Figure 1. U.S. Mine Methane Emissions by Mine Type



Adapted from data presented in *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2011* (U.S. EPA 2013) and *Overview of Proposed Abandoned Mine Methane Protocol* (RCE 2013a).

The vast majority of mine methane that was captured, 16.7 MMtCO_2e at active underground mines and 4.9 MMtCO_2e at abandoned underground mines, was injected into natural gas pipelines for offsite usage. In addition to pipeline injection, one mine also utilized captured methane to fuel a thermal coal dryer and another mine destroyed ventilation air methane via thermal oxidation (U.S. EPA 2013). These activities demonstrate the opportunity for significant additional emission reductions from the capture and destruction of mine methane that is currently vented into the atmosphere. Outside of the climate benefits that would result from the destruction of mine methane that is currently vented, additional benefits would be achieved if captured mine methane is utilized for productive purposes such as the generation of electricity or thermal power, production of transportation fuel, or injection into a natural gas pipeline.

B. Development of the Compliance Offset Protocol for Mine Methane Capture Projects

The process of developing the MMC Protocol involved an extensive review of relevant documents and literature as well as a stakeholder process which included soliciting input from industry experts, government agencies, project developers, academia and the general public through a series of workshops, technical working group meetings, and small group discussions.

The MMC Protocol stakeholder process began on March 28, 2013, when ARB staff held a public workshop to discuss the decision to develop potential Compliance Offset Protocols, including the MMC Protocol. During this public stakeholder workshop, ARB invited interested members of the public to participate in an MMC technical working group and in the formal rulemaking process. The technical working group held four meetings through the spring and summer of 2013 during which many topics were addressed, including: the assessment of common practice with regard to natural gas pipeline injection, the feasibility of allowing for projects situated on federal lands, quantification of baseline emissions for projects at abandoned mines using a modeled decline curve, spatial and temporal boundaries applicable to the extraction and quantification of methane drained in advance of mining activities, the merit of accounting for non-methane hydrocarbons, and standards for project expansion. Workshop and meeting materials are available on the MMC Protocol website: http://www.arb.ca.gov/cc/capandtrade/protocols/mmcprotocol.htm. Staff also had many other interactions with stakeholders interested in discussing protocol related issues, and this staff proposal reflects those discussions.

As part of its development of this protocol, ARB staff reviewed existing voluntary market offset protocols to evaluate their scope, additionality provisions, GHG assessment boundary, quantification methodologies, and requirements for monitoring, reporting, and verification. ARB staff also reviewed publicly available documents from the U.S. EPA Coalbed Methane Outreach Program and documents submitted by technical experts and other stakeholders in the development of the MMC Protocol. These documents are included in the reference section of this staff report, and are cited when relied upon for facts. Staff also had interactions with the U.S. Bureau of Land Management, the U.S. Mine Health and Safety Administration, and state agencies responsible for overseeing mining activities. The proposed MMC Protocol is the first “umbrella style” protocol for mine methane, covering emissions from active underground mines, active surface mines, and abandoned underground mines. The MMC Protocol incorporates elements from many of the existing voluntary methodologies as well as the best available science and information to ensure that emission reductions are real, permanent, quantifiable, additional, verifiable and enforceable.

A draft version of the MMC Protocol was made publicly available in August 2013. ARB staff again sought and incorporated input from stakeholders into the proposed final version for Board consideration released along with this staff report for public review on

September 4, 2013. The formal 45-day public comment period begins on September 9, 2013 and the new Compliance Offset Protocol will be considered at the October 24 and 25, 2013 Board hearing along with the proposed amendments to the Cap-and-Trade Regulation.

C. Description of the Compliance Offset Protocol for Mine Methane Capture Projects

1. Overview

ARB's proposed MMC Protocol incentivizes the reduction of GHG emissions resulting from coal and trona mining activities in the United States. The MMC Protocol will allow for the issuance of carbon offset credits for emission reductions achieved from the installation and operation of a device or set of devices that capture and destroy methane that would otherwise be released into the atmosphere as a result of mining activities at active underground mines, active surface mines, and abandoned underground mines. The MMC Protocol is applicable to projects within the United States. The MMC Protocol excludes projects from U.S. territories as there are no coal or trona mines located in territories of the United States.

The MMC Protocol allows for four types of activities:

- Active Underground Mine Ventilation Air Methane (VAM) Activities;
- Active Underground Mine Methane Drainage Activities;
- Active Surface Mine Methane Drainage Activities; and
- Abandoned Underground Mine Methane Recovery Activities

Project activities will vary depending upon the mine classification type and existing infrastructure as well as the end-use management option employed and technology utilized. All MMC projects will involve the capture and destruction of mine methane via an eligible end-use management option (i.e., oxidation, flaring, electricity or heat generation, injection into a natural gas pipeline, production of transportation fuels, etc.) as defined in the MMC Protocol as well as the monitoring of methane destruction. In addition to methane capture, destruction and monitoring that will occur at all projects, some MMC projects would also involve the extraction, transport, and processing of mine gas or ventilation air methane.

The MMC Protocol provides project definitions, eligibility rules, conservative GHG emission reduction quantification methodologies, and procedures for offset project monitoring, reporting, and verification. All projects that pass the eligibility requirements set forth in the MMC Protocol and the Cap-and-Trade Regulation are eligible to register GHG reductions for the duration of the project crediting period, which is ten years.

2. Additionality

Per AB 32 and the Cap-and-Trade Regulation, emission reductions achieved under Compliance Offset Protocols must be additional to what would have occurred in the absence of the project in a conservative business-as-usual scenario. Similar to the Compliance Offset Protocols approved by the Board in 2011, which ensured additionality by utilizing a regulatory additionality requirement and a performance standard approach, the MMC Protocol ensures compliance with the Regulation's additionality requirement through a performance standard evaluation and assessment of legal requirements.

The performance standard is an identified standard of performance applicable to all MMC projects. The purpose of a performance standard is to establish a threshold that is significantly better than average, business-as-usual greenhouse gas (GHG) emissions for a specified activity, which, if met or exceeded by a project developer, satisfies the criterion of "additionality." If the project meets the threshold, then it exceeds what would happen under the business-as-usual scenario and generates additional GHG reductions. The MMC Protocol uses a technology-specific threshold, sometimes also referred to as a practice-based threshold, where it serves as the "best-practice standard" for managing mine methane.

In addition to the performance standard, projects must show regulatory additionality, meaning that there are no federal, state or local laws, regulations or legally-binding mandates requiring the destruction of mine methane. In addition, projects must comply with all applicable local, state, and federal regulations, whether for air and water quality, energy regulations, or others.

Performance Standard Evaluation for Active Surface and Abandoned Underground Mines. Based on ARB staff's review of existing literature (U.S. EPA CMOP 2008a; U.S. EPA CMOP 2008b; U.S. EPA CMOP 2011; U.S. EPA CMOP 2012) and the stakeholder discussions described above, from the population of active surface mines and abandoned underground mines in the United States, few currently capture and destroy mine methane. Methane capture and destruction is therefore deemed not to be business-as-usual at these mines, which means that active surface mine methane drainage activities and abandoned underground mine methane recovery activities are deemed additional.

Performance Standard Evaluation for Active Underground Mines. In the case of active underground mines, ventilation and methane drainage systems have been employed at mines as a strategy for compliance with the safety regulations described in section II.A. above. All active underground mines have ventilation systems, yet only a small fraction destroy the methane released through the ventilation shaft(s) (U.S. EPA CMOP 2012; U.S. EPA CMOP 2011; U.S. EPA CMOP 2008c). VAM capture and destruction is therefore deemed not to be business-as-usual, which means that active underground mine VAM activities are deemed additional. Conversely, only 25 particularly gassy active underground mines, out of a population of over 500, utilized a methane drainage system in addition to a ventilation system in 2012 (RCE 2013b; U.S. EIA 2012). As previously mentioned, mine operators are under no obligation to capture or destroy the extracted methane, but because the installation of a methane drainage system is considered a response to regulation (U.S. EPA CMOP 2009; SAIC 2009), common practice is assessed by examining the practices of the smaller population of active underground mines with existing methane drainage systems. Most active underground mines with drainage systems inject into a natural gas pipeline (U.S. EPA 2013; U.S. EPA CMOP 2010). Where mine methane is not injected into a pipeline it is usually because pipeline injection has been deemed to be infeasible, either due to the distance or rough terrain between the mine and a transmission line or low annual methane liberation rates (SAIC 2009; U.S. EPA CMOP 2012; U.S. EPA CMOP 2008c). Based on ARB staff's review of the existing practice, and to ensure a conservative assessment of business-as-usual, pipeline injection is deemed to be business-as-usual for underground mines with methane drainage systems. Injection into a natural gas pipeline is therefore not considered additional and is not an eligible end-use management option for active underground mine methane drainage activities in terms of offset credit issuance under the proposed MMC Protocol. Alternative methane destruction methods, including generation of electricity or thermal power, production of transportation fuel, or flaring, are not business-as-usual and therefore deemed additional and eligible under the MMC Protocol.

Legal Requirements. Emission reductions achieved by an MMC project must also exceed those required by any law, regulation, or legally binding mandate at the time of offset project commencement. If no law, regulation, or legally binding mandate requiring the destruction of methane at the mine at which the project is located exists at the time of offset project commencement, all emission reductions resulting from the capture and destruction of mine methane are considered to not be legally required, and therefore eligible for crediting under this Protocol, subject to the performance standard evaluation above. If any law, regulation, or legally binding mandate requiring the destruction of methane at the mine at which the project is located exists at the time of offset project commencement, only emission reductions resulting from the capture and destruction of mine methane that are in excess of what is legally required are eligible for crediting under this Protocol, subject to a performance standard evaluation as described above.

3. Permanence

Project operators may choose from a variety of eligible methane destruction technologies, but in order to be eligible for crediting under the MMC Protocol, the ultimate fate of the captured mine methane must be destruction. Due to the fact that the Cap-and-Trade Regulation requires claimed emission reductions to be verified prior to the issuance of offset credits and that the destruction of methane does not pose a risk for reversal, GHG emission reductions resulting from the installation and operation of a device or set of devices that capture and destroy methane are permanent.

One of the issues discussed during the Technical Working Group meetings related to the potential eligibility of MMC projects on federal lands, given that the Compliance Offset Protocol for U.S. Forest Projects excludes projects on federal lands due to issues related to sovereignty and permanence. Based on ARB staff's review of existing permitting and safety regulations, as well as discussions with the U.S. Bureau of Land Management and the U.S. Mine Health and Safety Administration, these same issues do not exist for MMC projects. As such, MMC projects on federal lands are eligible if they meet the requirements of the Cap-and-Trade Regulation and the MMC Protocol. With respect to the AB 32 requirement that any offset credits be subject to ARB enforcement, ARB staff notes that it is unlikely that ARB's enforcement authority would conflict with the mission or authority of the Bureau of Land Management or any other federal agency responsible for overseeing coal and gas leases on federal lands.

Finally, while MMC projects on federal lands could be impacted by changes to policies or management practices prescribed by relevant agencies, such changes would not be retroactively effective nor call into question any offset credits issued for emission reductions achieved prior to new regulatory promulgation. ARB will continue to monitor the adoption of new or modified regulations that could affect the performance standard or legal requirement assessment and warrant a change to an existing Compliance Offset Protocol. Any amendments to an existing Compliance Offset Protocol would involve the same APA process as developing a new Compliance Offset Protocol. If ARB updates an existing Compliance Offset Protocol, the previous version would no longer be used by new projects from the date that Office of Administrative Law approves the new version. Any existing projects under the previous version of the Compliance Offset Protocol would be required to use the new version of the Compliance Offset Protocol once the existing crediting period has ended.

4. Leakage

Per the Cap-and-Trade Regulation, offset protocols must conservatively account for activity-shifting and market-shifting leakage risks associated with an offset project. Activity-shifting leakage is defined as increased GHG emissions or decreased GHG removals that result from the displacement of activities or resources from inside the offset project's boundary to locations outside the offset project's boundary as a result of the offset project activity. Market-shifting leakage is defined as increased GHG emissions or decreased GHG removals outside an offset project's boundary due to the effects of an offset project on an established market for goods or services. ARB staff examined the potential for leakage and determined that there is no risk of leakage associated with the MMC Protocol.

The prospect of activity-shifting leakage is not a concern because the MMC Protocol does not inhibit or interfere with the normal mining operations at a project site. The MMC Protocol does not place limitations on mining activities and would not impact the production of coal at a mine operating an offset project. Because mining activities are not restricted by the MMC Protocol, there is no potential for the displacement of such activities to outside of the project boundary. Therefore there is no risk of activity-shifting leakage.

The MMC Protocol provides a financial incentive for mine operators to capture and destroy mine methane that would otherwise be released into the atmosphere as a result of mining activities. ARB staff examined concerns raised over the impact of this additional revenue stream on coal mining production and found that the potential revenue from offsets is generally less than one percent of the revenue a mine operator would take in from the sale of coal. This conclusion was reached by evaluating mine methane emissions reported to the U.S. EPA and reasonable assumptions of the price of carbon offsets compared to the coal production and sale price data contained in the U.S. Energy Information Administration’s Annual Coal Report 2011 (U.S. EIA 2012). The annual coal report compiles information collected from coal mining companies who owned a mining operation that produced 25,000 or more short tons of coal during the reporting year. A less than one percent increase in coal mining revenue from the sale of earned offset credits is not considered substantial enough to impact the established market and therefore does not pose a risk of market-shifting leakage.

ARB staff also considered the possibility of the MMC Protocol’s impact on coal production within the project boundary as highlighted and accounted for in the U.N.’s Clean Development Mechanism (CDM) methodology. The logic behind the CDM methodology is that coal production could increase at an underground mine where constraints on mining are reduced through utilization of enhanced methane drainage that could result in the opening up of previously unsafe areas for mining. After examining the rationale behind the international CDM protocol, ARB staff determined that this concern is not applicable to mines in the United States. The potential increase in coal production envisioned by the CDM methodology is primarily an issue in China where gob wells are rarely, if ever, used. (John Savage, personal communication, June 26, 2013). In the United States, gob wells are ubiquitous at underground mines with drainage systems because the potential revenue from the extraction and sale of coal is sufficient to incentivize methane drainage in the absence of the offset project. Drainage capacity and the resulting mining capacity would therefore not be enhanced but rather on par with that which would have taken place without the project. At active underground mines, the protocol is likely to only incentivize the capture and destruction of mine methane, not additional drainage that reduces constraints on mining. No impact on the quantity or speed of coal production is expected as a result of implementation of the MMC Protocol.

5. Quantification Methodologies

The quantification methodologies contained in the MMC Protocol are derived from the Kyoto Protocol’s Clean Development Mechanism methodology ACM0008 V.6 (March 25, 2009); the two Verified Carbon Standard approved methodologies specifying revisions to ACM0008: VMR0001 developed by Ruby Canyon Engineering, Inc. (March 30, 2009) and VMR0002 developed by Vessels Coal Gas, Inc. (July 19, 2010); the Climate Action Reserve’s Coal Mine Methane Project Protocol V1.1 (October 26, 2012); two draft protocols developed by Ruby Canyon Engineering, Inc. (March 11, 2013, revised draft: July 16, 2013); and the U.S. EPA Coalbed Methane Outreach Program’s

Methane Emissions From Abandoned Coal Mines in the United States: Emission Inventory Methodology and 1990-2002 Emissions Estimates (April 2004).

The calculation methodologies in the MMC Protocol include emissions and emission reductions from mine methane extraction, capture, transport, treatment, storage, and destruction. In addition to methane, carbon dioxide emissions from the combustion of methane and the additional energy consumed by project equipment are also accounted for as part of these methodologies. Quantification methodologies rely upon monitored data including: flow rate, volume or mass, methane concentration, temperature and pressure of ventilation air methane or mine gas sent to destruction devices, as well as the operation time and efficiency of destruction devices. The MMC Protocol contains explicit monitoring, reporting, and verification requirements to ensure that the issuance of offset credits coincides with the amount of methane being destroyed.

Quantification of the baseline emissions for an abandoned underground mine methane recovery activity requires the use of an emission rate decline curve that relies upon existing mine-specific emission rate data and national decline curve coefficients derived from basin specific coefficients originally published by the U.S. EPA's Coalbed Methane Outreach Program (U.S. EPA CMOP 2007). This curve predicts the quantitiy of methane emissions that would be emitted from an abandoned mine in the absence of an MMC project for every year after mine closure. Members of the firm Ruby Canyon Engineering Inc. were involved in the development of the U.S. EPA emission inventory methodology for abandoned mines and, in conjunction with the discussions of the Technical Working Group, proceeded to develop a single set of decline curve coefficients (RCE, 2013e). The coefficients provided in the MMC Protocol are the mean results of a Monte Carlo simulation. The use of these coefficients results in a conservative estimation of the baseline emissions of methane at abandoned mines. There is, however, still uncertainty associated with these coefficients based on national averages. For this reason, the MMC Protocol applies a 20% uncertainty deduction to the emission reductions achieved by an abandoned mine methane recovery activity that relies upon the standardized coefficients provided. Alternatively, Offset Project Operators may choose to develop their own mine-specific coefficients using the methodology provided in the MMC Protocol. Mine specific coefficients must be demonstrated to the satisfaction of the Executive Officer as being equally or more accurate than the default hyperbolic decline curve coefficients. Finally, because a project at an abandoned mine is likely to utilize a vacuum to extract methane and this would result in methane leaving the mine at a quicker pace than would occur naturally, the MMC Protocol stipulates that the emission reductions must be equal to or less than the baseline emissions for that reporting period. This ensures that offset credits are not issued for emission reductions beyond the methane emissions that would have occurred during the reporting period in the absence of the project.

Based on the stakeholder engagement described previously, ARB staff believes that the impact of non-methane hydrocarbons (NMHC) on emission reduction calculations is insignificant, and because of the uncertainty of the global warming potential (GWP) of NMHC (Collins et al. 2002), emissions from the venting and combustion of NMHC are excluded from the GHG assessment boundary. The omission of NMHC from the baseline and project scenarios is conservative since the GWPs (applicable to baseline quantification where NMHC are vented) are greater than their carbon emission factors (applicable to project quantification where NMHC are combusted) for the NMHC commonly found in mine gas, including specifically ethane, butane, and propane (Solomon, et al. 2007; Sindicatum Sustainable Resources 2013).

6. Monitoring, Reporting, and Verification

Offset Project Operators (OPOs) or Authorized Project Designees (APDs) are responsible for monitoring the performance of the project and operating each component of the collection and destruction system in a manner consistent with the manufacturer's specifications.

The volumetric or mass gas flow, methane concentration, temperature, and pressure of ventilation air methane or mine gas from each methane source (i.e., ventilation shaft, pre-mining surface wells, pre-mining in-mine boreholes, post-mining gob wells, etc.) must be monitored separately prior to interconnection with other methane sources except under specific conditions articulated in the MMC Protocol. The MMC Protocol contains explicit requirements for monitoring and recording these parameters.

Operational activity of the methane drainage and ventilation systems as well as the destruction devices must be monitored and documented at least hourly to ensure actual methane destruction. If for any reason the destruction device or the operational monitoring equipment is inoperable, then all metered gas going to the particular device is assumed to be released to the atmosphere during the period of inoperability. GHG reductions will not be accounted for (nor credited) during periods in which the destruction device is not operational.

In addition, the MMC Protocol includes quality assurance and quality control (QA/QC) requirements for monitoring equipment, including gas flow meters and methane analyzers. The MMC Protocol includes a data substitution methodology applicable only to gas flow metering and methane concentration parameters. Data substitution is not allowed for equipment that monitors the proper functioning of destruction devices such as thermocouples.

OPOs or APDs must report GHG emission reductions resulting from project activities and submit Offset Project Data Reports (OPDRs) annually. The MMC Protocol and the Cap-and-Trade Regulation include specific requirements for these OPDRs, which must be verified by an ARB-accredited offset verification body prior to credit issuance. For transparency, project information will be made publically available.

III. Environmental Impacts Analysis

A. Introduction

This chapter of the Staff Report provides an environmental analysis (EA) that evaluates the environmental impacts of the proposed Compliance Offset Protocol for Mine Methane Capture (MMC Protocol) amendment to the 2010 California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation (Cap-and-Trade Regulation).

Based on ARB's review of the proposed MMC Protocol, staff determined that it would have potentially significant effects on the physical environment. ARB staff utilized the CEQA Guidelines Checklist to determine whether the proposed protocol may result in potentially adverse environmental impacts. ARB staff determined that implementation of MMC projects would result in no adverse impacts to greenhouse gas emissions and public services. Less than significant impacts were identified for aesthetics, agriculture and forest resources, air quality, energy demand, geology, soils, and minerals, hazards and hazardous materials, hydrology and water quality, land use and planning, noise, population and housing, recreation, transportation and traffic, and utilities and service systems. Impacts to biological resources and cultural resources were determined to be potentially significant related to landscape disturbance required for construction of facilities and infrastructure. This analysis provides the basis for reaching this conclusion. This chapter of the Staff Report also discusses environmental benefits expected from implementing the proposed Protocol.

B. Proposed Offset Protocol

1. Description

The proposed MMC Protocol incentivizes the reduction of greenhouse gas (GHG) emissions resulting from mining activities in the United States. The Protocol would allow for the issuance of carbon offset credits for emission reductions achieved from the installation and operation of a device or set of devices that capture and destroy methane that would otherwise be released into the atmosphere as a result of mining. The uncontrolled venting of methane occurs at active underground mines, active surface mines, and abandoned underground mines. Methane can be released both as ventilation air methane (VAM) through ventilation shafts and as mine gas (MG) through methane drainage systems. Methane drainage systems are comprised of individual gas wells and boreholes. The MMC Protocol allows for four types of activity:

- Active Underground Mine VAM Activities;
- Active Underground Mine Methane Drainage Activities;
- Active Surface Mine Methane Drainage Activities; and
- Abandoned Underground Mine Methane Recovery Activities

Captured methane must be destroyed via an eligible end-use management option (i.e., ventilation air methane oxidation, flaring, electricity or heat generation, injection into natural gas pipeline, production of transportation fuels, etc.) as defined in the MMC Protocol. Active underground mine VAM activities, active surface mine methane drainage activities, and abandoned underground mine methane recovery activities may destroy the captured methane by any end-use management option. Active underground mine methane drainage activities may destroy captured methane by any end-use management option other than injection into a natural gas pipeline.

The MMC Protocol provides project definitions, eligibility rules, conservative GHG emission reduction quantification methodologies, and offset project monitoring, reporting and verification instructions. Under this protocol, overall emissions and emission reductions in methane (CH_4) and carbon dioxide (CO_2) are accounted for in determining the net emissions reductions of an MMC project. In addition to CH_4 emissions, the protocol accounts for the CO_2 emissions that result from the combustion of methane. CO_2 emissions that result from additional energy consumption by equipment used to collect, treat, store and destruct methane are also accounted for as are fugitive emissions resulting from natural gas pipeline injection.

The Protocol is described in more detail in Chapter II of this Staff Report.

2. Project Objectives

The primary objectives of offset protocols in the Cap-and-Trade program that are applicable to the proposed MMC Protocol include the following:

a) Ensure Program Cost Effectiveness. AB 32 states that the Board shall adopt rules and regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions in furtherance of meeting the State's GHG reduction goals. Offsets serve to broaden the compliance instrument market to provide greater flexibility to California businesses by offering a wider range of emissions reduction opportunities and greater market liquidity.

b) Encourage Technological Innovation and Reductions from Non-Capped Sectors. Offsets encourage reductions (beyond common business practice and what is required by regulation) from non-capped sources. Offsets support the development of innovative projects and technologies from sources outside capped sectors that can play a key role in reducing emissions both inside and outside California.

c) Decrease GHG Emissions. Offsets decrease GHG emissions in order to achieve the AB 32 mandate.

d) Maximize Environmental Benefits. Offsets maximize the environmental benefits for California.

3. Compliance Responses

Implementation of the MMC Protocol would reduce the amount of GHG emitted relative to a baseline, by altering mine methane management practices. MMC projects would involve the installation and operation of equipment used to capture and destroy methane in mine gas or ventilation air that would otherwise be vented into the atmosphere. While providing quantification methodologies to account for the reduction in methane emissions, the Protocol does not prescribe the use of any particular destruction technologies. Project activities would vary depending upon the mine classification type and existing infrastructure as well as the end-use management option employed and technology utilized. All MMC projects would involve the capture and destruction of mine methane as well as the monitoring of methane destruction. In addition to capture, destruction and monitoring, it is expected that some MMC projects would also involve the extraction, transport, and treating of mine gas or ventilation air methane. It is expected that the following reasonably foreseeable compliance responses would occur as a result of implementing the MMC Protocol:

- Gas Extraction: For active surface mine methane drainage activities and abandoned mine methane recovery activities, it is expected that new wells and boreholes may be drilled at the mine site to extract methane. Drilling of new wells typically involves: construction of a drill pad; use of a drill rig, drill bit, and motor to drill below the surface to a pre-determined depth of the target formation/strata; and insertion of a steel casing and cement barriers to protect any freshwater aquifers. Active underground mine methane drainage activities are less likely to involve the drilling of new wells, because it is expected that they would extract mine gas through drainage systems that would otherwise be installed for mine safety purposes. Well drilling is not expected to take place for active underground mine methane VAM activities. Ventilation air methane is instead captured from the mine ventilation shaft(s), which would still be constructed in the absence of an MMC project.

- Gas Capture: New equipment would be installed at the mine site to capture ventilation air methane from a ventilation system or mine gas from the newly drilled and/or existing wells that make up the drainage system.

- Gas Transport: Natural gas gathering lines may be constructed to transport the captured mine gas to a gas treatment facility or destruction device. Natural gas gathering lines are typically eight to 30 inches in diameter, constructed of steel, have a cathodic protection applied to guard against corrosion, and are buried four feet underground. Gathering lines are not expected to be installed for active underground mine VAM activities, because the available destruction device technology expected to be employed by projects would be installed within 100 feet of the emission source, the ventilation air exhaust.

- Gas Treatment: Depending upon the methane content of the mine gas and the end-use management option employed, new equipment may be installed at the mine site to treat the mine gas extracted from a drainage system. Gas treatment is largely characterized by dehydration and separation to remove water and other gas components and compression as appropriate for the selected end-use. Gas treatment equipment is not expected to be installed for active underground mine VAM activities.

- Gas Destruction: New equipment would be installed at the mine site to destroy the captured methane. Active underground VAM activities would likely utilize an oxidation unit. Other activity types are likely to destroy captured methane via either a flare or through productive utilization such as electricity or thermal energy production, transformation to compressed natural gas (CNG) or liquefied natural gas (LNG), and natural gas pipeline injection. The MMC Protocol does not limit methane destruction to this list of end-use management options; rather the end-uses described represent known methods of destruction that may be reasonably assumed to be utilized.

- Methane Destruction Monitoring: Some destruction device technologies have sufficient internal monitoring capabilities to meet the standards of the MMC Protocol. Other technologies would require the utilization of separate monitoring equipment. Compliance with the MMC Protocol would involve the use of flow meters and methane analyzers as well as instruments to measure temperature and pressure.

- Construction Activities: Installation of some project equipment, equipment pads, gathering lines, and infrastructure may require site grading, berming, trenching, foundation preparation, delivery of materials and construction equipment, and transport of construction workers to and from the mine site.

C. Impacts and Mitigation Measures

1. Regulatory Setting

As described in the *Functional Equivalent Document prepared for the California Cap on GHG Emissions and Market-Based Compliance Mechanisms* (2010 FED), Compliance Offset Protocols include several elements to support existing health and environmental protection measures. Specifically, each individual offset protocol requires all offset projects to be developed in compliance with all federal, state, and local laws, regulations, ordinances, and any other legal mandate, including all CEQA and National Environmental Policy Act (NEPA) requirements where applicable. The Offset Project Operator is required to attest to ARB that their project meets these requirements. If during verification, it is found that the offset project does not meet any of these requirements, the project is ineligible to be issued ARB offset credits for methane destruction that occurred during the time that the project was out compliance. In addition to the regulatory compliance requirements, Offset Project Operators must provide detailed information regarding the project at the time of project listing that would be posted on the internet and available for public review.

Many of the compliance responses under the proposed MMC Protocol are regulated activities that require the acquisition of a permit from a relevant governing body or jurisdiction. The Regulatory Setting established in the 2010 FED, and as amended in this EA, includes a number of federal or other laws and regulations that could be applicable to the proposed MMC Protocol and would likely trigger such permitting activity.

a) Mining Regulations

A number of laws apply specifically to mining activities, including the Surface Mining Control and Reclamation Act of 1977 (SMCRA), and the Federal Mine Safety and Health Act of 1977 (Mine Act) as amended by the Mine Improvement and New Emergency Response Act of 2007 (MINER Act). These regulations are applicable and central in the impact analysis contained in this EA and are summarized briefly below:

- SMCRA is the primary legal basis for regulation and permitting of coal mining in the United States. It establishes minimum federal standards that each state must enforce through their own regulatory and permitting programs that govern mining. The Office of Surface Mining, Reclamation and Enforcement (OSMRE) in the U.S. Department of the Interior provides oversight for all regulations and programs under SMCRA nationwide. Where mining occurs on federal lands, or where states have delegated their authority, OSMRE administers SMCRA regulations directly or in coordination with appropriate federal agencies.

  SMCRA applies to all surface coal mining operations in the U.S., as well as the surface effects of underground coal mining. SMCRA regulations affect proposed and existing active mines, as well as many closed or abandoned mines. It establishes detailed permitting procedures and bonding requirements that all states must enforce prior to the issuance of mining permits. These procedures are rigorous and require detailed studies and documentation of the nature and extent of proposed mining operations, existing environmental conditions and potential impacts and mitigation, regulatory compliance activities pursuant to other laws and enforcing agencies (e.g. Clean Water Act, Clean Air Act, Endangered Species Act, National Historic Preservation Act, etc.), and plans for reclamation activities that will be undertaken both during and after mining activities. Detailed environmental performance standards are required for mining on both private and public lands to ensure restoration and reclamation of affected lands to a condition capable of supporting pre-mining conditions or to new higher or better uses. Permit applications must demonstrate how the performance standards will be achieved.

- The Mine Act applies health and safety regulations to all active mining operations in the U.S. and is administered by the Mine Safety and Health Administration (MSHA) in the U.S. Department of Labor. MSHA's Coal Mine Safety and Health Division administers regulations applicable to coal mining, while the Metal and Nonmetal Mine Safety and Health Division administers regulations applicable to all other forms of mining.

  Under the Mine Act, MSHA conducts safety inspections biannually at surface mines and quarterly at underground mines. Included in these inspections are proper installation and operation of ventilation systems to reduce coal mine methane and other gases that are hazardous to mine worker health. Accordingly, MSHA also has permitting and inspection authority over the installation of mine methane ventilation and drainage systems, as well as methane capture and destruction devices or technologies similar to those described above under Compliance Responses.

  The provisions of the MINER Act introduced more comprehensive emergency response planning to mitigate numerous potential hazards associated with mining, and imposes more stringent enforcement provisions and penalties relative to Mine Act regulations.

A number of additional updates to the Regulatory Setting in the 2010 FED are summarized below. These updates are applicable to the MMC Protocol, and may be applicable to other potential future protocols to be developed as part of the Cap-and-Trade program.

b) Cultural Resources:

- Archaeological Resources Protection Act (ARPA): requires protection of archaeological resources and sites on federal public lands and Native American lands.

- Paleontological Resources Preservation Act: requires the U.S. Secretary of the Interior to manage and protect paleontological resources on federal public lands using scientific principals and expertise.

c) Hazardous Materials

A number of federal laws administered by the U.S. EPA and/or state agencies throughout the nation govern the use, storage, and disposal of hazardous substances. These generally include the following:

- Resources Conservation and Recovery Act (RCRA): establishes regulations for hazardous waste management in Section C.

- Hazardous and Solid Waste Amendments Act: hazardous waste management

- Comprehensive Environmental Response Compensation and Liability Act (CERCLA): cleanup of contamination and contaminated sites

- Superfund Amendments and Reauthorization Act (SARA): cleanup of contamination and contaminated sites

- Emergency Planning and Community Right-to-Know: business inventories and emergency response planning

- Toxic Substances Control Act (TSCA): tracking and screening industrial chemicals

- Federal Insecticide, Fungicide, and Rodenticide Act: pesticide distribution, sale, and use.

d) Transport of Hazardous Materials

- Pipeline Safety, Regulatory Certainty, and Job Creation Act (2011): provides for enhanced safety, reliability and environmental protection in the transportation of energy products by pipeline. Regulations promulgated under the Act will be administered by the Pipeline and Hazardous Materials Safety Administration (PHMSA) in the U.S. Department of Transportation.

As described in the 2010 FED, Compliance Offset Protocols include several elements to support existing health and environmental protection measures. Specifically, each individual offset protocol requires all offset projects to be developed in compliance with all federal, state, and local laws, regulations, ordinances, and any other legal mandate, including all CEQA and NEPA requirements where applicable. The Offset Project Operator is required to attest to ARB that their project meets these requirements. If during verification, it is found that the offset project does not meet any of these requirements, the project is ineligible to be issued ARB offset credits for methane destruction that occurred during the time that the project was out compliance. In addition to the regulatory compliance requirements, Offset Project Operators must provide detailed information regarding the project at the time of project listing which will be posted on the internet and available for public review.

This analysis is necessarily programmatic in nature because site-specific or project-specific aspects of environmental impacts cannot be precisely described at this time since the specific location, type, and number of offset projects that would occur under this protocol in-state and out-of-state cannot be known and are dependent upon a variety of factors that are not within the control of ARB, including economic costs, offset demand, permitting requirements, environmental constraints, and other market constraints. Therefore, this EA addresses broadly defined types of impacts without the ability to determine the specific GHG reduction action or offset project locations, project size and character, or site-specific environmental characteristics. In light of these uncertainties, staff took a conservative approach in its evaluation in order to satisfy the good-faith, full-disclosure intent of CEQA.

2. Beneficial Impacts

In accordance with ARB's CRP, as well as considering the legislative intent of AB 32 and the latitude under CEQA to recognize environmental co-benefits (beneficial impacts), this EA incorporates discussion of potential beneficial environmental impacts when those impacts are considered reasonable and foreseeable, and they are relevant to the decisions to be made by ARB regarding the proposed MMC Protocol. In most instances it is not possible to quantify these impacts at this level because of the broad nature of this programmatic analysis. At a project specific level the quantification of beneficial impacts would be possible. Any beneficial impacts associated with the proposed Compliance Offset Protocol will be included in the impact assessment for each resources area listed below.

3. Resource Area Impacts

The environmental assessment in this EA is necessarily programmatic in nature. Site-specific or project-specific aspects of environmental impacts cannot be precisely described at this time, because the specific location, type, and number of offset projects that would occur under this protocol in-state and out-of-state cannot be known and are dependent upon a variety of factors that are not within the control of ARB, including economic costs, offset demand, permitting requirements, environmental constraints, and other market constraints. Therefore, this EA addresses broadly defined types of impacts without the ability to define the specific GHG reduction actions or offset project locations, project size and character, or site-specific environmental characteristics. In light of these uncertainties, the EA uses a conservative approach in its evaluation to satisfy the good-faith, full-disclosure intent of CEQA.

Where potentially significant impacts were identified, feasible mitigation measures have been identified. However, because ARB is not responsible for implementation of project-specific mitigation and the programmatic analysis does not allow project-specific details of what impacts would definitively occur or the effectiveness of any specific mitigation, there is inherent uncertainty in the degree of mitigation ultimately implemented to reduce potentially significant impacts. Consequently, while it is reasonable to expect that mitigation and regulatory compliance would resolve potentially significant environmental impacts, the EA takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that potentially significant environmental impacts may be unavoidable.

a) <u>Aesthetics</u>

i. Impacts Analysis

The installation of mine methane gas extraction, capture, transportation, treatment, destruction, and monitoring equipment at active or abandoned mine sites would likely be of similar size, scale, and visual character to those typical of active mining operations. Given that mine locations are generally isolated, it is expected that installation of this equipment under the Protocol would not result in substantial changes to scenic vistas, resources, visual character, or light and glare impacts from active mining operations. Any potential adverse effects would likely be minimized as the result of regulatory oversight, particularly on federal lands as governed by a number of regulations administered and enforced by various federal or state agencies. Relevant and applicable laws and regulations include but are not limited to SMCRA, Forest and Rangeland Renewable Resources Planning Act, Public Rangelands Improvement Act, Federal Land Policy and Management Act, Wild and Scenic Rivers Act, Wilderness Act, and other applicable laws and regulations.

Abandoned mining sites and adjacent areas, however, may have experienced varying degrees of reclamation, reuse and/or redevelopment since mine closure and abandonment, pursuant to SMCRA. OSMRE operates several programs that include best practices and support for geomorphological reclamation and reforestation on abandoned mine lands. Construction of offset projects at abandoned mining sites could thus alter the visual character of such sites and adjacent surrounding areas, or introduce new sources of nighttime lighting that could adversely affect surrounding areas that may have been restored for active public recreation or uses other than mining.

Because specific offset projects at abandoned mines have not yet been identified, the degree to which reclaimed or redeveloped areas at or adjacent to abandoned mines would be affected remains uncertain. However, any MMC projects would be required to comply with federal and state permitting requirements under SMCRA to avoid potential conflicts with forest management, agricultural activities, or other existing land uses on affected reclaimed mining lands. Aesthetic impacts would, therefore, be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

b) Agriculture and Forest Resources

i. Impacts Analysis

The installation of mine methane gas extraction, capture, transportation, treatment, destruction, and monitoring equipment would be situated on either active or abandoned mines throughout the United States. For the most part, MMC projects would be located on land designated for active mining and as such there would be no conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance, or land zoned for agriculture.

In some circumstances, offset projects located at active or abandoned mines could be located within or adjacent to National Forests or other forests protected by state or local authorities. If the mine is situated within or adjacent to a national forest, this would be on federal land, which would trigger NEPA and would require the involvement of the U.S. Forest Service in the environmental analysis. Similarly, offset projects at abandoned sites could conflict with reforestation activities that have taken place subsequent to a mine's closure and abandonment, pursuant to the SMCRA. OSMRE operates several programs that include best practices and support for reforestation on abandoned mine lands. Because specific offset projects at abandoned mines have not yet been identified, the degree to which agriculture or forested areas at or adjacent to abandoned mines would be affected remains uncertain. However, any MMC projects at abandoned mining sites would be required to comply with permitting requirements pursuant to SMCRA to avoid potential conflicts with reforestation activities or restoration of agricultural activities under any approved mine reclamation plans. Therefore, impacts to agriculture and forest resources would be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

c) <u>Air Quality</u>

i. Impacts Analysis

Construction Activities:

The construction activities associated with the installation of gas extraction, capture, transportation, treatment, destruction, and monitoring equipment could cause a temporary increase in criteria pollutant (or precursor) emissions, toxic air contaminant (TAC) emissions, and odors associated with short-term construction activities (e.g., use of heavy-duty construction equipment).

Operational Activities:

Mine gas treatment and methane destruction via certain end-use management options (e.g., oxidation, flaring, etc.) can cause an increase in emissions of sulfur oxide (SO_x), nitrogen oxide (NO_x), particulate matter (PM_{10}), carbon monoxide (CO), water vapor, and reactive organic gasses (ROG) including volatile organic compounds (VOCs). Alternatively, emissions of VOCs could also be reduced as a result of their combustion along with the methane. TAC emissions and odors could also be generated as a result of offset project operations.

A net increase in criteria pollutant (or precursor) emissions is not allowed in locations designated as nonattainment areas per the National Ambient Air Quality Standards (NAAQS). The potential emissions from projects located in these areas would need to be considered in the context of a state implementation plan (SIP) to bring an area back into compliance.

All projects implemented under the MMC Protocol must be in accordance with all applicable federal, state, and local regulations and regulatory oversight requirements in order to be issued credits for emission reductions. These regulatory requirements could include, but would not be limited to, the following:

- Compliance with all appropriate air quality permits for project construction and operations from the local agencies with air quality jurisdiction and from other applicable agencies (e.g., U.S. EPA), if appropriate, prior to construction mobilization.

- Compliance with the CAA and the CCAA (e.g., NSR and BACT criteria if applicable).

- Compliance with local plans, policies, ordinances, rules, and regulations regarding air quality-related emissions and associated exposure.

- Coordination with local land use agencies to seek entitlements for development including completing all necessary environmental review requirements (e.g., NEPA if federal action is involved, local entitlements).

- Based on the results of the environmental review, proponents would be required to implement all mitigation identified in the environmental document. Local or state land use agencies or governing bodies would also certify that the environmental document was prepared in compliance with applicable regulations.

- For projects located in PM nonattainment areas, preparation and compliance with a dust abatement plan that addresses emissions of fugitive dust during construction and operation of the project.

Consequently, the potential impacts to air quality would likely not be adverse, and where an adverse impact may occur, would be less than significant due to the required compliance with laws and regulations. Therefore, implementation of the MMC Protocol would not result in a conflict with adopted air quality plans, violation of NAAQS or other air quality standards, and/or cumulatively significant increases in criteria pollutants. Impact to air quality would be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

d) <u>Biological Resources</u>

i. Impacts Analysis

The installation of gas extraction, capture, transportation, treatment, destruction, and monitoring equipment could cause direct and indirect adverse impacts to special status species and habitats. Direct impacts to special status species and habitats may result from, but not be limited to, construction or vehicle travel. Direct mortality could result from destruction of dens, burrows, or nests through ground compaction, ground disturbance, debris, or vegetation removal within mine sites due to compliance response activities. Indirect impacts to animals could result from noise disturbance that might reduce nest or den abandonment and loss of reproductive or foraging potential around the site during construction, transportation, or destruction of equipment.

Most new equipment would be situated on land with existing mining operations where disturbance to natural habitats is expected to already be present. Most facilities exist on sites that are/have been subjected to severe disturbance including grading, trenching, paving, and construction of roads and structures. Daily activities often include the presence of humans, movement of automobiles, trucks and heavy equipment, and operation of stationary equipment. This environment is not considered conducive to many biological resources. Vegetation is often removed or controlled and wildlife displaced to more suitable surroundings. Nonetheless, there are plant and animal species that occur, or even thrive, in developed settings. Also, activities that require disturbance of undeveloped areas, such as the construction of new structures, boreholes, surface wells, roads or paving have the potential to adversely affect plant or animal species that may reside in those areas.

Construction of new equipment may require minor expansion of the development footprint within the existing mine site or affect adjacent or nearby areas where special-status species or sensitive habitats could be present. In some circumstances, offset projects located at abandoned mines could be located within or adjacent to areas where natural habitat has been restored subsequent to a mine’s closure or where special status species have occupied the area or site. Because specific offset projects at abandoned mines have not yet been identified, however, the degree to which any restored natural habitats or special status species at or adjacent to abandoned mines would be affected remains uncertain. Consequently, construction activities that could disturb undeveloped areas on the surface (even within the mine site) pose a potentially significant impact to biological resources.

Installation of new wells or boreholes could have the potential to connect with underground aquifers and might cause water removal from aquifers. Removal or interruption of water from aquifers could cause dewatering of streams or springs important to special status species or habitats (such as wetlands or riparian habitat). Consequently, construction activities that disturb aquifer resources could pose a potentially significant impact to biological resources.

Removal of water from mine sites as a result of drilling activities related to the installation of new boreholes or wells and subsequent dispersal of that water over and adjacent to the mine site could cause impacts to soil or water quality from salinization or sodium; especially if it leaches into another aquifer, nearby waterways or open water sources such as ponds. Salinity and sodium or other mineral changes to soils or available water for special status plants or aquatic wildlife could result in toxic impacts. Consequently, construction activities that disturb and distribute non-filtered aquifer resources could pose a potentially significant impact to biological resources on or adjacent to the mine site.

Because of the possible presence of special status species or habitat that might be directly or indirectly adversely impacted by project implementation, compliance response could result in potentially significant impacts to biological resources. Depending on the status of the species and the nature of the habitat disturbance, compliance with permitting requirements under SMCRA, NEPA, the federal Endangered Species Act, Migratory Bird Treaty Act, Clean Water Act, Section 404, or related state or local laws would be required. Accordingly, the potential impact to special-status species and sensitive habitats would be minimized. However, the possibility cannot be ruled out that a special-status species or its habitat could be adversely affected, even with applicable regulations in place, recognizing the potential changes in habitat expected from MMC Protocol compliance responses under some circumstances. Therefore, a conservative interpretation would warrant a conclusion that impacts to special-status species and their sensitive habitats are considered to be potentially significant.

ii. Mitigation Measures

The appended Regulatory Framework identifies statutes and regulations that provide regulatory protection of biological resources. Additional statutes and regulations may also exist. ARB does not have the authority to require implementation of mitigation that could reduce these potential impacts. The ability to require such measures is under the purview of jurisdictions with local permitting authority. Project-specific impacts and mitigation would be identified during the environmental review by agencies with regulatory authority. Recognized practices that are routinely required to avoid and/or minimize impacts to biological resources include:

- Preparation of a biological inventory of site resources by a qualified biologist prior to ground disturbance or construction. If protected species or their habitats are present, comply with applicable federal and state endangered species acts and regulations. Ensure that important fish or wildlife movement corridors or nursery sites are not impeded by project activities.

- Preparation of a wetland survey of onsite resources. Establish setbacks and prohibit disturbance of riparian habitats, streams, intermittent and ephemeral drainages, and other wetlands. Wetland delineation is required by Section 3030(d) of the Clean Water Act administered by the U.S. Army Corps of Engineers.

- Prohibit construction activities during the rainy season with requirements for seasonal weatherization and implementation of erosion prevention practices.

- Prohibit construction activities in the vicinity of special status nests, dens, burrows or roosts during nesting season or establish protective buffers and provide monitoring as needed to ensure that project activity does not cause an active nest to fail.

- Preparation of site design and development plans that avoid or minimize disturbance of habitat and wildlife resources, and prevents stormwater discharge that could contribute to sedimentation and degradation of local waterways. Depending on disturbance size and location, a National Pollution Discharge Elimination System (NPDES) construction permit may be required from the appropriate state or local enforcement authority under the Clean Water Act.

- Plant replacement trees and establish permanently protection suitable habitat at ratios considered acceptable to comply with local requirements, if necessary.

Because ARB is not responsible for implementation of project-specific mitigation and the programmatic analysis does not allow project-specific details of mitigation, there is inherent uncertainty in the degree of mitigation ultimately implemented to reduce potentially significant impacts. Consequently the EA takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that potentially significant environmental impacts may be unavoidable.

e) Cultural Resources

i. Impacts Analysis

The installation of mine methane gas extraction, capture, transportation, treatment, destruction, and monitoring equipment would be located at both active mining operations as well as abandoned mines. Construction activities related to such installation could include drilling, boring, trenching and other activities that would generally be consistent with ongoing permitted mining activities. However, the scope and extent of additional ground disturbance or related activities could still potentially affect cultural resources in areas not covered by existing permits, particularly subsurface areas at mines or in adjacent lands that were previously undisturbed. Potential adverse effects include direct damage to or destruction of undocumented historical resources of an architectural or archaeological nature; undocumented human remains not interred in cemeteries or marked, formal burials; or unique paleontological resources or sites by ground-disturbance or demolition activities at the surface or in the subsurface, particularly during trenching for underground pipelines and utility infrastructure or drilling new wells or boreholes. Direct impacts to such resources may result from, but not be limited to, the immediate disturbance of the materials, features or deposits, whether from vegetation removal, compaction or vibrations resulting from vehicle travel over the surface, earth-moving activities, excavation, or demolition of overlying structures.

Indirect operational impacts to identified or undocumented historical resources or significant archaeological resources would be related to potential alteration of the resource setting through the introduction of visual project elements that contrast with the setting of the historical or significant archaeological resource and could diminish the integrity of the resource’s significant historic features. Other indirect impacts to consider include increased erosion due to clearance and preparation of the project area, or from inadvertent damage or outright vandalism to exposed resource materials due to improved accessibility. Increased human exposure to sensitive paleontological sites would have the potential to damage or destroy paleontological resources in those areas determined to be paleontologically sensitive.

The potential for discovery of prehistoric or ethno-historic archaeological resources throughout the U.S. where mining activities occur is considered highly sensitive within or near slope or topographic features, or within natural resource collecting areas considered culturally sensitive for Native Americans, such as natural rivers and streams, springs, ponds/lakes, eco-tones, ridge-tops, mid-slope benches, flat benches, meadows, oak groves, and source areas for raw materials. Similarly, the potential for discovery of historic-period archaeological resources is considered highly sensitive within or near areas directly related to areas used historically for industrial, commercial, agricultural or mining activity and related infrastructure, traces of which, such as railroad corridors and bridges, working housing, mining buildings and appurtenant structures, farms, ranches, early mining operations, and other features could occur in virtually any setting or landform.

Because of the possible presence of identified or undocumented historical resources, significant or unique archaeological resources, undocumented human remains, or unique paleontological resources or sites that could be directly or indirectly disturbed, materially altered, or demolished by project implementation, compliance response could result in potentially significant impacts to cultural resources.

Regulatory permitting activities on federally-managed or other lands could include the following activities that would serve to reduce or minimize adverse effects:

- SMCRA requires permitting compliance in coordination with appropriate Federal and State agencies, and includes documentation of cultural resources and potential adverse effects and compliance procedures related to other laws and regulations.

- Section 106 of the National Historic Preservation Act, which requires consultation with the State Historic Preservation Officers, Native American Tribes, and others as appropriate in the event that cultural resources are discovered.

- Consultation with potentially affected Native American tribes pursuant to the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) would help to ensure the rightful disposition, or repatriation, of Native American remains and items of cultural patrimony that are in federal possession or control, in the event of the inadvertent discovery of human remains of Native American origin.

- The Archaeological Resources Protection Act (ARPA) also governs the excavation of archaeological sites on federal and Native American lands, as well as removal of resources from such sites, on Federal lands.

- Consultation with federal agencies with respect to the potential presence of paleontological resources, pursuant to the Paleontological Resources Preservation Act, and other applicable federal laws and regulations.

While these regulatory activities could serve to reduce or minimize adverse effects on cultural resources, impacts would remain potentially significant under some circumstances where federal, state or local regulatory oversight is limited, or where cultural resource surveys have not been previously conducted and, as a result, resources that may be disturbed by construction have not yet been discovered or documented.

ii. Mitigation Measures

The following mitigation applies to address potentially significant cultural resources impacts:

- Retain the services of cultural resources specialists with training and background that conforms to the U.S. Secretary of Interior's Professional Qualifications Standards, as published in Title 36, Code of Federal Regulations, part 61 (36 CFR Part 61).

- Seek guidance from the State Historic Preservation Officer and federal lead agencies, as appropriate, for coordination of Nation-to-Nation consultations with the Native American tribes.

- Proponents of the MMC offset projects shall consult with lead agencies early in the planning process to identify the potential presence of cultural properties. The agencies shall provide the project developers with specific instruction on policies for compliance with the various laws and regulations governing cultural resources management, including coordination with regulatory agencies and Native American Tribes.

- Proponents of the MMC offset projects shall define the area of potential effect (APE) for each project, which is the area where project construction and operation may directly or indirectly cause alterations in the character or use of historic properties. The APE shall include a reasonable construction buffer zone and laydown areas, access roads, and borrow areas, as well as a reasonable assessment of areas subject to effects from visual, auditory, or atmospheric impacts, or impacts from increased access.

- Proponents of the MMC offset projects shall retain the services of a paleontological resources specialist with training and background that conforms with the minimum qualifications for a vertebrate paleontologist as described in Measures for Assessment and Mitigation of Adverse Impacts to Non-Renewable Paleontological Resources: Standard Procedures, Society of Vertebrate

Paleontology, 1995
http://www.vertpaleo.org/society/polstateconfomimpactmigig.cfm.

- Proponents of the MMC offset projects shall conduct initial scoping assessments to determine whether proposed construction activities, if any, could disturb formations that may contain important paleontological resources. Whenever possible potential impacts to paleontological resources should be avoided by moving the site of construction or removing or reducing the need for surface disturbance. The scoping assessment shall be conducted by the qualified paleontological resources specialist in accordance with applicable agency requirements.

- The project proponent's qualified paleontological resources specialist shall determine whether paleontological resources would likely be disturbed in a project area on the basis of the sedimentary context of the area and a records search for past paleontological finds in the area. The assessment may suggest areas of high known potential for containing resources. If the assessment is inconclusive a surface survey is recommended to determine the fossiliferous potential and extent of the pertinent sedimentary units within the project site. If the site contains areas of high potential for significant paleontological resources and avoidance is not possible, prepare a paleontological resources management and mitigation plan that addresses the following steps:
  a) a preliminary survey (if not conducted earlier) and surface salvage prior to construction;
  b) physical and administrative protective measures and protocols such as halting work, to be implemented in the event of fossil discoveries;
  c) monitoring and salvage during excavation;
  d) specimen preparation;
  e) identification, cataloging, curation and storage; and
  f) a final report of the findings and their significance.
  g) Choose sites that avoid areas of special scientific value.

Because ARB is not responsible for implementation of project-specific mitigation and the programmatic analysis does not allow project-specific details of mitigation, there is inherent uncertainty in the degree of mitigation ultimately implemented to reduce potentially significant impacts. Consequently, the EA takes the conservative approach in its post-mitigation significance conclusion and discloses, for CEQA compliance purposes, that potentially significant environmental impacts may be unavoidable.

f) Energy Demand

i. Impacts Analysis

The installation and operation of new equipment for the purpose of mine methane gas extraction, capture, transportation, treatment, destruction, and monitoring could result in additional energy consumption. Implementation of MMC projects would not conflict with existing energy conservation plans, would not require the expansion of existing energy facilities because of the dispersed location of MMC offset projects and relatively low energy demands compared to the overall mining operations at which offset projects would occur, and would therefore not result in substantial increases in peak energy demands.

Active underground mine methane drainage activities, active surface mine methane drainage activities and abandoned underground mine methane recovery activities may offset the increased energy demand by using the captured methane to power on-site stationary and mobile combustion sources. This could reduce the facility's reliance on fossil fuel demand and would be a beneficial impact of this offset protocol. Projects may also supply additional energy off-site. While the Protocol's quantification methodologies do not recognize greenhouse gas emission reductions associated with potential fossil fuel displacement, increasing the supplies of electricity and natural gas are other potentially beneficial impacts of the MMC Protocol. Impacts on energy demand would, therefore, be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

g) Geology, Soils, and Minerals

i. Impacts Analysis

Construction activities related to MMC offset project implementation could include drilling, trenching, excavation and other activities that are similar to activities that would otherwise occur at active mining operations. However, such activities could still affect geological formations, soils and minerals at mining sites that are not included within the scope of permitted mining activity. The extent to which such resources would be adversely affected depends on the extent of the construction activity at mine sites, the extent to which such activities would affect previously undisturbed soils or surface or subsurface geological formations, and the potential presence or absence of any geologic formation, soil or mineral type that is unique and distinct from what is included in permitted activities. However, because no specific MMC offset project locations or associated project details are known, the possibility of any specific adverse effects that would occur to these resources, or the safety of any specific mining operations, remains uncertain.

In some cases, MMC projects would require the drilling of new methane drainage wells and boreholes, trenching for gathering pipelines, and other activities involving new ground disturbance and excavation. Such activities would either be covered by existing federal or state mining permits or require the advance acquisition of such permits. As noted in the Regulatory Setting, the safety of active and abandoned mining operations are regulated extensively by federal and state agencies pursuant to MSHA, as well as SMCRA, and therefore, permitting and enforcement activities under these regulations would be expected to minimize the exposure of people or structures to any potential adverse effects from implementation of an MMC project incidental to mining activities. This regulatory structure would ensure that adequate measures are in place to prevent adverse effects to geological and mineral resources, along with any potential adverse effects to mineral resources at these locations.

Some minor soil erosion impacts may result from the installation of new equipment; however, Offset Project Operators would be required to implement MMC projects in accordance with all federal, state and local regulations to control erosion, drainage, and grading pursuant to SMCRA, the Clean Water Act, the Soil and Water Resources Conservation Act and other similar laws. These requirements would ensure that adequate measures would be in place to prevent the substantial erosion of onsite soils. Impacts to geology, soils, and minerals would be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

h) Greenhouse Gas Emissions

i. Impacts Analysis

Methane destruction devices employed as part of an MMC project would result in an increase in CO_2 emissions associated with the combustion of CH_4 in ventilation air and mine gas. These emissions, however, would be in lieu of the release of CH_4, which has a significantly higher global warming potential (GWP) than CO_2. Therefore combustion of CH_4 and the associated conversion to CO_2 results in a net reduction in GHG emissions and the associated climate change impacts would be beneficial.

ii. Mitigation Measures

Mitigation is not warranted.

i) Hazards and Hazardous Materials

i. Impacts Analysis

Methane is not classified by the U.S. EPA as a hazardous material; however, it is classified as a hazardous material in California. While methane is not toxic below the lower explosive limit of 5% (50,000 ppm), it does act as a simple asphyxiate by displacing oxygen in the air at higher concentrations. Symptoms of oxygen deprivation (asphyxiation) will occur if the available oxygen falls below 18%; methane displaces oxygen to 18% in air when present at 14% (140,000 ppm). Methane is extremely flammable and can explode at concentrations between 5% (lower explosive limit) and 15% (upper explosive limit). These concentrations are lower than concentrations at which asphyxiation risk is significant. Mines are therefore in the practice of being well ventilated to maintain safe methane concentration levels at or below 1%, and MSHA regularly conducts mine inspections to ensure compliance with the Mine Act.

The management of hazardous materials and hazardous wastes, such as fuels and solvents used on-site, would require permits from applicable federal, state, and local regulating agencies. Specific applicable laws and regulations that would apply include (but are not limited to) the Hazardous Waste Program specified under Subtitle C of the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), the Hazardous Materials Transportation Act (HMTA), SMCRA, and other applicable laws and regulations.

It is expected that a mine would already have secured such approval pursuant to these regulations and that the implementation of the project would not substantially change the routine transport, storage, use, and disposition of such hazardous materials and resulting wastes. Should new gas treatment activities take place as a result of MMC project implementation, it is expected that the equipment involved would require a permit to operate and would be subject to regular monitoring and inspection. SMCRA and the Mine Act, as well as regulations enacted in the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 would serve to minimize hazards associated with the construction of any gathering pipelines related to compliance activities that would involve transport of captured methane for gas treatment and pipeline injection.

MMC projects would be located on active mines and existing abandoned mine sites that are located primarily in rural areas and are therefore not likely to be located at any of the following: 1) within one-quarter mile of an existing or proposed school; 2) on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5; 3) within an airport land use plan or within two miles of a public airport; or 4) within the vicinity of a private airstrip. SMCRA regulations include specific performance standards and siting criteria that establish buffering requirements for adjacent land uses. An MMC project would therefore not present a significant safety hazard for people at such locations. Because MMC projects would be located at active mines and existing abandoned mines, implementation of the MMC Protocol would not be anticipated to impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.

An MMC project may utilize a flare as an end-use management option for destruction of captured mine methane gas. Such a device would require a permit from MSHA which would take into consideration the safety of employing a flare at the project site. Operators of the flare would be required to provide adequate fire suppression and water supply pressure consistent with applicable requirements.

Impacts related to hazards and hazardous materials would, therefore, be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

j) Hydrology and Water Quality

i. Impacts Analysis

Construction Activities:

Hydrology
Some projects may drill new methane drainage wells and boreholes for the purpose of gas extraction when implementing the MMC Protocol. Drilling and well development can result in the removal of significant amounts of groundwater resulting from drawdown of water in the coalbed. This groundwater depletion could eventually impact adjacent shallow aquifers and surface waters (Keith et al. 2003). How these wells are regulated would depend chiefly on land ownership and the state in which the well is located.

As of 2012, 43 percent of all coal produced in the United States originated from public lands (Goad et al. 2012). Any drilling activity on a mine located on federally owned land which would result in an amendment to the federal mining permit would be subject to the conditions of the NEPA. NEPA requires that the federal agency analyze the potential environmental consequences of any major federal action including the preparation of an Environmental Assessment (NEPA EA) or a more detailed Environmental Impact Statement. The level of environmental review required by NEPA is dependent on the extent of the impacts of the proposed action, however recent NEPA EAs have been prepared for federal permit modifications to allow methane capture for mines in Colorado and Pennsylvania. This environmental review would include consideration of potential impacts to groundwater resources.

Well development on both public and private land would be subject to the water rights regulations of the State in which the well is located. The states of Montana, Wyoming, and Colorado have developed specific water-rights regulations related to coalbed methane produced water, detailing such things as the allowable amount of drawdown in aquifers adjacent to the proposed well or requirements for mitigation agreements with effected water-rights holders (NRC 2013). How each state regulates wells drilled for methane capture depends primarily on whether produced water is categorized as a “beneficial use” or as a waste product within the state. If the state classifies produced water as a “beneficial use” the methane capture well would be subject to a water-right allocation. In this case, the state could not grant the allocation without ensuring the protection of adjacent water rights. If classified as a waste product, produced water could not be put to “beneficial use” unless the owner of the water approves. In this case, a well drilled for the purposes of methane capture would not be subject to water rights regulation but would be overseen by the state’s division of environmental quality or a similar governing body (NRC 2013).

Well drilling activities would be covered by existing federal or state mining permits or state water rights allocations, or would require the advance acquisition of such permits. In addition, wells drilled for methane capture on federally owned lands would require amending the federal mining permit and could trigger additional environmental review. Finally, in states where methane capture wells would not require water right allocations, the potential for depletion of groundwater would be overseen by the state’s division of environmental quality or a similar governing body. This regulatory structure would ensure that adequate measures are in place to prevent adverse impacts to hydrology and the quantity of groundwater.

Water Quality

The groundwater extracted during drilling, known as produced water, can contain high levels of salts, hydrocarbons, organic and inorganic chemical compounds and naturally occurring radioactive material (NETL 2013). Produced water must be treated and disposed of properly or risk contamination of soils or surface waters. Common disposal methods include evaporation, re-injection, discharge to surface water, and repurposing for beneficial use. The following federal regulations protect surface and groundwater from point-source pollution resulting from disposal of produced water.

- The Safe Drinking Water Act of 1974 (SDWA) established the Underground Injections Control (UIC) program which protects potential sources of drinking water from contamination through underground injection. The strong protections of the UIC program establish performance criteria, require integrity testing of the injection well, monitoring, and annual reporting (EPA 2001).

- The Clean Water Act of 1977 (CWA) requires a National Pollutant Discharge Elimination System (NPDES) permit (and associated environmental review) for any discharge to regulated waters of the United States. The NPDES permit specifies an acceptable level of pollutant or a pollutant parameter within a discharge. This program may also set non-degradation standards for surface waters.

These federal regulations provide protections to surface and groundwater resources and greatly reduce the potential for contamination resulting from the disposal of produced water. In addition, all MMC projects would be required to comply with existing state and local regulations governing the disposal of produced water.

The specific design details and siting locations for new wells and well pads are not known at this time. New drill pads would vary in size from ¼ to ½ acre and would be likely to generate greater run-off compared to undisturbed sites. However, Offset Project Operators would be required to implement MMC projects in accordance with all federal, state and local erosion, drainage, and water quality requirements. These requirements would ensure that adequate measures would be in place to prevent adverse water quality impacts.

Operational Activities:

Operation of a methane drainage well would continue to create produced water. As described above, this water can contain contaminants and requires treatment or disposal in accordance with the provisions of the CWA and SDWA, as well as any applicable State and local regulations. If gas treatment takes place at a mine as part of an MMC project, it would likely rely upon groundwater supplies. Access to groundwater would be regulated by the states' water rights allocation programs or overseen by the division of environmental quality or a similar governing body. This regulatory structure would ensure that adequate measures are in place to prevent adverse impacts to hydrology and water quality. Gas treatment activities may also result in waste which must be discharged in a fashion compliant with applicable waste discharge requirements per the Protocol's requirement that Offset Project Operators comply with all federal, state, and local laws and regulations.

Gas transport, gas destruction and methane destruction monitoring would result in no impacts to hydrology and water quality.

It is unlikely that MMC projects would result in any of the following: 1) the alteration of an existing drainage pattern; 2) create or contribute runoff water which would exceed the capacity of existing or planned storm-water drainage systems or provide substantial additional sources of polluted runoff; 3) the placement of a structure within a 100-year flood hazard that would impeded or redirect flood flows; 4) expose people or structures to a significant risk involving flooding; or 5) the inundation by seiche, tsunami, or mudflow.

All projects implemented under the MMC Protocol must be in accordance with all applicable federal, state, and local regulations and regulatory oversight requirements in order to be issued credits for emission reductions. Consequently, the potential impacts to hydrology and water quality would likely not be adverse, and where an adverse impact may occur, would be less than significant due to the required compliance with laws and regulations.

ii. Mitigation Measures

Mitigation is not warranted.

k) Land Use and Planning

i. Impacts Analysis

The installation of mine methane gas extraction, capture, transportation, treatment, destruction, and monitoring equipment would be situated at either active or abandoned mines throughout the United States. For the most part, such projects would be located in rural areas on land designated for mining in applicable federal, state or local land use or natural resource management plans. Mine methane management can be considered an integral part of mine operations and therefore would not result in land use conflicts at active mines.

In some circumstances, MMC offset projects located at abandoned mines could be located within or adjacent to areas where reclamation has occurred subsequent to a mine's closure and abandonment, pursuant to the SMCRA. Mine reclamation activities such as re-vegetation, reforestation, and geomorphological restoration on abandoned mine lands can also eventually lead to restored public use. Other “higher or better” land uses may also be permitted subject to completion of reclamation activities. Because specific offset projects at abandoned mines have not yet been identified, however, the degree to which reclaimed or other new land uses at or adjacent to abandoned mines could be affected remains uncertain.

Any MMC compliance response activities at abandoned mining sites would be required to comply with federal, state and local permitting requirements under SMCRA or applicable land use and zoning regulations that are in effect subsequent to completion of reclamation activities, in order to avoid potential land use conflicts on abandoned mining lands. Thus, any potential adverse effects related to MMC projects at abandoned mines with respect to applicable land use policies and regulations would be minimized. No conflicts with land use plans, policies or physical division of existing communities would be expected occur as a result of the MMC Protocol.

Impacts related to land use and planning would, therefore, be considered less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

l) Noise

i. Impacts Analysis

Construction Activities:

All MMC projects would involve construction activities related to the installation of mine methane gas extraction, capture, transportation, treatment, destruction and monitoring equipment and related infrastructure, such as gathering lines. Construction activities would involve the use of heavy off-road equipment, as well as trucks and passenger vehicles to transport materials and construction workers to and from construction sites. These activities would be expected to occur at both active and abandoned mines.

The drilling of new methane drainage wells for the purpose of methane extraction would involve the most extensive construction activities of an MMC project. Construction noise levels in the vicinity of the mine during the well drilling process would depend largely on the phase of construction as well as the particular type, number and duration of usage for the varying equipment. Additionally, construction activities could result in varying degrees of temporary ground-borne noise and vibration, depending on the specific construction equipment used and activities involved. The construction phase of project implementation would last approximately 3 – 12 months per project.

Operational Activities:

Implementation of MMC offset projects could introduce new on-site stationary noise sources (e.g., compressors, flares, oxidizers, and other equipment). Noise levels associated with these types of sources vary greatly, but would likely not surpass the noise levels associated with active mining activities. Noise from the operation of new stationary sources would not substantially increase the ambient noise level at an active mine site. However, operational noise from new on-site stationary sources at abandoned mines could increase ambient noise levels at abandoned mine site and surrounding areas.

The potential effects of noise depend on the distance to noise sensitive receptors, the time of day and duration of activity, the type of equipment to be used in construction and operations, and the existing ambient noise environment in the receptor's vicinity. Because specific MMC offset projects have not been proposed and associated details as to location, size and extent of associated compliance response activities are unknown, precise noise levels cannot be estimated. Noise from compliance response activities would be similar to and consistent with the noise from activities generated by active mining operations.

Offset Project Operators at active mines would be required to comply with any existing federal, state and local noise codes applicable to the jurisdiction including occupational noise exposure standards promulgated by the MSHA. Given that both active and abandoned mine locations are generally located in rural areas and are often isolated, it is not expected that noise generated by MMC projects would be within close enough proximity to noise-sensitive receptors to result in a substantially adverse effect. MMC offset projects located at abandoned mines would be required to comply with any noise abatement provisions in SMCRA regulations and permitting requirements through OSMRE, or any applicable federal, state or local noise codes or ordinances.

Noise related impacts would, therefore, be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

m) Population and Housing

i. Impacts Analysis

The installation of mine methane gas extraction, capture, transportation, treatment, destruction, and monitoring equipment would be located at active or abandoned mining site in rural locations. No existing homes or population would be displaced as a result of these compliance response activities. The construction phase of MMC project implementation would typically require small crews (approximately 5-10 people per project) for a temporary period of time (typically 3-12 months per project). Operation of an MMC project would require minimal (if any) new additional personnel at mines. Proposed MMC offset projects would not be concentrated in any one area but would rather be located at mines throughout the United States. Given the anticipated dispersion of project locations and the limited number of new employment opportunities associated with the construction and operation of the MMC projects, the number of workers migrating to a project area would be minimal, and therefore no adverse impacts to employment, population and housing are expected.

It is also unlikely that new roads would be built as a result of MMC project implementation since in most cases adequate, although potentially seasonal, access to mine sites exists. If road extension is required on or near a mine site as a result of MMC project implementation, it is still unlikely that it would result in population growth in the area as it would be located at or adjacent to existing mining operations. Therefore, it is expected that MMC offset project impacts related to employment, population and housing would be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

n) Public Services

i. Impacts Analysis

Implementation of an MMC project would not result in additional housing or other facilities that would increase demand for public services including fire and police protection, schools, parks, and other public facilities. There are no impacts to public services.

ii. Mitigation Measures

Mitigation is not warranted.

o) Recreation

i. Impacts Analysis

MMC offset projects would be located at both active mines and existing abandoned mine sites. MMC offset projects at active mines would not be expected to have any substantial effect on the use of existing neighborhood or regional parks or other recreational facilities, since such parks and facilities are not typically located within active mining areas. However, MMC offset projects could be located at abandoned mines where reclamation or restoration activities are underway or planned pursuant to SMCRA, which could potentially affect recreational uses on reclaimed mining lands. In some cases, restoration of natural resources at abandoned mines through reforestation or other activities could result in recreation amenities accessible to the public.

Because specific MMC offset projects have not been proposed and associated details as to location, size and extent of associated compliance response activities are unknown, the extent of potential impacts to recreation facilities or uses at abandoned mines is uncertain. In the event that MMC offset projects would be located at abandoned mines where recreation activities are included as permitted uses under an approved mine reclamation plan, any such activities would be required to comply with federal and state permitting requirements under SMCRA through OSMRE or other state agencies with permitting authority. Such permitting requirements would ensure that any potential conflicts with recreation activities under an approved reclamation plan would be minimized. Therefore, any potential impacts related to recreation would be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

p) Transportation and Traffic

i. Impacts Analysis

Construction Activities:

An MMC project requiring construction would likely result in a minimal amount of short-term construction traffic (primarily motorized) from the transport of heavy off-road equipment, and worker commute- and material delivery-related trips to active or abandoned mines. The amount of construction activity would fluctuate depending on the particular type, number, and duration of usage for the varying equipment, and the phase of construction (e.g., site preparation, well drilling, well completion). Due to the isolated location of active or abandoned mines in rural settings where MMC offset projects would be located, it is unlikely that implementation would conflict with applicable transportation programs, plans, ordinances, or policies (e.g., performance standards, congestion management).

If any construction traffic control plans or measures, such as temporary roadway closures or detours, would be required in order to construct an MMC project at an active or abandoned mine, compliance with the appropriate federal, state or local transportation agencies would be required. Any hazardous design features and emergency access issues from road closures, detours, and obstruction of emergency vehicle movement would be minimized.

Operational Activities:

With respect to operational-related activities, minimal (if any) additional personnel would be needed to operate typical MMC projects at active mining operations. Similarly, MMC projects at abandoned mines would require minimal personnel on-site to monitor the performance of MMC equipment, once the construction phase is completed. Consequently, these projects would not be expected to result in substantial traffic volumes on local roadways. Thus, implementation of the MMC Protocol would not generate long-term operational traffic that conflicts with applicable programs, plans, ordinances, or policies; result in a change in air traffic patterns; substantially increase hazards due to design features; or result in inadequate emergency access. Impacts on transportation and traffic would, therefore, be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

q) Utilities and Service Systems

i. Impacts Analysis

MMC projects could result in an increase in demand on utilities and/or service systems that serve typical mining operations, due to the need for additional electricity, natural gas, water supply, and treatment and disposal of wastewater to support construction and operation of the MMC project at active mining sites. Similarly, increased demands on utilities and service systems could be required at abandoned mining sites. In some cases, however, operations of MMC projects could result in a net increase in the available supply of energy at active mining sites where mine methane gas would be converted through gas treatment activities, or injected into local pipelines, resulting in beneficial effects to energy supplies and local utilities.

The capacity of localized or regional utilities and service systems that serve all potential active or abandoned mines where MMC projects could occur is unknown, however any increased demands would not be expected to exceed the capacity of local service providers or result in adverse environmental impacts due solely to the installation of MMC offset projects. Any increased demand would be relatively small and contained, would be additive to existing mining operations, and would not be concentrated in any one area such that they would result in a substantial demand for utilities and service systems (e.g., solid waste facilities capacity, electricity, natural gas, wastewater services, water demand and supply services, wastewater treatment requirements, and solid waste regulations) above and beyond what could be provided by existing service providers and resources.

Impacts to utilities and service systems would, therefore, be less than significant.

ii. Mitigation Measures

Mitigation is not warranted.

r) Summary of Impacts and Mitigation Measures

i. Summary Impact Matrix for the MMC Protocol

Potential Impact	Significance Before Mitigation	Potential Mitigation	Significance After Mitigation
Aesthetics			
Result in adverse change to scenic vistas and resources or visual character and quality, light and	Less than significant	Mitigation is not warranted	Less than significant

glare			
Agriculture and Forest Resources			
Convert agricultural or forest land; conflict with existing zoning uses	Less than significant	Mitigation is not warranted	Less than significant
Air Quality			
Substantially contribute to air quality violation; conflict with air quality plan; contribute to net increase in criteria pollutant deemed to be in non-attainment under AAQS	Less than significant	Mitigation is not warranted	Less than significant
Biological Resources			
Result in adverse impact to species with special status, migratory patterns, riparian habitats or federally protected wetlands; conflict with local protective policies or conservation plans	Potentially significant	Mitigation is warranted The following mitigation applies to address potentially significant biological resources impacts: • Preparation of a biological inventory of site resources by a qualified biologist prior to ground disturbance or construction. If protected species or their habitats are present, comply with applicable federal and state endangered species acts and regulations. Ensure that important fish or wildlife movement corridors or nursery sites are not impeded by project activities. • Preparation of a wetland survey of onsite resources. Establish setbacks and prohibit disturbance of riparian habitats, streams, intermittent and ephemeral drainages, and other wetlands. Wetland delineation is	Significant and Unavoidable

		required by Section 3030(d) of the Clean Water Act administered by the U.S. Army Corps of Engineers. • Prohibit construction activities during the rainy season with requirements for seasonal weatherization and implementation of erosion prevention practices. • Prohibit construction activities in the vicinity of special status nests, dens, burrows or roosts during nesting season or establish protective buffers and provide monitoring as needed to ensure that project activity does not cause an active nest to fail. • Preparation of site design and development plans that avoid or minimize disturbance of habitat and wildlife resources, and prevents stormwater discharge that could contribute to sedimentation and degradation of local waterways. Depending on disturbance size and location, a National Pollution Discharge Elimination System (NPDES) construction permit may be required from the appropriate state or local enforcement authority under the CWA. • Plant replacement trees and establish permanently protection suitable habitat at ratios considered acceptable to comply with local requirements, if necessary.	
Cultural Resources			
Result in adverse impact to the significance of a historical or archaeological	Potentially significant	Mitigation is warranted The following mitigation applies to address potentially significant cultural resources impacts:	Significant and Unavoidable

resource; destroy of paleontological resources; disturb human remains		• Retain the services of cultural resources specialists with training and background that conforms to the U.S. Secretary of Interior's Professional Qualifications Standards, as published in Title 36, Code of Federal Regulations, part 61 (36 CFR Part 61). • Seek guidance from the State Historic Preservation Officer and federal lead agencies, as appropriate, for coordination of Nation-to-Nation consultations with the Native American tribes. • Proponents of the MMC offset projects shall consult with lead agencies early in the planning process to identify the potential presence of cultural properties. The agencies shall provide the project developers with specific instruction on policies for compliance with the various laws and regulations governing cultural resources management, including coordination with regulatory agencies and Native American Tribes. • Proponents of the MMC offset projects shall define the area of potential effect (APE) for each project, which is the area within which project construction and operation may directly or indirectly cause alterations in the character or use of historic properties. The APE shall include a reasonable construction buffer zone and laydown areas, access roads, and borrow areas, as well as a reasonable assessment of areas subject to effects from visual, auditory, or atmospheric	

		impacts, or impacts from increased access. • Proponents of the MMC offset projects shall retain the services of a paleontological resources specialist with training and background that conforms with the minimum qualifications for a vertebrate paleontologist as described in Measures for Assessment and Mitigation of Adverse Impacts to Non-Renewable Paleontologic Resources: Standard Procedures, Society of Vertebrate Paleontology, 1995 http://www.vertpaleo.org/society/polstateconfomimpactmigig.cfm. • Proponents of the MMC offset projects shall conduct initial scoping assessments to determine whether proposed construction activities, if any, could disturb formations that may contain important paleontological resources. Whenever possible potential impacts to paleontological resources should be avoided by moving the site of construction or removing or reducing the need for surface disturbance. The scoping assessment shall be conducted by the qualified paleontological resources specialist in accordance with applicable agency requirements. • The project proponent's qualified paleontological resources specialist shall determine whether paleontological resources would likely be disturbed in a project area on the basis of the sedimentary context of the area and a records search for past	

		paleontological finds in the area. The assessment may suggest areas of high known potential for containing resources. If the assessment is inconclusive a surface survey is recommended to determine the fossilferous potential and extent of the pertinent sedimentary units within the project site. If the site contains areas of high potential for significant paleontological resources and avoidance is not possible, prepare a paleontological resources management and mitigation plan that addresses the following steps: a) a preliminary survey (if not conducted earlier) and surface salvage prior to construction; b) physical and administrative protective measures and protocols such as halting work, to be implemented in the event of fossil discoveries; c) monitoring and salvage during excavation; d) specimen preparation; e) identification, cataloging, curation and storage; and f) a final report of the findings and their significance. g) Choose sites that avoid areas of special scientific value.	
Energy Demand			
Increase energy demand, conflict with energy plans	Less than significant	Mitigation is not warranted	Less than significant
Geology, Soils and Minerals			
Expose people or structures to rupture of a known	Less than significant	Mitigation is not warranted	Less than significant

earthquake fault, ground shaking or failure, or landslide; substantial soil erosion; location on an unstable geologic unit or soil			
Greenhouse Gas Emissions			
None	No adverse impact	Mitigation is not warranted	No adverse impact
Hazards and Hazardous Materials			
Create hazard to the public or environment from routine management or accidental release of hazardous materials	Less than significant	Mitigation is not warranted	Less than significant
Hydrology and Water Quality			
Violate water quality standards or waste discharge requirements; substantially deplete or interfere with recharge of groundwater supplies; alter existing drainage pattern; exceed capacity for runoff water	Less than significant	Mitigation is not warranted	Less than significant
Land Use and Planning			
Physically divide an existing community, conflict with an applicable land use plan, conflict with habitat conservation plan or natural community	Less than significant	Mitigation is not warranted	Less than significant

conservation plan			
Noise			
Generate and expose persons to noise levels in excess of established noise and vibration standards; substantially increase permanent or temporary ambient noise levels	Less than significant	Mitigation is not warranted	Less than significant
Population and Housing			
Induce substantial population growth in an area, either directly or indirectly	Less than significant	Mitigation is not warranted	Less than significant
Public Services			
None	No adverse impact	Mitigation is not warranted	No adverse impact
Recreation			
Adverse impacts to existing recreational facilities	Less than significant	Mitigation is not warranted	Less than significant
Transportation and Traffic			
Conflict with transportation or traffic management plan, ordinance or policy	Less than significant	Mitigation is not warranted	Less than significant
Utilities and Service Systems			
Exceed the capacity of water, wastewater, storm water drainage, or landfill facilities;	Less than significant	Mitigation is not warranted	Less than significant

4. Mandatory Findings of Significance

Consistent with the requirements of the CEQA Guidelines, Appendix G, Environmental Checklist, Section 18, the 2010 FED addressed the mandatory findings of significance as discussed below. The 2010 FED also included discussions on significant and unavoidable environmental effects and significant and irreversible environmental changes. As with all of the environmental effects and issue areas, the precise nature and magnitude of impacts would depend on the types of projects authorized, their locations, their aerial extent, and a variety of site-specific factors that are not known at this time but that would be addressed by environmental reviews at the project-specific level. Outside of California, other federal, state and local agencies would consider the proposed projects in accordance with their laws and regulations. ARB would not be the agency responsible for conducting the project-specific environmental or approval reviews because it is not the agency with authority for making land use or project implementation decisions.

The 2010 FED, in its entirety, addressed and disclosed potential environmental effects associated with implementation of California‘s Cap-and-Trade regulation. As described in the impact analyses for the 2010 FED, as well as in this EA, potential environmental impacts, the level of significance prior to mitigation, mitigation measures, and the level of significance after the incorporation of mitigation measures are disclosed.

a) Does the project have impacts that are individually limited, but cumulatively considerable?

Cumulative impacts were discussed in the 2010 FED and referred to in this in the EA (See Section 5 below).

b) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?

While changes to the environment that could indirectly affect human beings would be represented by all of the designated CEQA issue areas, those that could directly affect human beings include air quality, geology and soils, hazards and hazardous materials, hydrology and water quality, noise, population and housing, public services, transportation/traffic, and utilities, which are all addressed above in this EA. The results of the impact analysis in this EA determined that any impacts in the resource areas would be less than significant, and therefore no substantial adverse impacts would directly affect human beings.

5. Cumulative and Growth-Inducing Impacts

The 2010 FED disclosed cumulative impacts for resource topics in general qualitative terms, recognizing the programmatic nature of the 2010 FED, as they pertain to reasonably foreseeable development. The cumulative impacts are required to be addressed when the cumulative impacts are expected to be significant and when the project‘s incremental contribution to the effect is cumulatively considerable. Where a lead agency is examining a project with an incremental effect that is not “cumulatively considerable,” a lead agency need not consider that effect significant, but must briefly describe its basis for concluding that the incremental effect is not cumulatively considerable. ARB considered in the 2010 FED the cumulative impacts analysis of other projects that, like Cap-and-Trade, are designed to reduce annual emissions of GHGs, and not simply every project that emits GHGs. This approach is “guided by the standards of practicality and reasonableness” and serves the purposes of the cumulative impacts analysis, which is to provide “a context for considering whether the incremental effects of the project at issue are considerable” when judged “against the backdrop of the environmental effects of other projects.” (*CBE v. Cal. Res. Agency* (2002) 103 Cal.App.4th 98, 119).

The level of detail in the cumulative and growth-inducing impacts discussion in the 2010 FED was guided by what is practical and reasonable, and contained the following elements (CARB 2010o):

- An analysis of related future projects or planned development that would affect resources in the project area similar to those affected by the proposed project.

- A summary of the expected environmental effects to be produced by those projects with specific reference to additional information stating where that information is available.

- A reasonable analysis of the cumulative impacts of the relevant projects. An environmental document must examine reasonable feasible options for mitigating or avoiding the project‘s contribution to any significant cumulative effects.

Due to the reach of California‘s Cap-and-Trade program and, consequently, also the reach of the Proposed MMC Protocol, the impact analysis is inherently cumulative in nature, rather than site- or project-specific. As a result, the character of impact conclusions in the resource-oriented impact analysis discussions are cumulative, considering the potential effects of the full range of reasonably foreseeable methods of compliance, along with expected background growth in California, as appropriate.

For purposes of the cumulative analysis contained in the 2010 FED, impacts were based on the program‘s contribution to environmental impacts in combination with the environmental effects of the ongoing, adopted, and reasonably foreseeable Scoping Plan measures, and the State Implementation Plan (SIP), which includes goods movement measures (heavy-duty vehicle efficiency, ship electrification, port drayage truck measures, and vessel speed reduction). The ongoing, adopted, and foreseeable Scoping Plan measures (as numbered in the Scoping Plan) are as follows:

Measures in Capped Sectors

Transportation

T-1 Advanced Clean Cars
T-2 Low Carbon Fuel Standard
T-3 Regional Targets (SB 375)
T-4 Tire Pressure Program

T-5 Ship Electrification
T-7 Heavy Duty Aerodynamics
T-8 Medium/Heavy Hybridization
T-9 High Speed Rail

Electricity and Natural Gas
E-1 Energy Efficiency and Conservation
CR-1 Energy Efficiency and Conservation
CR-2 Solar Hot Water (AB 1470)
E-3 Renewable Electricity Standard (20 percent–33 percent)
E-4 Million Solar Roofs

Industrial Measures
I-1 Energy Efficiency and Co-Benefits Audits for Large Industrial Sources

Measures In Uncapped Sources/Sectors

H-1 Motor Vehicle A/C Refrigerant Emissions
H-2 SF6 Limits on non-utility and non-semiconductor applications
H-3 Reduce Perfluorocarbons in Semiconductor Manufacturing
H-4 Limit High GWP use in Consumer Products
H-6 Refrigerant Tracking/Reporting/Repair Deposit Program
H-6 SF6 Leak Reduction and Recycling in Electrical Applications
F-1 Sustainable Forests
RW-1 Landfill Methane Control Measure

The cumulative impact analysis determined the combined effect of California's Cap-and-Trade regulation and other closely related, reasonably foreseeable projects. The discussion of cumulative impacts need not provide as much detail as the discussion of effects attributable to the program alone. The level of detail in the 2010 FED was guided by what was practical and reasonable.

As disclosed in the 2010 FED, implementation of California's Cap-and-Trade regulation (which assumed the implementation of new offset protocols in addition to what was analyzed in the 2010 FED) was determined to potentially result in cumulatively considerable impacts. While suggested mitigation was provided for each potentially cumulatively considerable impact, the mitigation would need to be implemented by other agencies. Where impacts could not be feasibly mitigated, the 2010 FED recognized the impact as significant and unavoidable. The Board adopted Findings and a Statement of Overriding Considerations. Any potential cumulative impacts from implementation of the proposed MMC Offset Protocol were addressed in the prior 2010 FED, and no further analysis is required.

D. Alternatives

Under ARB's CEQA Certified Regulatory Program (CRP), an EA shall address "feasible alternatives to the proposed action [that] would substantially reduce any significant adverse impact identified" (CCR, Title 17, Section 60005[b]). Additionally, any ARB action or proposal for which significant adverse environmental impacts have been identified shall not be approved or adopted as proposed, if there are "feasible alternatives available [that] would substantially reduce such adverse impact" (CCR, Title 17, Section 60006). CEQA Guidelines, CCR, Title 14, Section 15126.6(a) also indicates the need for an evaluation of "a range of reasonable alternatives to the project, or the location of the project, [that] would feasibly attain most of the basic project objectives but would avoid or substantially lessen any of the significant effects, and evaluate the comparative merits of the alternatives."

The purpose of the alternatives analysis is to determine whether or not a variation of the proposed action would reduce or eliminate significant project impacts, within the framework of achieving the basic project objectives. The proposed action could be designed differently, which provides opportunities to define alternatives for the EA analysis. This section of the chapter describes and analyzes a reasonable range of alternatives that could feasibly avoid or lessen any significant environmental impacts while substantially attaining the basic project objectives.

1. No Project Alternative

a) Description and Consistency with Project Objectives

CEQA requires a specific "No Project" alternative to be evaluated. The "No Project" alternative defines a scenario in which ARB would not adopt the MMC Protocol. Under this alternative, California entities could not use carbon offset credits for emission reductions achieved from the installation and operation of a device or set of devices that capture and destroy methane that would otherwise be released into the atmosphere as a result of mining.

The primary objectives of offsets in the Cap-and-Trade program that are applicable to the proposed MMC Protocol are described above in Section B of this EA. By not implementing the MMC Protocol, none of the primary objectives would be achieved. The supply of offsets to broaden the compliance instrument market would not be expanded, thereby diminishing an opportunity to ensure cost-effective GHG reductions. Potential technological innovations developed through the implementation of MMC technologies and associated projects would not occur, and the potential for additional GHG emissions within the mining sector would not be achieved.

b) Environmental Impacts

There would be no significant environmental impacts under the No Project alternative, because no compliance responses would occur. Environmental benefits resulting from the capture of methane achieved under the proposed project would also not occur.

2. Exclude Abandoned Mines Alternative

a) Description and Consistency with Project Objectives

Another alternative to adopting the proposed MMC Protocol would be to limit the issuance of Air Resources Board Offset Credits (ARBOCs) to the destruction of methane extracted from active surface or underground mines only. Abandoned underground mine methane recovery activities would be excluded.

This alternative would result in fewer ARBOCs being issued than under the proposed project. Because issuance of ARBOCs would still occur for projects at active mining operations, this alternative would be consistent with the stated primary objectives of the project but would not fulfill those objectives to the fullest extent. Excluding abandoned mines could result in a narrower range of potential activities, resulting in a reduced supply of offsets available and therefore a lower potential for program cost effectiveness in the cap-and-trade program. Similarly, eliminating abandoned mines would result in fewer opportunities for technological innovation that could occur as a result of project deployment, and fewer GHG reductions would be achieved under this alternative than under the proposed MMC Protocol. Therefore, while this alternative is conceptually feasible, the primary objectives would not be fully realized.

b) Environmental Impacts

Abandoned mining sites, similar to active mines, are subject to regulation of reclamation activities under SMCRA. This EA identified potentially significant impacts to biological and cultural resources at these sites. Exclusion of abandoned underground mine methane recovery activities would avoid environmental impacts at abandoned mining sites; however, potentially significant biological and cultural resources impacts could still occur at active mining sites in cases where the MMC Protocol would still apply. Environmental effects related to other resource topics would be similar to those described for the proposed MMC Protocol.

3. Surface Equipment Only Alternative

a) Description and Consistency with Project Objectives

Another alternative to the proposed MMC Protocol would be to limit the issuance of ARBOCs to projects that involve the installation of surface equipment for the destruction of mine methane extracted only from (1) existing permitted ventilation shafts and drainage wells/boreholes currently located at an active or abandoned mine, or (2) new ventilation shafts and drainage wells/boreholes slated to be constructed in a mine plan for currently operating or new mines that are identified as necessary to ongoing or proposed mining activities.

MMC projects requiring construction of entirely new ventilation shafts and drainage wells/boreholes at a new or existing mine for the sole purpose of receiving ARBOC's for mine methane capture and destruction would not receive credit under this alternative; rather, these components must be identified in the mine plan as necessary components to overall mining operations. Therefore, if this alternative were pursued, ventilation shafts and drainage wells/boreholes constructed specifically for the purpose of mine methane capture and destruction, above and beyond those required to meet safety regulations and those previously utilized to extract virgin coal bed methane, would not be deemed eligible methane sources.

Similarly, other compliance response activities, such as construction of gathering pipelines for gas transport, construction of gas treatment facilities, or other activities with the potential for significant excavation, trenching, drilling or other construction methods involving substantial ground disturbance would be excluded under this alternative.

This alternative would substantially reduce the range of potential MMC project compliance responses and, accordingly, the amount of mine methane captured, destroyed, and credited for all four activity types described in the proposed MMC Protocol. Compared to the "No Abandoned Mines" alternative, this alternative could result in substantially fewer ARBOCs being issued and would, therefore, fall short of meeting the primary objectives of achieving the maximum technologically feasible and cost effective GHG emission reductions, encouraging technological innovation in non-capped sectors, and decreasing greenhouse gas emissions.

b) Environmental Impacts

By restricting MMC projects to surface equipment installations connecting with existing or new ventilation or drainage systems as defined above, this alternative would avoid the need for drilling additional wells or boreholes and, therefore, avoid or further reduce potentially significant impacts to biological and cultural resources. Likewise, excluding the possibility of additional drilling, excavation or other substantial ground-disturbing construction activities related to gas extraction, transport, and treatment would avoid and/or further reduce potentially significant impacts to biological and cultural resources. Environmental effects related to other resource topics would be similar to those described for the proposed MMC Protocol.

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California Environmental Protection Agency

AIR RESOURCES BOARD

Proposed Compliance Offset Protocol Mine Methane Capture Projects

Capturing and Destroying Methane From U.S. Coal and Trona Mines

Adopted: [INSERT Date of Board Adoption]

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Table of Contents

Chapter 1: Purpose and Definitions

§ 1.1. Purpose.

(a) The purpose of the Compliance Offset Protocol Mine Methane Capture Projects (protocol) is to quantify greenhouse gas (GHG) emission reductions associated with the capture and destruction of methane (CH_4) that would otherwise be vented into the atmosphere as a result of mining operations at active underground and surface coal and trona mines and abandoned underground coal mines.

(b) AB 32 exempts quantification methodologies from the Administrative Procedure Act (APA);[1] however those elements of the protocol are still regulatory. The exemption allows future updates to the quantification methodologies to be made through a public review and Board adoption process but without the need for rulemaking documents. Each protocol identifies sections that are considered quantification methodologies and exempt from APA requirements. Any changes to the non-quantification elements of the offset protocols would be considered a regulatory update subject to the full regulatory development process. Those sections that are considered to be a quantification methodology are clearly indicated in the title of the chapter or subchapter if only a portion of that chapter is considered part of the quantification methodology of the protocol.

§ 1.2. Definitions.

(a) For the purposes of this protocol, the following definitions apply:

(1) "Abandoned Underground Mine" means a mine where all mining activity including mine development and mineral production has ceased, mine personnel are not present in the mine workings, and mine ventilation fans are no longer operative. A mine must be classified by the Mine Safety and Health Administration (MSHA) as abandoned or temporarily idle in order to be eligible for an abandoned mine methane recovery activity.

(2) "Abandoned Mine Methane" or "AMM" means methane released from an abandoned mine.

[1] Health and Safety Code section 38571

(3) “Accuracy” means the closeness of the agreement between the result of the measurement and the true value of the particular quantity (or a reference value determined empirically using internationally accepted and traceable calibration materials and standard methods), taking into account both random and systematic factors.

(4) “Active Surface Mine” means a permitted mine in which the mineral lies near the surface and can be extracted by removing the covering layers of rock and soil. A mine must be classified by the Mine Safety and Health Administration (MSHA) as active or intermittent in order to be eligible for an active surface mine methane drainage activity.

(5) “Active Underground Mine” means a permitted mine usually located several hundred feet below the earth’s surface. A mine must be classified by the Mine Safety and Health Administration (MSHA) as active or intermittent in order to be eligible for an active underground mine methane drainage or ventilation air methane activity.

(6) “ASTM” means the American Society of Testing and Materials.

(7) “Basin” means geological provinces as defined by the American Association of Petroleum Geologists (AAPG) Geologic Note: AAPG-CSD Geological Provinces Code Map: AAPG Bulletin, Prepared by Richard F. Meyer, Laurie G. Wallace, and Fred J. Wagner, Jr., Volume 75, Number 10 (October 1991), which is hereby incorporated by reference.

(8) “Boiler” means a closed vessel or arrangement of vessels and tubes, together with a furnace or other heat source, in which water is heated to produce hot water or steam.

(9) “Borehole” means a hole made with a drill, augur or other tool into a coal seam or surrounding strata from which natural gas is extracted.

(10) “Cap-and-Trade Regulation” or “Regulation” or “Cap-and-Trade Program” means ARB’s regulation establishing the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms set forth in title 17, California Code of Regulations, Chapter 1, Subchapter 10, article 5 (commencing with section 95800).

(11) “Coal” means all solid fuels classified as anthracite, bituminous, sub-bituminous, or lignite by the American Society for Testing and Materials Designation ASTM D388-05 “Standard Classification of Coals by Rank” (2005), which is hereby incorporated by reference.

(12) “Coal Bed Methane” or “CBM” or “Virgin Coal Bed Methane” means methane-rich natural gas drained from coal seams and surrounding strata not disturbed by mining. The extraction, capture, and destruction of virgin coal bed methane are unrelated to mining activities and are not eligible under this protocol.

(13) “Emission Factor” means a unique value for determining an amount of a GHG emitted for a given quantity of activity (e.g., metric tons of carbon dioxide emitted per barrel of fossil fuel burned).

(14) “Enclosed Flare” means a flare that is situated in an enclosure for the purposes of safety and accurate measurement of gas combustion.

(15) “End-use Management Option” means a method of methane destruction deemed either eligible or ineligible for the purpose crediting under this protocol.

(16) “Executive Officer” means the Executive Officer of the California Air Resources Board, or his or her delegate.

(17) “Flare” means a combustion device, whether at ground level or elevated, that uses an open flame to burn combustible gases with combustion air provided by uncontrolled ambient air around the flame. For purposes of this protocol, an enclosed flare is considered a flare.

(18) “Flooded Mine” means a mine that is flooded, i.e. filled with water, as a result of the turning off of pumps at time of abandonment and has no detectable freely venting methane emissions. Mines that either pump water due to regulatory or legal requirements or have detectable free standing water shall not be considered flooded provided that they still freely vent methane.

(19) “Flow Meter” means a measurement device consisting of one or more individual components that is designed to measure the bulk fluid

movement of liquid or gas through a piped system at a designated point. Bulk fluid movement can be measured with a variety of devices in units of mass flow or volume.

(20) “Gas Treatment” means applying techniques to extracted mine gas such as dehydration, gas separation, and the removal of non-methane components to prepare the mine gas for an end-use management option, including pipeline injection.

(21) “Gob” means the part of the mine from which the mineral and artificial supports have been removed and the roof allowed to fall in. Gob is also known as “Goaf.”

(22) “Greenhouse Gas Assessment Boundary” or “GHG Assessment Boundary” or “Offset Project Boundary” is defined by and includes all GHG emission sources, GHG sinks or GHG reservoirs that are affected by an offset project and under control of the Offset Project Operator or Authorized Project Designee. GHG emissions sources, GHG sinks or GHG reservoirs not under control of the Offset Project Operator or Authorized Project Designee are not included in the offset project boundary.

(23) “Longwall” means a method of underground mining where a mechanical shearer is pulled back and forth across a coal face and loosened coal falls onto a conveyor for removal from the mine.

(24) “Methane Drainage System” or “Drainage System” means a system that drains methane from coal or trona seams and/or surrounding rock strata and transports it to a common collection point. Methane drainage systems may comprise multiple methane sources.

(25) “Methane Source” means a methane source type (i.e., ventilation shafts, pre-mining surface wells, pre-mining in-mine boreholes, post-mining gob wells, existing coal bed methane wells that would otherwise be shut-in and abandoned, abandoned wells that are re-activated, and converted dewatering wells) in the aggregate. In this protocol, “methane source” does not refer to any specific ventilation shaft, borehole, or well, but

instead refers to all the ventilation shafts, boreholes, and wells of the same type collectively.

(26) “Mine Gas” or “MG” means the untreated gas extracted from within a mine through a methane drainage system that often contains various levels of other components (e.g. nitrogen, oxygen, carbon dioxide, hydrogen sulfide, NMHC, etc.).

(27) “Mine Methane” or “MM” means methane contained in mineral deposits and surrounding strata that is released as a result of mining operations; the methane portion of mine gas.

(28) “Mine Operator” means any owner, lessee, or other person who operates, controls, or supervises a coal or other mine or any independent contractor performing services or construction at such mine. For purposes of this protocol, the Mine Operator is the operating entity listed on the state well drilling permit, or a state operating permit for wells where no drilling permit is issued by the state.

(29) “Mine Safety and Health Administration” or “MSHA” means the U.S. federal agency that regulates mine health and safety.

(30) “Mining Activities” means working an area, or panel, of coal or trona that has been developed and equipped to facilitate mineral extraction and is shown on a mining plan.

(31) “Mountaintop Removal Mining” means a method of surface mining involving the removal of the covering layers of rock and soil at or near the top of a mountain to expose coal seams. Projects which occur at mines that employ mountaintop removal mining are not eligible under this protocol.

(32) “Natural Gas Pipeline” or “Pipeline” means a high pressure pipeline transporting saleable quality natural gas offsite to distribution, metering or regulating stations or directly to customers.

(33) “Non-Qualifying Destruction Device” or “Non-Qualifying Device” means a destruction device that is either operational at the mine prior to offset project commencement or used to combust mine methane via an ineligible

end-use management option per section 3.4. Methane destroyed by a non-qualifying device must be monitored for quantification of both the baseline and project scenarios.

(34) "Offset Project Expansion" means the addition of a new methane source or new destruction device to an existing MMC project. A methane source is deemed new if it is either drilled after offset project commencement or connected to a destruction device after offset project commencement. A destruction device is deemed new if it becomes operational after offset project commencement. Under certain circumstances, described in Chapter 2, the addition of new methane sources or new destruction devices may qualify as a new MMC project or an offset project expansion. In those cases, an Offset Project Operator may choose how to define the addition. Offset project expansion, unlike the establishment of a new MMC project, will not result in a new offset project commencement date or crediting period. Offset project expansion, unlike the establishment of a new MMC project, allows the Offset Project Operator to submit a single annual Offset Project Data Report (OPDR) and undergo a single annual verification.

(35) "Open-pit" means a method of surface mining where coal is exposed by removing the overlying rock. This is also known as open-cut or opencast mining.

(36) "Oxidation" means a reaction in which the atoms in an element lose electrons and the valence of the element is correspondingly increased. An example of an oxidation reaction is the combustion of CH_4 in air to form CO_2 and water.

(37) "Pre-mining In-mine Boreholes" means a borehole drilled into an unmined seam from within the mine to drain methane from the seam ahead of the advancement of mining. This is also known as horizontal pre-mining boreholes.

(38) "Pre-mining Surface Wells" means a well drilled into an unmined seam from the surface to drain methane from the seam and surrounding strata,

often months or years in advance of mining. This is also known as surface pre-mining boreholes, surface-to-seam boreholes, and surface-drilled directional boreholes.

(39) "Post-mining Gob Well" or "Gob Well" means a well used to extract or vent methane from the gob. Gob wells may be drilled from the surface or within the mine.

(40) "Project Activity" means a change in mine methane management that leads to a reduction in GHG emissions in comparison to the baseline management and GHG emissions.

(41) "Qualifying Destruction Device" or "Qualifying Device" means a destruction device that was not operational at the mine prior to offset project commencement and that was not used to combust mine methane via an ineligible end-use management option per section 3.4. Methane destructed by a non-qualifying device must be monitored for quantification of both the baseline and project scenarios.

(42) "Room and Pillar" means a method of underground mining in which approximately half of the coal is left in place as "pillars" to support the roof of the active mining area while "rooms" of coal are extracted.

(43) "Sealed," in reference to an abandoned mine, means any entrance into the mine (e.g., portals, ventilation shafts, methane drainage wells) has been sealed. The volume of methane trapped in the mine and the rate at which mine gas is emitted from the mine is dependent on the effectiveness of the sealing.

(44) "Shut-in" means to close, temporarily, a well capable of production.

(45) "Standard Conditions" or "Standard Temperature and Pressure" or "STP" means 60 degrees Fahrenheit and 14.7 pounds per square in absolute.

(46) "Standard Cubic Foot" or "scf" is a measure of quantity of gas, equal to a cubic foot of volume at 60 degrees Fahrenheit and 14.7 pounds per square inch (1 atm) of pressure.

(47) "Strata", plural of stratum, means the layers of sedimentary rock surrounding a coal seam.

(48) “Surface Mine Methane” or “SMM” means methane contained in mineral deposits and surrounding strata that is released as a result of surface mining operations.

(49) “Thermal Energy” means the thermal output produced by a combustion source used directly as part of a manufacturing process, industrial/commercial process, or heating/cooling application, but not used to produce electricity.

(50) “Trona” means a water-bearing sodium carbonate compound mineral that is mined and processed into soda ash or bicarbonate of soda.

(51) “Uncertainty” means the degree to which data or a data system is deemed to be indefinite or unreliable.

(52) “Uncertainty Deduction” means an adjustment applied to the emission reductions achieved by an abandoned mine methane recovery activity to account for uncertainty related to the use of emission rate decline curves. The purpose of an uncertainty deduction is to ensure that credited emission reductions remain conservative.

(53) “Vented Emissions” means, for purposes of this protocol, intentional or designed releases of CH_4 containing natural gas or hydrocarbon gases through mine ventilation and methane drainage systems.

(54) “Ventilation Air Methane” or “VAM” means methane contained in exhaust air of the ventilation system of a mine, which originates across the mine workings and is diluted to low concentrations by the circulation of outside air.

(55) “Ventilation Air Methane Collection System” or “VAM Collection System” means a system that captures the ventilation air methane from the ventilation system.

(56) “Ventilation Shaft” means a vertical passage used to move fresh air underground and/or to remove methane and other gases from an underground mine.

(57) “Ventilation System” means a system of fans that provides a flow of air to underground workings of a mine for the purpose of sufficiently diluting and removing methane and other noxious gases.

(58) “Venting,” in reference to an abandoned mine, means that existing wells and ventilation shafts are left unsealed, allowing air into the mine and methane to escape freely to the atmosphere.

(59) “Well” means a well drilled for extraction of natural gas from a coal seam, surrounding strata, or mine.

(b) For terms not defined in section 1.2(a), the definitions in section 95802 of the Regulation apply.

(c) Acronyms. For purposes of this protocol, the following acronyms apply:

(1) “AAPG” means American Association of Petroleum Geologists.

(2) “AB 32” means Assembly Bill 32, the Global Warming Solutions Act of 2006.

(3) “AMM” means abandoned mine methane.

(4) “APA” means Administrative Procedure Act.

(5) “APD” means Authorized Project Designee.

(6) “ARB” means the California Air Resources Board.

(7) “atm” means atmosphere in reference to a unit of pressure.

(8) “BAU” means business as usual.

(9) “Btu” means British thermal unit.

(10) “CBM” means coal bed methane.

(11) “CH_4” means methane.

(12) “CO_2” means carbon dioxide.

(13) “CO_2e” means carbon dioxide equivalent.

(14) “F” means Fahrenheit.

(15) “GHG” means greenhouse gas.

(16) “GWP” means global warming potential.

(17) “kg” means kilogram.

(18) “lb” means pound.

(19) “m” means minute.

(20) “MG” means mine gas.

(21) “MM” means mine methane.

(22) “MMBtu” means million British thermal units.

(23) “MMC” means mine methane capture.

(24) “MRR” means Mandatory Reporting Regulation; the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions.

(25) “Mscf” means thousand standard cubic feet.

(26) “MSHA” means Mine Safety and Health Administration.

(27) “MWh” means megawatt hour.

(28) “N_2O” means nitrous oxide.

(29) “OPDR” means Offset Project Development Report.

(30) “OPO” means Offset Project Operator.

(31) “R” means Rankine.

(32) “scf” means standard cubic foot.

(33) “scf/d” means standard cubic feet per day.

(34) “scfm” means standard cubic feet per minute.

(35) “SMM” mean surface mine methane.

(36) “SSR” means GHG sources, sinks, and reservoirs.

(37) “STP” means standard temperature and pressure.

(38) “t” means metric ton.

(39) “QA/QC” means quality assurance and quality control.

(40) “VAM” means ventilation air methane.

Chapter 2: Eligible Activities – Quantification Methodology

This protocol includes four mine methane capture activities designed to reduce GHG emissions that result from the mining process at active underground mines, active surface mines, and abandoned underground mines. The following types of mine methane capture activities are eligible:

§ 2.1. Active Underground Mine Ventilation Air Methane Activities.

This protocol applies to MMC projects that install a ventilation air methane (VAM) collection system and qualifying device to destroy the methane in VAM otherwise vented into the atmosphere through the return air shaft(s) as a result of underground coal or trona mining operations.

(a) Methane source eligible for VAM activities include:

1) Ventilation shafts
2) Methane drainage systems from which mine gas is extracted and used to supplement VAM. Only the mine methane sent with ventilation air to a destruction device is eligible.

(b) In order to be considered a qualifying device for the purpose of this protocol, the device must not be operating at the mine prior to offset project commencement.

(c) At active underground mines, an Offset Project Operator or Authorized Project Designee may operate both VAM and methane drainage activities as a single offset project all sharing the earliest commencement date. Alternatively, the Offset Project Operator or Authorized Project Designee may elect to operate separate offset projects for each activity with unique commencement dates.

(d) If a newly constructed ventilation shaft is connected to an existing or new destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(e) If an existing ventilation shaft that was not connected to a destruction device at time of offset project commencement is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(f) If a new qualifying destruction device is added to a ventilation shaft currently connected to an existing qualifying destruction device this addition of the new destruction device is considered an offset project expansion.

(g) Ventilation air methane from any ventilation shaft connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

§ 2.2. Active Underground Mine Methane Drainage Activities.

This protocol applies to MMC projects that install equipment to capture and destroy methane extracted through a methane drainage system that would otherwise be vented into the atmosphere as a result of underground coal or trona mining operations.

(a) Methane drainage systems must consist of one, or a combination of, the following methane sources that drain methane from the mineral seam, surrounding strata, or underground workings of the mine before, during, and/or after mining:

   (1) pre-mining surface wells;

   (2) pre-mining in-mine boreholes; and

   (3) post-mining gob wells.

(b) In order to be considered a qualifying device for the purpose of this protocol, a methane destruction device for an active underground mine methane drainage activity must not be operating at the mine prior to offset project commencement and must represent an end-use management option other than natural gas pipeline injection.

(c) At active underground mines, an Offset Project Operator or Authorized Project Designee may operate both VAM and methane drainage activities as a single project all sharing the earliest commencement date. Alternatively, the Offset Project Operator or Authorized Project Designee may elect to operate separate projects for each activity with unique commencement dates.

(d) If a newly drilled well/borehole is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(e) If an existing well/borehole that was not connected to a destruction device at time of offset project commencement is connected to an existing or new destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(f) If a new qualifying destruction device is connected to a well/borehole currently connected to an existing qualifying destruction device, this addition of the new destruction device is considered an offset project expansion.

(g) Mine methane from any well or borehole connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

(h) Active underground mines with MMC projects must not:

  (1) account for virgin coal bed methane (CBM) extracted from coal seams outside the extents of the mine according to the mine plan or from outside the methane source boundaries as described in section 3.5; or

  (2) use CO_2, steam, or any other fluid/gas to enhance mine methane drainage.

§ 2.3. Active Surface Mine Methane Drainage Activities.

This protocol applies to MMC projects that install equipment to capture and destroy methane extracted through a methane drainage system that would otherwise be vented into the atmosphere as a result of surface coal or trona mining operations.

(a) Methane drainage systems must consist of one, or a combination, of the following methane sources that drain methane from the coal seam or surrounding strata before and/or during mining:

  (1) pre-mining surface wells;

  (2) pre-mining in-mine boreholes;

  (3) existing coal bed methane (CBM) wells that would otherwise be shut-in and abandoned as a result of encroaching mining;

  (4) abandoned wells that are re-activated; and

  (5) converted dewatering wells.

(b) In order to be considered a qualifying device for the purpose of this protocol, a methane destruction device for an active surface mine methane drainage activity must not be operating at the mine prior to offset project commencement.

(c) If a newly drilled well/borehole is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project

Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(d) If an existing well/borehole that was not connected to a destruction device at time of offset project commencement is connected to an existing or new destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(e) If a new qualifying destruction device is connected to a well/borehole currently connected to an existing qualifying destruction device, this addition of the new destruction device is considered an offset project expansion.

(f) SMM from any well or borehole connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

(g) To be eligible for crediting under this protocol, MMC projects at active surface mines must not:

(1) account for virgin CBM extracted from wells outside the extents of the mine according to the mine plan or from outside the methane source boundaries as described in section 3.5; or

(2) use CO_2, steam, or any other fluid/gas to enhance mine methane drainage; or

(3) occur at mines that employ mountaintop removal mining methods.

§ 2.4. Abandoned Underground Mine Methane Recovery Activities.

This protocol applies to MMC projects that install equipment to capture and destroy methane extracted through a methane drainage system that would otherwise be vented into the atmosphere as a result of previous underground coal mining operations.

(a) Methane drainage systems must consist of one, or a combination of, the following methane sources:

(1) pre-mining surface wells, pre-mining in-mine boreholes, or post-mining gob wells drilled into the mine during active mining operations; and

(2) newly drilled surface wells.

(b) In order to be considered a qualifying device for the purpose of this protocol, a methane destruction device for an abandoned underground mine methane recovery activity must not be operating at the mine prior to offset project commencement.

(c) Abandoned underground mine methane recovery activities at multiple mines with multiple mine operators may report and verify together as a single project per the requirements of section 95977 of the Regulation if they meet the following criteria:

(1) A single Offset Project Operator is identified and emission reductions achieved by the project will be credited to that Offset Project Operator.

(2) The methane recovered from the mines is metered at a centralized point prior to being sent to a destruction device.

(3) The Offset Project Operator meets all monitoring, reporting and verification requirements in Chapters 6, 7, and 8.

(4) Offset projects at all mines are in compliance with regulations per section 3.8. If any mine is found to be out of compliance, no emission reductions will be credited to the project even if achieved by one of the other mines found to be in compliance.

(d) In the event that there are vertically separated mines overlying and underlying other mines, wells completed in one mine can be used to capture methane in overlying or underlying mines provided the wells are within the maximum vertical extent of each mine per section 3.5(d)(4).

(e) If a newly drilled well/borehole is connected to an existing or new qualifying destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(f) If an existing well/borehole that was not connected to a destruction device at time of offset project commencement is connected to an existing or new destruction device after offset project commencement, the Offset Project Operator may either classify it as an offset project expansion or register the addition as a new MMC project.

(g) If a new qualifying destruction device is connected to a well/borehole currently connected to an existing qualifying destruction device, this addition of the new destruction device is considered an offset project expansion.

(h) AMM from any well or borehole connected to a non-qualifying destruction device at any point during the year prior to offset project commencement is not eligible for crediting.

(i) To be eligible for crediting under this protocol, MMC projects at abandoned underground mines must not:

  (1) account for virgin coal bed methane (CBM) from wells outside the extents of the mine according to the final mine map(s) or from outside the methane source boundaries ascribed in section 3.5; or

  (2) use CO_2, steam, or any other fluid/gas to enhance mine methane drainage; or

  (3) occur at flooded mines.

Chapter 3. Eligibility

In addition to the offset project eligibility criteria and regulatory program requirements set forth in Subarticle 13 of the Cap-and-Trade Regulation (Regulation), mine methane capture offset projects must adhere to the eligibility requirements below.

§ 3.1. General Eligibility Requirements.

(a) Offset projects that use this protocol must:

  (1) involve the installation and operation of a device, or set of devices, associated with the capture and destruction of mine methane;

  (2) capture mine methane that would otherwise be emitted to the atmosphere; and

  (3) destroy the captured mine methane through an eligible end-use management option per section 3.4.

(b) Offset Project Operators or Authorized Project Designees that use this protocol must:

  (1) provide the listing information required by section 95975 of the Regulation and section 7.1;

(2) monitor GHG emission sources within the GHG Assessment Boundary as delineated in Chapter 4 per the requirements of Chapter 6;

(3) quantify GHG emission reductions per Chapter 5;

(4) prepare and submit annual Offset Project Data Reports (OPDRs) that include the information requirements in section 7.2; and

(5) undergo required, independent verification by an ARB-accredited offset verification body in accordance with section 95977 of the Regulation and Chapter 8.

§ 3.2. Location.

(a) Only projects located in the United States are eligible under this protocol.

(b) Offset projects situated on the following categories of land are only eligible under this protocol if they meet the requirements of this protocol and the Regulation, including the waiver of sovereign immunity requirements of section 95975(l) of the Regulation:

1) Land that is owned by, or subject to an ownership or possessory interest of a Tribe;

2) Land that is “Indian lands” of a Tribe, as defined by 25 U.S.C. §81(a)(1); or

3) Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands.

(c) Projects must take place at either:

1) an active underground or surface mine permitted for coal or trona mining by an appropriate state or federal agency and classified by Mine Safety and Health Administration (MSHA) as an active or intermittent mine; or

2) an abandoned underground coal mine classified as temporarily idle or permanently abandoned by MSHA.

(d) Mines located on federal lands are eligible for implementation of MMC projects.

§ 3.3. Offset Project Operator or Authorized Project Designee.

(a) The Offset Project Operator or Authorized Project Designee is responsible for project listing, monitoring, reporting, and verification.

(b) The Offset Project Operator or Authorized Project Designee must submit the information required by Subarticle 13 of the Regulation and in Chapter 7.

(c) The Offset Project Operator must have legal authority to implement the offset project.

(d) The Offset Project Operator must be a mine operator as defined in section 1.2(a)(28).

§ 3.4. Additionality.

Offset projects must meet the additionality requirements set out in section 95973(a)(2) the Regulation, in addition to the requirements in this protocol. Eligible offsets must be generated by projects that yield surplus GHG reductions that exceed any GHG reductions otherwise required by law or regulation or any GHG reduction that would otherwise occur in a conservative business-as-usual scenario. These requirements are assessed through the Legal Requirement Test in section 3.4.1 and the Performance Standard Evaluation in section 3.4.2.

§ 3.4.1. Legal Requirement Test.

(a) Emission reductions achieved by an MMC project must exceed those required by any law, regulation, or legally binding mandate at the time of offset project commencement.

(b) The following legal requirement test applies to all MMC projects:

   (1) If no law, regulation, or legally binding mandate requiring the destruction of methane at the mine at which the project is located exists at the time of offset project commencement, all emission reductions resulting from the capture and destruction of mine methane are considered to not be legally required, and therefore eligible for crediting under this protocol.

   (2) If any law, regulation, or legally binding mandate requiring the destruction of methane at the mine at which the project is located exists at the time of offset project commencement, only emission reductions resulting from the capture and destruction of mine methane that are in excess of what is required to comply with those laws, regulations, and/or legally binding mandates are eligible for crediting under this protocol.

§ 3.4.2. Performance Standard Evaluation.

(a) Emission reductions achieved by an MMC project must exceed those likely to occur in a conservative business-as-usual scenario.

(b) The performance standard evaluation is satisfied if the following requirements are met, depending on the basis of activity type:

(1) Active Underground Mine VAM Activities

(A) Destruction of VAM via any end-use management option automatically satisfies the performance standard evaluation because destruction of VAM is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

(2) Active Underground Mine Methane Drainage Activities

(A) Destruction of extracted mine methane via any end-use management option other than injection into a natural gas pipeline for off-site consumption automatically satisfies the performance standard evaluation because it is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

(B) Pipeline injection of mine methane extracted from methane drainage systems at active underground mines is common practice and considered business-as-usual, and therefore ineligible for crediting under this protocol.

(3) Active Surface Mine Methane Drainage Activities

(A) Destruction of extracted mine methane via any end-use management option automatically meets the performance standard evaluation because it is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

(4) Abandoned Mine Methane Recovery Activities

(A) Destruction of extracted mine methane via any end-use management option automatically meets the performance standard evaluation because is not common practice nor considered business-as-usual, and is therefore eligible for crediting under this protocol.

§ 3.5. Methane Source Boundaries.

(a) The methane destroyed for the purpose of reducing mine methane emissions under this protocol must be methane that would otherwise be emitted into the atmosphere during the normal course of mining activities.

(b) To ensure that virgin coal bed methane is excluded from the destructed mine methane accounted for in this protocol, physical boundaries must be placed on the source of the methane.

(c) All methane from a mine's ventilation and drainage systems must be collected from within the mine extents according to an up-to-date mine plan.

(d) Additional physical boundaries on the basis of activity type are as follows:

(1) Active underground mine ventilation air methane activities may account for:

(A) all destructed methane contained in VAM collected from a mine ventilation system; and

(B) all destructed mine methane contained in mine gas extracted from a methane drainage system used to supplement VAM.

(2) Active underground mine methane drainage activities may account for:

(A) destructed mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mined seam through pre-mining surface wells and pre-mining in-mine boreholes; and

(B) all destructed mine methane contained in mine gas extracted through gob wells.

(3) Active surface mine methane drainage activities may account for destructed surface mine methane contained in mine gas extracted from all strata above and up to 50 meters below a mined seam through pre-mining surface wells, pre-mining in-mine boreholes, existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining, abandoned wells that are re-activated, and converted dewatering wells.

(4) Abandoned underground mine methane recovery activities may account for:

(A) Destructed abandoned mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mined seam through pre-mining surface wells and pre-mining in-mine boreholes drilled during active mining operations;

(B) Destructed abandoned mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mine seam through newly drilled surface wells; and

(C) Destructed abandoned mine methane contained in mine gas extracted from strata up to 150 meters above and 50 meters below a mined seam through existing post-mining gob wells.

§ 3.6. Offset Project Commencement.

(a) For this protocol, offset project commencement is defined as the date at which the offset project's mine methane capture and destruction equipment becomes operational. Equipment is considered *operational* on the date at which the system begins capturing and destroying methane gas upon completion of an initial start-up period.

(b) Per section 95973(a)(2)(B) of the Regulation, compliance offset projects must have an offset project commencement date after December 31, 2006.

§ 3.7. Project Crediting Period.

The crediting period for this protocol is ten years.

§ 3.8. Regulatory Compliance.

(a) An Offset Project Operator or Authorized Project Designee must fulfill all applicable local, regional, and national requirements on environmental impact assessments that apply based on the offset project location.

(b) Offset projects must fulfill all local, regional, and national environmental and health and safety laws and regulations that apply based on the offset project location and that directly apply to the offset project

(c) The project is in regulatory compliance if the project activities were not subject to enforcement action by a regulatory oversight body during the Reporting Period.

(d) Offset projects are not eligible to receive ARB or registry offset credits for GHG reductions or GHG removal enhancements for the entire Reporting Period if the offset project is not in compliance with regulatory requirements directly applicable to the offset project during the Reporting Period.

Chapter 4. GHG Assessment Boundary – Quantification Methodology

The greenhouse gas assessment boundary, or offset project boundary, delineates the GHG emission sources, sinks, and reservoirs (SSRs) that must be included or excluded when quantifying the net change in emissions associated with the installation and operation of a device, or set of devices, associated with the capture and destruction of mine methane. The following GHG assessment boundaries apply to all MMC projects on the basis of activity type:

§ 4.1. Active Underground Mine VAM Activities.

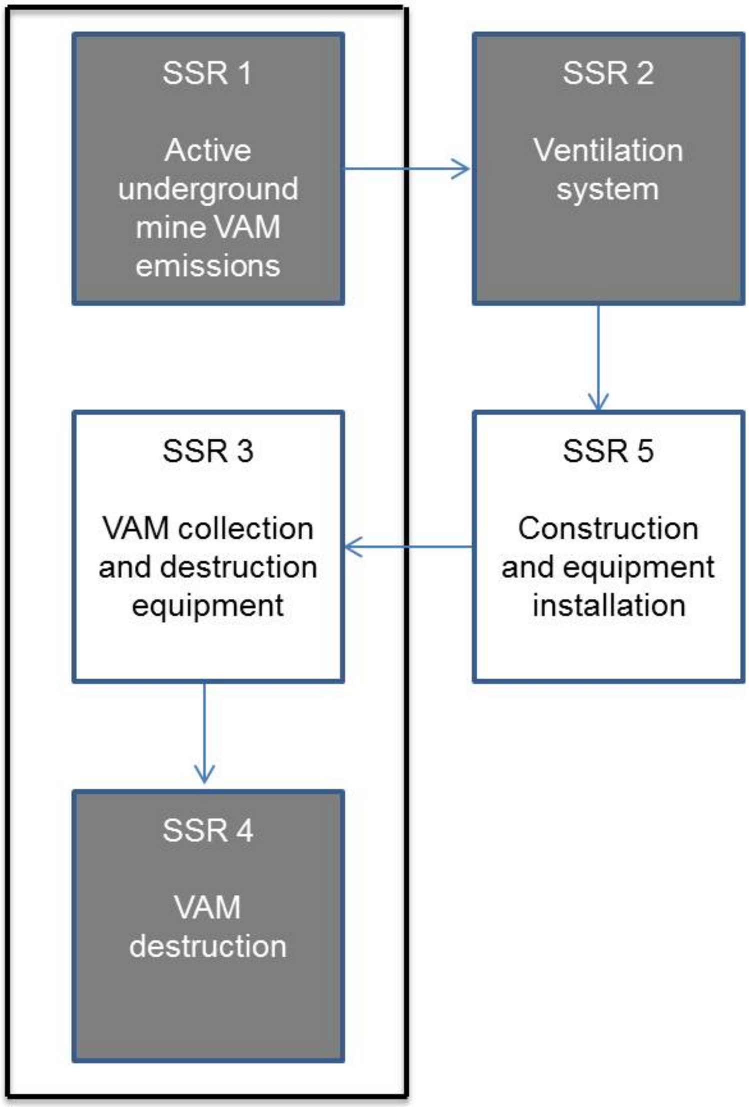
(a) Figure 4.1 illustrates the GHG assessment boundary for active underground mine VAM activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.1. Illustration of the greenhouse gas assessment boundary for active underground mine VAM activities.



(b) Table 4.1 lists the SSRs for active underground mine VAM activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.1. List of the greenhouse gas sinks, sources, and reservoirs for active underground mine VAM activities.

SSR	Description	GHG	Baseline (B) or Project (P)	Included/ Excluded
1	Emissions from the venting of VAM through mine ventilation system	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate mine ventilation system	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
3	Emissions resulting from energy consumed to operate VAM collection system/ destruction device	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
4	Emissions resulting from VAM destruction	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions of uncombusted methane	CH_4	B, P	Included
5	Emissions from construction and/or installation of new equipment	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from construction	CH_4	n/a	Excluded

§ 4.2. Active Underground Mine Methane Drainage Activities.

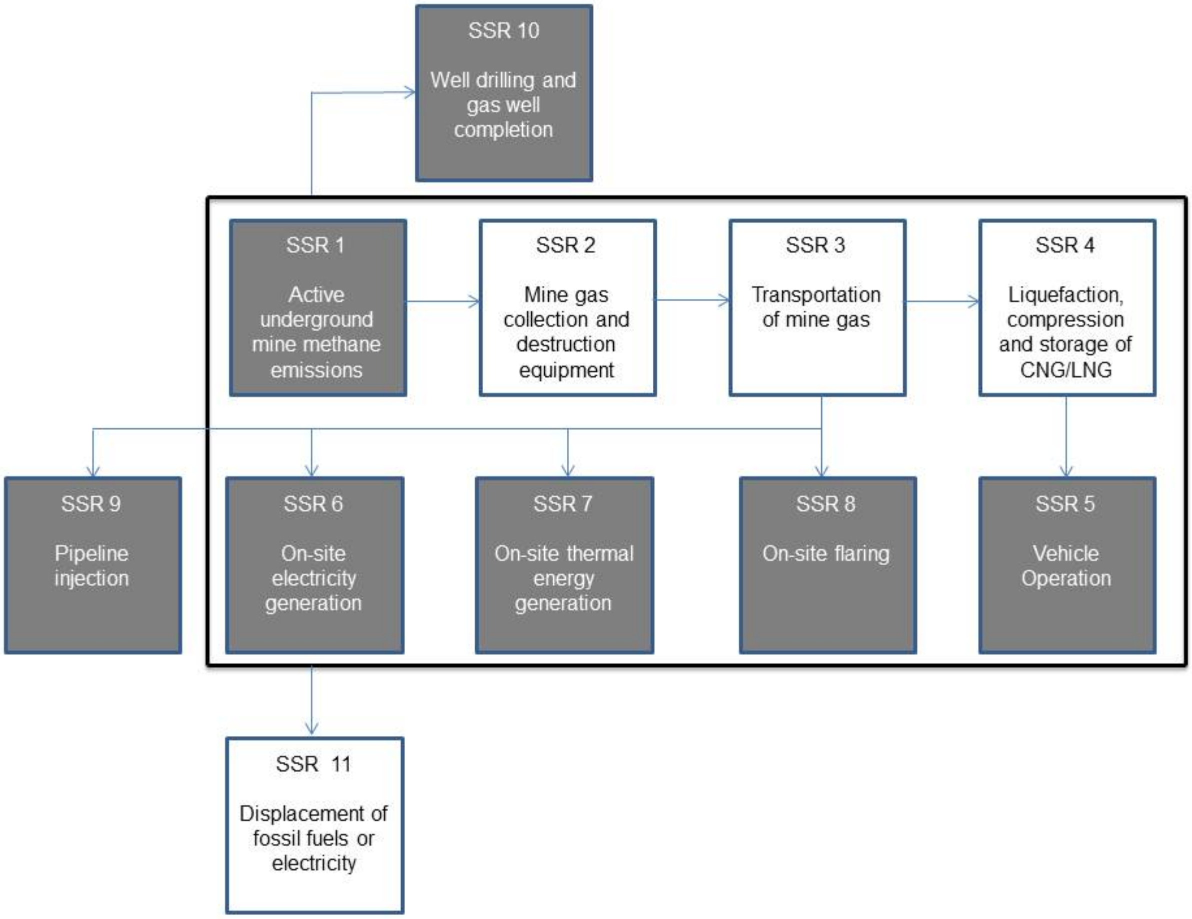
(a) Figure 4.2 illustrates the GHG assessment boundary for active underground mine methane drainage activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.2. Illustration of the greenhouse gas assessment boundary for active underground mine methane drainage activities.



(b) Table 4.2 lists the identified SSRs for active underground mine methane drainage activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.2. List of identified greenhouse gas sinks, sources, and reservoirs for active underground mine methane drainage activities.

SSR	Description	GHG	Relevant to Baseline (B) or Project (P)	Included/ Excluded
1	Emissions from the venting of mine methane extracted through methane drainage system	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate equipment used to capture or treat drained mine gas	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of equipment used to capture or treat drained mine gas	CH_4	n/a	Excluded
3	Emissions resulting from energy consumed to transport mine gas to treatment or destruction equipment	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from the on-site transportation of mine gas	CH_4	n/a	Excluded
4	Emissions resulting from energy consumed to operate equipment used to liquefy, compress, or store methane for vehicle use.	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of equipment used to liquefy, compress, or store methane for vehicle use	CH_4	n/a	Excluded
5	Emissions resulting from methane combustion during vehicle operation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during vehicle operation	CH_4	B, P	Included
6	Emissions resulting from methane combustion during on-site electricity generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included
7	Emissions resulting from methane combustion during on-site thermal energy generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site thermal energy generation	CH_4	B, P	Included
8	Emissions resulting from	CO_2	B, P	Included

	methane combustion during on-site flaring	N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during flaring	CH_4	B, P	Included
9	Emissions resulting from methane combustion resulting from pipeline injection	CO_2	n/a	Excluded
		N_2O	n/a	Excluded
	Emissions resulting from the incomplete methane combustion resulting from pipeline injection	CH_4	n/a	Excluded
10	Emissions from well drilling and gas well completion	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from well drilling and gas well completion	CH_4	n/a	Excluded
11	Emission reductions resulting from the displacement of fossil fuels or electricity	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded

§ 4.3. Active Surface Mine Methane Drainage Activities.

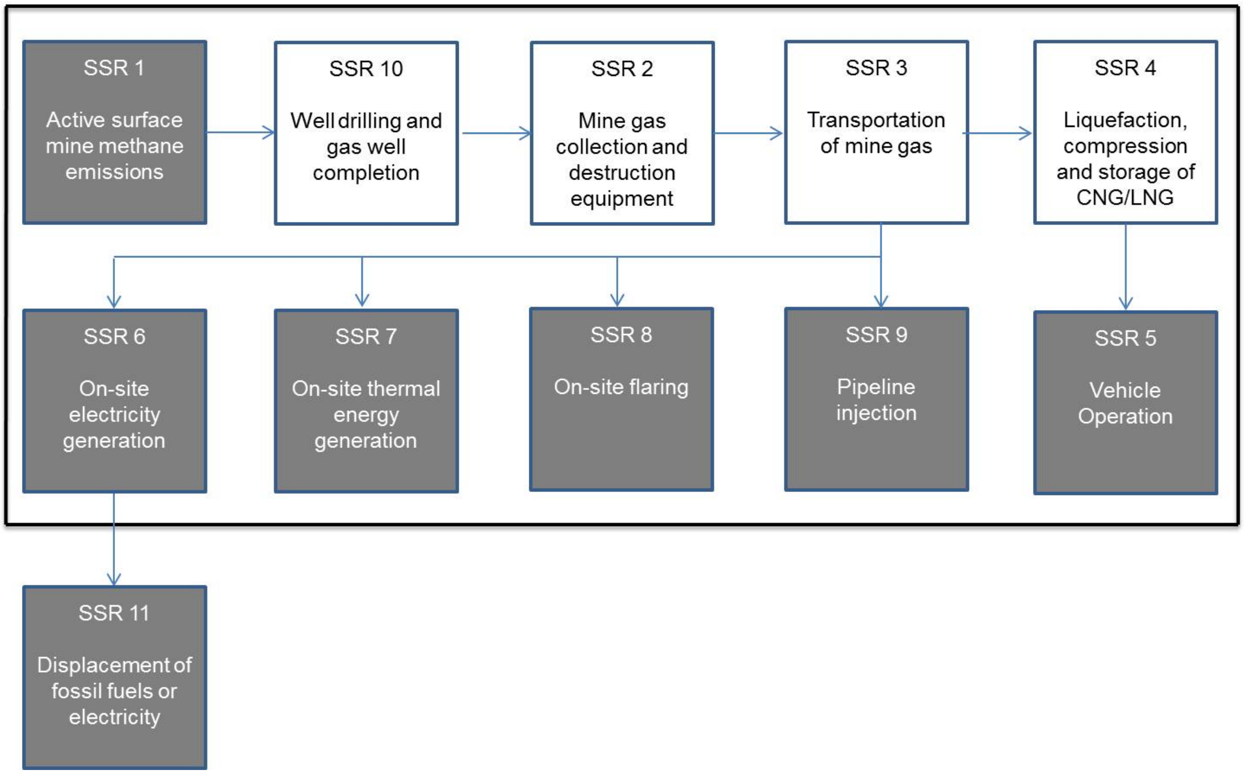
(a) Figure 4.3 illustrates the GHG assessment boundary for active surface mine methane drainage activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.3. Illustration of the greenhouse gas assessment boundary for active surface mine methane drainage activities.



(b) Table 4.3 lists the SSRs for active surface mine methane drainage activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.3. List of the greenhouse gas sinks, sources, and reservoirs for active surface mine methane drainage activities.

SSR	Description	GHG	Relevant to Baseline (B) or Project (P)	Included/ Excluded
1	Emissions from the venting of mine methane during the mining process	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate equipment used to capture or treat drained mine gas	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of equipment used to capture or treat drained mine gas	CH_4	n/a	Excluded
3	Emissions resulting from energy consumed to transport mine gas to treatment or destruction equipment	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from the on-site transportation of mine gas	CH_4	n/a	Excluded
4	Emissions resulting from energy	CO_2	P	Included

	consumed to operate equipment used to liquefy, compress, or store methane for vehicle use.	CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of equipment used to liquefy, compress, or store methane for vehicle use	CH_4	n/a	Excluded
5	Emissions resulting from methane combustion during vehicle operation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during vehicle operation	CH_4	B, P	Included
6	Emissions resulting from methane combustion during on-site electricity generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included
7	Emissions resulting from methane combustion during on-site thermal energy generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site thermal energy generation	CH_4	B, P	Included
8	Emissions resulting from methane combustion during on-site flaring	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during flaring	CH_4	B, P	Included
9	Emissions resulting from methane combustion resulting from pipeline injection	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from the incomplete methane combustion resulting from pipeline injection	CH_4	B, P	Included
10	Emissions from well drilling and well gas completion	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from well drilling and gas well completion	CH_4	n/a	Excluded
11	Emission reductions resulting from the displacement of fossil fuels or electricity	CO_2	n/a	Excluded
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded

§ 4.4. Abandoned Underground Mine Methane Recovery Activities.

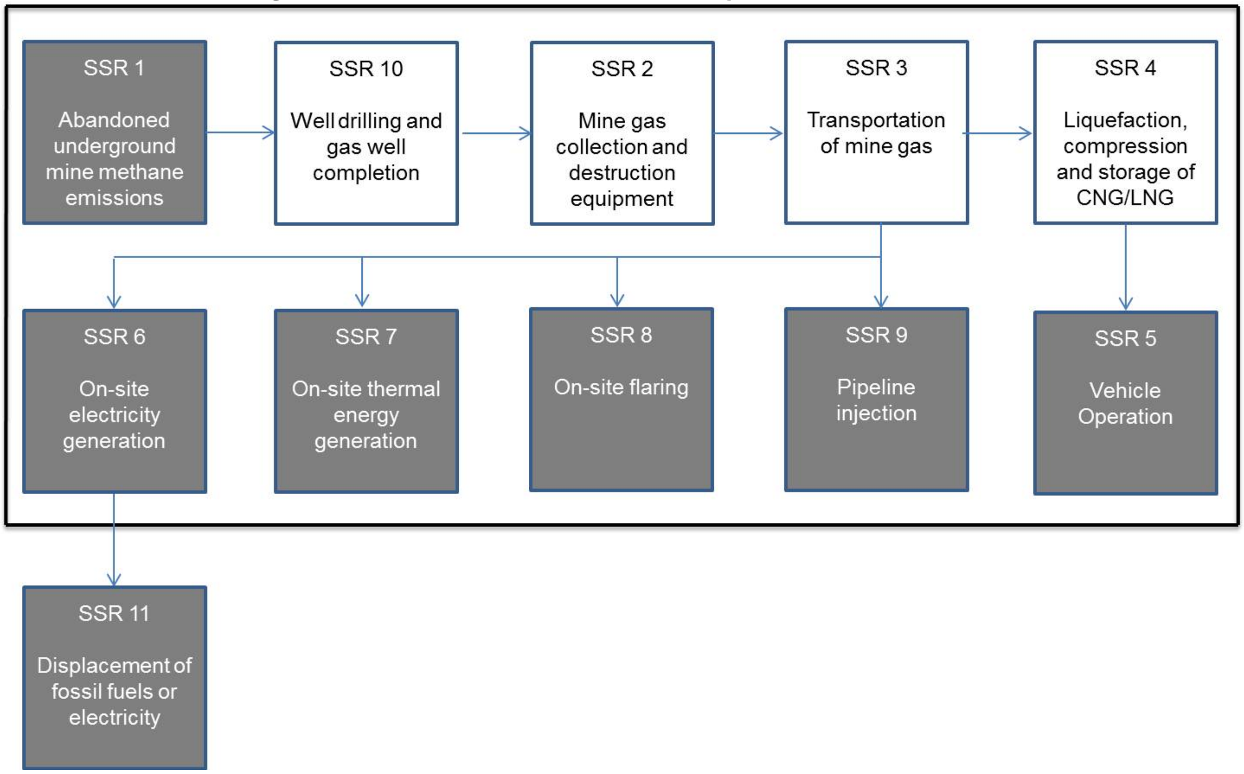
(a) Figure 4.4 illustrates the GHG assessment boundary for abandoned underground mine methane recovery activities, indicating which SSRs are included or excluded from the offset project boundary.

(1) All SSRs within the bold line are included and must be accounted for under this protocol.

(2) SSRs in shaded boxes are relevant to the baseline and project emissions.

(3) SSRs in unshaded boxes are relevant only to the project emissions.

Figure 4.4. Illustration of the greenhouse gas assessment boundary for abandoned underground mine methane recovery activities.



(b) Table 4.4 lists the SSRs for abandoned underground mine methane recovery activities, indicating which gases are included or excluded from the offset project boundary.

Table 4.4. List of the greenhouse gas sinks, sources, and reservoirs for abandoned underground mine methane recovery activities.

SSR	Description	GHG	Relevant to Baseline (B) or Project (P)	Included/ Excluded
1	Emissions of mine methane liberated after the conclusion of mining operations	CH_4	B, P	Included
2	Emissions resulting from energy consumed to operate equipment used to collect or treat drained mine gas	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded

	Fugitive emissions from operation of equipment used to collect or treat drained mine gas	CH_4	n/a	Excluded
3	Emissions resulting from energy consumed to transport mine gas to treatment or destruction equipment	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from the on-site transportation of mine gas	CH_4	n/a	Excluded
4	Emissions resulting from energy consumed to operate equipment used to liquefy, compress, or store methane for vehicle use.	CO_2	P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from operation of equipment used to liquefy, compress, or store methane for vehicle use	CH_4	n/a	Excluded
5	Emissions resulting from methane combustion during vehicle operation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during vehicle operation	CH_4	B, P	Included
6	Emissions resulting from methane combustion during on-site electricity generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included
7	Emissions resulting from methane combustion during on-site thermal energy generation	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during on-site electricity generation	CH_4	B, P	Included
8	Emissions resulting from methane combustion during on-site flaring	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from incomplete methane combustion during flaring	CH_4	B, P	Included
9	Emissions resulting from methane combustion resulting from pipeline injection	CO_2	B, P	Included
		N_2O	n/a	Excluded
	Emissions resulting from the incomplete methane combustion resulting from pipeline injection	CH_4	B, P	Included
10	Emissions from well drilling and well gas completion	CO_2	B, P	Included
		CH_4	n/a	Excluded
		N_2O	n/a	Excluded
	Fugitive emissions from well drilling and gas well completion	CH_4	n/a	Excluded
11	Emission reductions resulting	CO_2	n/a	Excluded

	from the displacement of fossil fuels or electricity	CH_4	n/a	Excluded
		N_2O	n/a	Excluded

Chapter 5. Quantifying GHG Emission Reductions – Quantification Methodology

(a) GHG emission reductions from an MMC project are quantified by comparing actual project emissions to project baseline emissions at the mine.

(b) Offset Project Operators and Authorized Project Designees must use the activity type-specific calculation methods provided in this protocol to determine baseline and project GHG emissions.

(c) GHG emission reductions must be quantified on at least an annual basis. The length of time over which GHG emission reductions are quantified is called the "reporting period."

(d) Measurements used to quantify emission reductions must be corrected to standard conditions of 60°F and 14.7 pounds per square inch (1 atm).

(e) Global warming potential values must be determined consistent with the definition of Carbon Dioxide Equivalent in MRR section 95102(a).

§ 5.1. Active Underground Mine Ventilation Air Methane Activities.

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) using Equation 5.1.

Equation 5.1: GHG Emission Reductions

$$ER = BE - PE$$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (tCO_2e)
BE	=	Baseline emissions during the reporting period (tCO_2e)
PE	=	Project emissions during the reporting period (tCO_2e)

§ 5.1.1. Quantifying Baseline Emissions

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in Table 4.1 and by using Equation 5.2.

Equation 5.2: Baseline Emissions		
$BE = BE_{MD} + BE_{MR}$		
Where,		
BE	=	Baseline emissions during the reporting period (tCO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)

(b) Baseline emissions from the destruction of methane (BE_{MD}) must be quantified using Equations 5.3 and 5.4.

(c) BE_{MD} must include the estimated CO_2 emissions from the destruction of VAM by non-qualifying devices.

(d) The volume or mass of VAM that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be the determined by calculating and comparing:

(1) The volume or mass of VAM sent to non-qualifying destruction devices during the reporting period, adjusted for temperature and pressure using Equation 5.11, if applicable; and

(2) The volume or mass of VAM sent to non-qualifying destruction devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using Equation 5.11, if applicable, and averaged according to the length of the reporting period.

(3) The volume or mass of VAM sent to non-qualifying devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using Equation 5.11, if applicable, and averaged according to the length of the reporting period.

(e) The largest of the three above quantities must be used for $VAM_{B,i}$ in Equation 5.4.

(f) If using a quantity from calculation (2) or (3) above and the project does not have data on the methane concentration of ventilation air in ventilation air exhaust to use in Equations 5.15, the highest single-hour average concentration of ventilation air in ventilation air exhaust during the reporting period must be used in its place.

(g) If using a quantity from calculation (2) or (3) above and the project does not have data on the methane concentration of ventilation air sent to destruction device to use in Equations 5.16, the highest single-hour average methane concentration of ventilation air sent to destruction device must be used in its place.

(h) For the purpose of baseline quantification, only non-qualifying devices that were operating during the year prior to offset project commencement should be taken into account.

(i) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.3: Baseline Emissions from Destruction of Methane

$$BE_{MD} = \sum_{i} MD_{B,i} \times CEF_{CH4}$$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
i	=	Use of methane (oxidation or alternative combustion end use)
$MD_{B,i}$	=	Methane that would be destroyed through use i by non qualifying devices during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

Equation 5.4: Methane Destroyed in Baseline

$$MD_{B,i} = \sum_{i} (VAM_{B,i} \times C_{CH4} \times 0.0423 \times 0.000454 - BE_{NO})$$

Where,

$VAM_{B,i}$	=	Volume of VAM that would have been sent to a non-qualifying device for destruction through use i during the reporting period in the baseline scenario (scf)
C_{CH4}	=	Weighted average of measured methane concentration of captured ventilation air sent to non-qualifying devices; calculated separately for each device (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

BE_{NO} = Baseline emissions of non-oxidized methane that would be emitted from oxidation of the VAM stream during the reporting period (tCH_4)

With:

$$C_{CH4} = \frac{\sum_t VAM_{flow,t} \times C_{CH4,t}}{\sum_t VAM_{flow,t}}$$

Where,

$C_{CH4,t}$ = Hourly average methane concentration of ventilation air sent to destruction device (scf CH_4/scf)

$VAM_{flow,t}$ = Hourly average flow of ventilation air sent to destruction device (scf/hour)

And:

$BE_{NO} = VAM_{FLOW,y} \times TIME_y \times C_{CH4,exhaust} \times 0.0423 \times 0.000454$

Where,

$VAM_{FLOW,y}$ = Corrected average flow rate or total volume of ventilation air that would be entering the non qualifying destruction device during period y, adjusted to 60°F and 1 atm (scf/unit of time)

$TIME_y$ = Time during which non qualifying destruction device would be operational during period y (m)

$C_{CH4,exhaust}$ = Weighted average of measured methane concentration in the ventilation air exhaust (scf CH_4/scf)

With:

$$C_{CH4,exhaust} = \frac{\sum_t VAM_{flow,t} \times C_{CH4,exhaust,t}}{\sum_t VAM_{flow,t}}$$

Where,

$C_{CH4,exhaust,t}$ = Hourly average methane concentration of ventilation air in ventilation air exhaust (scf CH_4/scf)

$VAM_{flow,t}$ = Hourly average flow of ventilation air sent to destruction device (scf /hour)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(j) Baseline emissions from the release of methane (BE_{MR}) must be quantified using Equation 5.5.

(k) BE_{MR} must account for the total amount of methane actually destroyed by all qualifying and non-qualifying devices.

(l) VAM project activities may supplement VAM with mine gas (MG) extracted from a methane drainage system to either increase or help balance the concentration of methane flowing into the destruction device. If MG is used to supplement VAM, the MG destructed by the project during the reporting period must be accounted for using Equation 5.5 either as $MG_{SUPP,i,}$ if VAM flow and mine methane flow are monitored separately, or through $VAM_{P,i}$ if only the resulting enriched flow is monitored.

(m) Methane that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions since it is vented in both scenarios.

Equation 5.5: Baseline Emissions from Release of Methane

$$BE_{MR} = \sum_i [(VAM_{P,i} \times C_{CH4} - VAM_{B,i} \times C_{CH4}) + MG_{SUPP,i} \times C_{CH4MG}] \times 0.0423 \times 0.000454 \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)
i	=	Use of methane (oxidation or alternative combustion end use)
$VAM_{P,i}$	=	Volume of ventilation air sent to qualifying and non-qualifying devices for destruction through use i during the project during the reporting period (scf)
$VAM_{B,i}$	=	Volume of ventilation air that would have sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
C_{CH4}	=	Weighted average of measured methane concentration of captured ventilation air sent to qualifying and non-qualifying devices; calculated separately for each device (scf CH_4/scf)

$MG_{SUPP,i}$	=	Volume of mine methane extracted from a methane drainage system and sent to qualifying and non-qualifying devices for destruction with VAM (scf)
C_{CH4MG}	=	Weighted average of measured methane concentration of captured mine gas (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4
GWP_{CH4}	=	Global warming potential of methane (tCO_2e/tCH_4)

With:

$$C_{CH4} = \frac{\sum_t VAM_{flow,t} \times C_{CH4,t}}{\sum_t VAM_{flow,t}}$$

Where,

$C_{CH4,t}$	=	Hourly average methane concentration of ventilation air sent to destruction device (scf CH_4/scf)
$VAM_{flow,t}$	=	Hourly average flow of ventilation air sent to destruction device (scf /hour)

And:

$$C_{CH4MG} = \frac{\sum_t DV_{MG,t} \times C_{CH4,MG,t}}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,\ MG,t}$	=	Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)
$DV_{MG,t}$	=	Daily volume of mine gas sent with ventilation air to destruction device (scf /day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

§ 5.1.2. Quantifying Project Emissions.

(a) Project emissions must be quantified on an annual basis.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in Table 4.1 and using Equation 5.6.

(c) Methane that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions since it is vented in both scenarios.

Equation 5.6: Project Emissions

$PE = PE_{EC} + PE_{MD} + PE_{UM}$

Where,

PE	=	Project emissions during the reporting period (tCO_2e)
PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)
PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)
PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (tCO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities, the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using Equation 5.7.

Equation 5.7: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF,})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)
$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from Appendix A (tCO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{HEAT}	=	CO_2 emission factor of heat used from Appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from Appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(e) Project emissions from the destruction of methane (PE_{MD}) must be quantified using Equations 5.8 and 5.9.

(f) PE_{MD} must include the estimated CO_2 emissions from the destruction of VAM by all qualifying and non-qualifying devices.

(g) If MG is used to supplement VAM, the MG destructed by the project during the reporting period must be accounted for using Equation 5.9 either as $MG_{SUPP,i}$, if VAM flow and mine methane flow are monitored separately, or through $VAM_{P,i}$ if only the resulting enriched flow is monitored.

Equation 5.8: Project Emissions from Destruction of Methane

$$PE_{MD} = \sum_{i} MD_{P,i} \times CEF_{CH4}$$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)
i	=	Use of methane (oxidation or alternative combustion end use) by all qualifying and non-qualifying devices
$MD_{P,i}$	=	Methane destroyed by use i during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

Equation 5.9: Methane Destroyed

$$MD_{P,i} = \sum_{i} MM_{P,i} - PE_{NO}$$

Where,

$MD_{P,i}$	=	Methane destroyed by use i during the reporting period (tCH_4)
i	=	Use of methane (oxidation or alternative combustion end use) by all qualifying and non-qualifying devices
$MM_{P,i}$	=	Mine methane sent to qualifying and non-qualifying destruction devices for destruction through use i during the reporting period corrected to standard conditions, if applicable, for pressure and temperature (tCH_4)
PE_{NO}	=	Project emissions of non-oxidized methane from oxidation of the VAM stream during the reporting period (tCH_4)

With:

$$MM_{P,i} = (VAM_{P,i} \times C_{CH4} + MG_{SUPP,i} \times C_{CH4MG}) \times 0.0423 \times 0.000454$$

Where,

$VAM_{P,i}$ = Volume of ventilation air sent to qualifying and non-qualifying devices for destruction through use i during the project during the reporting period (scf)

C_{CH4} = Weighted average of measured methane concentration of captured ventilation air sent to qualifying and non-qualifying devices; calculated separately for each device (scf CH_4/scf)

$MG_{SUPP,i}$ = Volume of mine methane extracted from a methane drainage system and sent to destruction device with VAM (scf)

C_{CH4MG} = Weighted average of measured methane concentration of captured mine gas (scf CH_4/scf)

0.0423 = Density of methane (lb CH_4/scf CH_4)

0.000454 = tCH_4/lb CH_4

With:

$VAM_{P,i} = VAM_{FLOW,y} \times TIME_y$

Where,

$VAM_{FLOW,y}$ = Average flow rate of ventilation air entering the destruction device during period y corrected to standard conditions, if applicable, for inlet flow gas pressure and temperature (scfm)

$TIME_y$ = Time during which destruction device is operational during period y (m)

And:

$$C_{CH4} = \frac{\sum_t VAM_{flow,t} \times C_{CH4,t}}{\sum_t VAM_{flow,t}}$$

Where,

$C_{CH4,t}$ = Hourly average methane concentration of ventilation air sent to destruction device (scf CH_4/scf)

$VAM_{flow,t}$ = Hourly average flow of ventilation air sent to destruction device (scf/hour)

And:

$$C_{CH4MG} = \frac{\sum_t DV_{MG,t} \times C_{CH4,MG,t}}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$	=	Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)
$DV_{MG,t}$	=	Daily volume of mine gas sent with ventilation air to destruction device (scf/day)

And:

$PE_{NO} = VAM_{FLOW,y} \times TIME_y \times C_{CH4,exhaust} \times 0.0423 \times 0.000454$

Where,

$C_{CH4,exhaust}$	=	Weighted average of measured methane concentration in the ventilation air exhaust (scf CH_4/scf)

With:

$$C_{CH4,exhaust} = \frac{\sum_t VAM_{flow,t} \times C_{CH4,exhaust,t}}{\sum_t VAM_{flow,t}}$$

Where,

$C_{CH4,exhaust,t}$	=	Hourly average methane concentration of ventilation air in ventilation air exhaust (scf CH_4/scf)
$VAM_{flow,t}$	=	Hourly average flow of ventilation air exhaust sent to destruction device (scf /hour)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(h) Project emissions from uncombusted methane (PE_{UM}) must be quantified using Equation 5.10.

Equation 5.10: Uncombusted Methane Emissions

$PE_{UM} = PE_{NO} \times GWP_{CH4}$

Where,

PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (tCO_2e)
PE_{NO}	=	Project emissions of non-oxidized methane from oxidation of the VAM stream during the reporting period (tCH_4)

GWP_{CH4}	=	Global warming potential of methane (tCO_2e/tCH_4)

With,

$PE_{NO} = VAM_{FLOW,y}$ x $TIME_y$ x $C_{CH4,exhaust}$ x 0.0423 x 0.000454

Where,

$VAM_{FLOW,y}$	=	Corrected average flow rate or total volume of ventilation air entering the destruction device during period y, adjusted to 60°F and 1 atm (scf/unit of time)
$TIME_y$	=	Time during which destruction device is operational during period y (m)
$C_{CH4,exhaust}$	=	Weighted average of measured methane concentration in the ventilation air exhaust (scf CH_4/scf)

With:

$$C_{CH4,exhaust} = \frac{\sum_t VAM_{flow,t} \times C_{CH4,exhaust,t}}{\sum_t VAM_{flow,t}}$$

Where,

$C_{CH4,exhaust,t}$	=	Hourly average methane concentration of ventilation air in ventilation air exhaust (scf CH_4/scf)
$VAM_{flow,t}$	=	Hourly average flow of ventilation air exhaust sent to destruction device (scf /hour)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(i) If gas flow metering equipment does not internally correct for temperature and pressure, apply Equation 5.11 to the flow rate of ventilation air entering the destruction device.

Equation 5.11: VAM Corrected for Temperature and Pressure

$$VAM_{FLOW,y} = VAM_{FLOWmeas,y} \times \frac{520}{T_{VAMinflow,y}} \times \frac{P_{VAMinflow,y}}{1}$$

Where,

$VAM_{FLOW,y}$	=	Corrected average flow rate or total volume of ventilation air entering the destruction device during period y, adjusted to 60°F and 1 atm (scf/unit of time)
$VAM_{FLOWmeas,y}$	=	Measured average flow rate or total volume of ventilation air entering the destruction device as measured during period y (scf/unit of time)
$T_{VAMinflow,y}$	=	Measured temperature of ventilation air entering the destruction device for the time interval y, °R=°F+460 (°R)
$P_{VAMinflow,y}$	=	Measured pressure of ventilation air entering the destruction device for the time interval y (atm)

§ 5.2. Active Underground Mine Methane Drainage Activities.

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) using Equation 5.12.

(b) If a mine that has historically sent mine methane (MM) to a natural gas pipeline ceases to do so, MM from that source (pre-mining surface wells, pre-mining in-mine boreholes, or post-mining gob wells) is ineligible for emission reduction under this protocol, even if the MM is sent to an otherwise eligible destruction device. If a mine begins to inject MM into a natural gas pipeline while the offset project is ongoing, MM from that source is ineligible for emission reductions going forward.

(c) MM that is injected into a natural gas pipeline in the project scenario is not accounted for in the project emissions or baseline emissions, since it is injected in both scenarios.

Equation 5.12: GHG Emission Reductions

$$ER = BE - PE$$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (tCO_2e)
BE	=	Baseline emissions during the reporting period (tCO_2e)
PE	=	Project emissions during the reporting period (tCO_2e)

§ 5.2.1. Quantifying Baseline Emissions.

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in Table 4.2 and using Equation 5.13.

Equation 5.13: Baseline Emissions

$$BE = BE_{MD} + BE_{MR}$$

Where,

BE	=	Baseline emissions during the reporting period (tCO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)

(b) Baseline emissions from the destruction of MM (BE_{MD}) must be quantified using Equations 5.14 and 5.15.

(c) BE_{MD} must include the estimated CO_2 emissions from the destruction of MM in non-qualifying devices.

(d) Mine gas (MG) can originate from three distinct sources for active underground mine methane drainage activities: pre-mining surface wells, pre-mining in-mine boreholes, and post-mining gob wells. MG from these sources must be measured and accounted for individually per the equations in this section.

(e) For each eligible methane source, the volume or mass of MG that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be the determined by calculating and comparing:

(1) The volume or mass of MG sent to non-qualifying devices during the reporting period, adjusted for temperature and pressure using Equation 5.23, if applicable; and

(2) The volume or mass of MG sent to non-qualifying devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using Equation 5.23, if applicable, and averaged according to the length of the reporting period.

(3) The volume or mass of MG sent to non-qualifying devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using Equation 5.23, if applicable, and averaged according to the length of the reporting period.

(f) For each methane source, the largest of the three above quantities must be used in Equation 5.15.

(g) If using a quantity from calculation (2) or (3) above and the project does not have data on the concentration of the methane to use in Equations 5.15 and 5.16, the highest single-day average methane concentration measured for that methane source during the reporting period must be used in its place.

(h) For the purpose of baseline quantification, only non-qualifying devices that were operating during the year prior to offset project commencement should be taken into account.

(i) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.14: Baseline Emissions from Destruction of Methane

$$BE_{MD} = \sum_i MD_{B,i} \times CEF_{CH4}$$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.)
$MD_{B,i}$	=	Methane that would be destroyed through use i by non qualifying devices during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

Equation 5.15: Methane Destroyed in Baseline

$$MD_{B,i} = \sum_i MM_{B,i} \times DE_i$$

Where,

$MD_{B,i}$	=	Methane that would be destroyed through use i by non qualifying devices during the reporting period (tCH_4)

i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying devices
$MM_{B,i}$	=	Methane that would have been sent to non-qualifying devices for destruction through use i during the reporting period; calculated separately for each device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)

With:

$$MM_{B,i} = \sum_i (PSW_{B,i} \text{ x } C_{CH4} + PIB_{B,i} \text{ x } C_{CH4} + ECW_{B,i} \text{ x } C_{CH4} + AWR_{B,i} \text{ x } C_{CH4} + \text{CDW}_{B,i} \text{ x } C_{CH4}) \text{ x } 0.0423 \text{ x } 0.000454$$

Where,

$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$PGW_{B,i}$	=	Volume of MG from post-mining gob wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)

DV_t	=	Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(j) Baseline emissions from the release of methane (BE_{MR}) must be quantified using Equation 5.16.

(k) BE_{MR} must account for the total amount of methane actually destroyed by all qualifying and non-qualifying devices.

(l) Emissions from the release of methane through pre-mining surface wells are only accounted for in the baseline during the reporting period(s) in which the emissions would have occurred (i.e. when the well is mined through). For the purposes of this protocol, a well at an active underground mine is considered mined through when any of the following occur:

(1) The working face intersects the borehole, as long as the endpoint of the borehole is not more than 50 meters below the mined coal seam;

(2) The working face passes directly underneath the bottom of the borehole, as long as the endpoint of the borehole is not more than 150 meters above the mined coal seam;

(3) The working face passes both underneath (not more than 150 meters below the endpoint of the borehole) and to the side of the borehole if room and pillar mining technique is employed and the endpoint of the borehole lies above a block of coal that will be left unmined as a pillar; or

(4) The well produces elevated amounts of atmospheric gases (the percent concentration of nitrogen in mine gas increases by five compared to baseline levels). A full gas analysis using a gas chromatograph must be completed by an ISO 17025 accredited lab. To ensure that elevated nitrogen levels are the result of a well being mined through and not the result of a leak in the well, the gas analysis must show that oxygen levels did not increase by the same proportion as the nitrogen levels.

(m) If using option 1, 2, or 3 to demonstrate that a well is mined through, an up-to-date mine plan must be used to identify which wells were mined through, based on the above criteria, and therefore eligible for baseline quantification in any given reporting period.

(n) If the mine plan calls for mining past rather than through a borehole, MM from that borehole is eligible for quantification in the baseline when the linear distance between the endpoint of the borehole and the working face that will pass nearest the endpoint of the borehole has reached an absolute minimum.

(o) If an MMC project at an active underground mine consists of both VAM and methane drainage activities, mine gas extracted from a methane drainage system (MG) may be used to supplement VAM to either increase or help balance the concentration of methane flowing into the destruction device. If MG is used to supplement VAM, the MG destructed by the project during the reporting period must be accounted for using Equation 5.16 as $MG_{SUPP,i,}$.

(p) MM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.16: Baseline Emissions from Release of Methane

$$BE_{MR} = \sum_{i} [(PSW_{P,i} \times C_{CH4} - PSW_{B,i,} \times C_{CH4\ i}) + (PIB_{P,i} \times C_{CH4} - PIB_{B,i} \times C_{CH4}) + (PGW_{P,i} \times C_{CH4} - PGW_{B,i} \times C_{CH4}) - MG_{SUPP,i} \times C_{CH4MG}] \times 0.0423 \times 0.000454 \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, etc.) by all qualifying and non-qualifying devices
$PSW_{P,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.17 in accordance with sections 5.2.1(k), (l) and (m) must be quantified (scf)
$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)

$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$PGW_{P,i}$	=	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{B,i}$	=	Volume of MG from post-mining gob wells that would have been sent to non-qualifying device for destruction through use i during the reporting period in the baseline scenario (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
$MG_{SUPP,i}$	=	Volume of mine methane extracted from a methane drainage system and sent to qualifying and non-qualifying devices for combustion with VAM (scf)
C_{CH4MG}	=	Weighted average of measured methane concentration of captured mine gas sent with ventilation air methane to destruction device (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4
GWP_{CH4}	=	Global warming potential of methane (tCO_2e/tCH_4)

With,

$PSW_{P,i} = PSWe_i + PSWnqd_i$

Where,

$PSWe_i$	=	Volume of MG from pre-mining surface wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period. Quantified using Equation 5.17. (scf)
$PSWnqd_i$	=	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device (scf/day)

And:

$$C_{CH4MG} = \frac{\sum_t DV_{MG,t} \times C_{CH4,MG,t}}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$	=	Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)
$DV_{MG,t}$	=	Daily volume of mine gas sent with ventilation air to destruction device (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(q) The eligible amount of MG from pre-mining surface wells destroyed by qualifying devices ($PSWe_i$) must be determined by using Equation 5.17.

Equation 5.17: Eligible MG from Pre-mining Surface Boreholes

$PSWe_i = PSWe_{pre,i} + PSWe_{post,i}$

Where,

$PSWe_i$	=	Volume of MG from pre-mining surface wells captured and destroyed by qualifying devices through use i that is eligible for quantification in the reporting period using Equation 5.16 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, etc.) by all qualifying devices
$PSWe_{pre,i}$	=	Volume of MG destroyed by qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from pre-mining surface wells that were mined through during the current reporting period (scf)
$PSWe_{post,i}$	=	Volume of MG destroyed by qualifying destruction devices in the current reporting period captured from pre-mining surface wells that were mined through during earlier reporting periods (scf)

§ 5.2.2. Quantifying Project Emissions.

(a) Project emissions must be quantified on an annual basis.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in Table 4.2 and using Equation 5.18.

(c) Methane that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions since it is vented in both scenarios.

Equation 5.18: Project Emissions

$$PE = PE_{EC} + PE_{MD} + PE_{UM}$$

Where,

PE	=	Project emissions during the reporting period (tCO_2e)
PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)
PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)
PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (tCO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities, the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using Equation 5.19.

(e) If the total electricity generated by project activities is greater than the additional electricity consumed for the capture and destruction of methane, then the $CONS_{ELEC}$ term may be omitted from Equation 5.19.

Equation 5.19: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)
$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from Appendix A (tCO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)

CEF_{HEAT}	=	CO_2 emission factor of heat used from Appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from Appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(f) Project emissions from the destruction of methane (PE_{MD}) must be quantified using Equations 5.20 and 5.21.

(g) Project emissions must include the CO_2 emissions resulting from the destruction of all MM from pre-mining surface wells that took place during the reporting period regardless of whether or not the well is mined through by the end of the reporting period.

Equation 5.20: Project Emissions from Destruction of Captured Methane

$$PE_{MD} = \sum_{i} MD_{P,i} \times CEF_{CH4}$$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, etc.) by all qualifying and non-qualifying devices
$MD_{P,i}$	=	Methane destroyed by use i during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

(h) The amount of mine methane destroyed (MD_i) must be quantified using Equation 5.21.

(i) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in Appendix B or site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.21: Methane Destroyed

$$MD_{P,i} = \sum_{i} MM_{P,i} \times DE_{i}$$

Where,		
$MD_{P,i}$	=	Methane destroyed by use i during the reporting period (tCH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, etc.) by all qualifying and non-qualifying devices
$MM_{P,i}$	=	Methane measured sent to qualifying and non-qualifying devices for destruction through use i during the reporting period corrected to standard conditions, if applicable, for pressure and temperature; calculated separately for each device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)

With:

$$MM_{P,i} = \sum_i (PSW_{P,all,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} - MG_{SUPP,i} \times C_{CH4MG}) \times 0.0423 \times 0.000454$$

Where,		
$PSW_{P,all,i}$	=	Volume of MG from pre-mining surface wells captured and destroyed by qualifying and non-qualifying devices through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not must be quantified (scf)
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes captured and destroyed by qualifying and non-qualifying devices through use i during the reporting period (scf)
$PGW_{P,i}$	=	Volume of MG from post-mining gob wells captured and destroyed by qualifying and non-qualifying devices through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
$MG_{SUPP,i}$	=	Volume of mine methane extracted from a methane drainage system and combusted with VAM (scf)
C_{CH4MG}	=	Weighted average of measured methane concentration of captured mine gas sent with ventilation air to destruction device (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

And:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane sourc (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device (scf/day)

And:

$$C_{CH4MG} = \frac{\sum_t DV_{MG,t} \times C_{CH4,MG,t}}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$	=	Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)
$DV_{MG,t}$	=	Daily volume of mine gas sent with ventilation air to destruction device (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(j) Project emissions from uncombusted methane (PE_{UM}) must be quantified using Equation 5.22.

(k) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in Appendix B or site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.22: Uncombusted Methane Emissions

$$PE_{UM} = \sum_i MM_{P,i} \times (1 - DE_i) \times GWP_{CH4}$$

Where,

PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, etc.) by all qualifying and non-qualifying devices

$MM_{P,i}$	=	Methane measured sent to use i during the reporting period; calculated separately for each destruction device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)
GWP_{CH4}	=	Global warming potential of methane (tCO_2e/tCH_4)

With:

$$MM_{P,i} = \sum_i (PSW_{P,all,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} - MG_{SUPP,i} \times C_{CH4MG}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{P,all,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not must be quantified (scf)
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{P,i}$	=	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
$MG_{SUPP,i}$	=	Volume of mine methane extracted from a methane drainage system and sent to destruction device with VAM(scf)
C_{CH4MG}	=	Weighted average of measured methane concentration of captured mine gas sent with ventilation air for destruction (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

And:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane sourc (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device (scf/day)

And:

$$C_{CH4MG} = \frac{\sum_t DV_{MG,t} \times C_{CH4,MG,t}}{\sum_t DV_{MG,t}}$$

Where,

$C_{CH4,MG,t}$	=	Daily average methane concentration of mine gas sent with ventilation air to destruction device (scf CH_4/scf)
$DV_{MG,t}$	=	Daily volume of mine gas sent with ventilation air to destruction device (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(l) If gas flow metering equipment does not internally correct for temperature and pressure, use Equation 5.23 to determine the amount of mine gas sent to each qualifying and non-qualifying device during the reporting period.

Equation 5.23: MG Corrected for Temperature and Pressure

$$MG_{corrected,i,y} = MG_{meas,i,y} \times \frac{520}{T_{MG,y}} \times \frac{P_{MG,y}}{1}$$

Where,

$MG_{corrected,i,y}$	=	Corrected flow rate or total volume of MG collected for the time interval y at utilization type i, adjusted to 60°F and 1 atm (scf/unit of time)
$MG_{meas,i,y}$	=	Measured flow rate or total volume of MG collected for the time interval y at utilization type i (scf/unit of time)
$T_{MG,y}$	=	Measured temperature of the MG for the time interval y, °R=°F+460 (°R)
$P_{MG,y}$	=	Measured pressure of the MG for the time interval y (atm)

§ 5.3. Active Surface Mine Methane Drainage Activities.

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) using Equation 5.24.

Equation 5.24: GHG Emission Reductions

$ER = BE - PE$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (tCO_2e)
BE	=	Baseline emissions during the reporting period (tCO_2e)
PE	=	Project emissions during the reporting period (tCO_2e)

§ 5.3.1. Quantifying Baseline Emissions.

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in Table 4.3 and using Equation 5.25.

Equation 5.25: Baseline Emissions

$$BE = BE_{MD} + BE_{MR}$$

Where,

BE	=	Baseline emissions during the reporting period (tCO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)

(b) Baseline emissions from the destruction of SMM (BE_{MD}) must be quantified using Equations 5.26 and 5.27.

(c) BE_{MD} must include the estimated CO_2 emissions from the destruction of SMM in non-qualifying devices.

(d) Mine gas (MG) can originate from five distinct sources for active surface mine methane drainage activities: pre-mining surface wells, pre-mining in-mine boreholes, existing coal bed methane (CBM) wells that would otherwise be shut-in and abandoned as a result of encroaching mining, abandoned wells that are re-activated, and converted dewatering wells. MG from these sources must be measured and accounted for individually per the equations in this section.

(e) For each eligible methane source, the volume or mass of MG that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be the determined by calculating and comparing:

(1) The volume or mass of MG sent to non-qualifying destruction devices during the reporting period, adjusted for temperature and pressure using Equation 5.38, if applicable; and

(2) The volume or mass of MG sent to non-qualifying destruction devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using Equation 5.38, if applicable and averaged according to the length of the reporting period.

(3) The volume or mass of MG sent to non-qualifying devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted for temperature and pressure using Equation 5.38, if applicable, and averaged according to the length of the reporting period.

(f) For each methane source, the largest of the three above quantities must be used in Equation 5.27.

(g) If using a quantity from calculation (2) or (3) above and the project does not have data on the concentration of the methane to use in Equations 5.27 and 5.28, the highest single-day average methane concentration measured for that methane source during the reporting period must be used in its place.

(h) For the purpose of baseline quantification, only non-qualifying devices that were operating during the year prior to offset project commencement should be taken into account.

(i) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.26: Baseline Emissions from Destruction of Methane

$$BE_{MD} = \sum_{i} MD_{B,i} \times CEF_{CH4}$$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.)
$MD_{B,i}$	=	Methane that would be destroyed through use i by non qualifying devices during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

Equation 5.27: Methane Destroyed in Baseline

$$MD_{B,i} = \sum_{i} MM_{B,i} \times DE_i$$

Where,

$MD_{B,i}$	=	Methane that would be destroyed through use i by non qualifying devices during the reporting period (tCH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying devices
$MM_{B,i}$	=	Methane that would have been sent to non qualifying devices for destruction through use i during the reporting period; calculated separately for each device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)

With:

$$MM_{B,i} = \sum_{i} (PSW_{B,i} \times C_{CH4} + PIB_{B,i} \times C_{CH\,4} + ECW_{B,i} \times C_{CH4} + AWR_{B,i} \times C_{CH4} + \mathrm{CDW}_{B,i} \times C_{CH4}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$ECW_{B,i}$	=	Volume of MG from existing coalbed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$AWR_{B,i}$	=	Volume of MG from abandoned wells that are reactivated that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)

$CDW_{B,i}$	=	Volume of MG from converted dewatering wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
C_{CH4}	=	Measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(j) Baseline emissions from the release of methane (BE_{MR}) must be quantified using Equation 5.28.

(k) BE_{MR} must account for the total amount of methane actually destroyed by all qualifying and non-qualifying devices.

(l) Emissions from the release of methane are only accounted for in the baseline during the reporting period(s) in which the emissions would have occurred (i.e., when the well is mined through). With the exception of pre-mining in-mine boreholes, all other methane sources must demonstrate that the well is mined through. For the purposes of this protocol, a well at an active surface mine is considered mined through when either of the following occurs:

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

(2) The well produces elevated amounts of atmospheric gases (the percent concentration of nitrogen in mine gas increases by five compared to baseline levels). A full gas analysis using a gas chromatograph must be completed by an ISO 17025 accredited lab. To ensure that elevated nitrogen levels are the result of a well being mined through and not the result of a leak in the well, the gas analysis must show that oxygen levels did not increase by the same proportion as the nitrogen levels.

(m) If using the first option to demonstrate that a well is mined through, an up-to-date mine plan must be used to identify which wells were mined through and therefore eligible for baseline quantification in any given reporting period.

(n) If the mine plan calls for mining past rather than through a borehole, SMM from that borehole is eligible for quantification in the baseline when the linear distance between the endpoint of the borehole and the working face that will pass nearest the endpoint of the borehole has reached an absolute minimum.

(o) SMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.28: Baseline Emissions from Release of Methane

$$BE_{MR} = \sum_i [(PSW_{P,i} \times C_{CH4} - PSW_{B,i} \times C_{CH4}) + (PIB_{P,i} \times C_{CH4} - PIB_{B,i} \times C_{CH4}) + (ECW_{P,i} \times C_{CH4} - ECW_{B,i} \times C_{CH4}) + (AWR_{P,i} \times C_{CH4} - AWR_{B,i} \times C_{CH4}) + (CDW_{P,i} \times C_{CH4} - CDW_{B,i} \times C_{CH4})] \times 0.0423 \times 0.000454 \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying devices
$PSW_{P,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.29 in accordance with sections 5.3.1(k), (l), and (m) must be quantified (scf)
$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)

$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$ECW_{P,i}$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.30 in accordance with sections 5.3.1(k), (l), and (m) must be quantified (scf)
$ECW_{B,i}$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$AWR_{P,i}$	=	Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.31 in accordance with sections 5.3.1(k), (l), and (m) must be quantified (scf)
$AWR_{B,i}$	=	Volume of MG from abandoned wells that are reactivated that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
$CDW_{P,i}$	=	Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.32 in accordance with sections 5.3.1(k), (l), and (m) must be quantified (scf)
$CDW_{B,i}$	=	Volume of MG from converted dewatering wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4
GWP_{CH4}	=	Global warming potential of methane (tCO_2e/tCH_4)

With,

$PSW_{P,i} = PSWe_i + PSWnqd_i$

Where,

$PSWe_i$	=	Volume of MG from pre-mining surface wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period. Quantified using Equation 5.29. (scf)
$PSWnqd_i$	=	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And,

$ECW_{P,i} = ECWe_i + ECWnqd_i$

Where,

$ECWe_i$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period. Quantified using Equation 5.30. (scf)
$ECWnqd_i$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And,

$AWR_{P,i} = AWRe_i + AWRnqd_i$

Where,

$AWRe_i$	=	Volume of MG from abandoned wells that are reactivated sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period. Quantified using Equation 5.31. (scf)
$AWRnqd_i$	=	Volume of MG from abandoned wells that are reactivated sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And,

$CDW_{P,i} = CDWe_i + CDWnqd_i$

Where,

$CDWe_i$	=	Volume of MG from converted dewatering wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period. Quantified using Equation 5.32. (scf)
$CDWnqd_i$	=	Volume of MG from converted dewatering wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)

And:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(p) The eligible amount of MG destroyed by qualifying devices must be determined by using Equations 5.29, 5.30, 5.31 and 5.32.

Equation 5.29: Eligible MG from Pre-mining Surface Wells

$PSWe_i = PSWe_{pre,i} + PSWe_{post,i}$

Where,

$PSWe_i$	=	Volume of MG from pre-mining surface wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period using Equation 5.28 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying devices
$PSWe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from pre-mining surface wells that were mined through during the current reporting period (scf)
$PSWe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the current reporting period captured from pre-mining surface wells that were mined through during earlier reporting periods (scf)

Equation 5.30: Eligible MG from Existing Coal Bed Methane Wells that Would Otherwise Be Shut-in and Abandoned as a Result of Encroaching Mining

$ECWe_i = ECWe_{pre,i} + ECWe_{post,i}$

Where,

$ECWe_i$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period using Equation 5.28 (scf)

i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying devices
$ECWe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during the current reporting period (scf)
$ECWe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the current reporting period captured from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during earlier reporting periods (scf)

Equation 5.31: Eligible MG from Abandoned Wells that are Reactivated

$$AWRe_i = AWEe_{pre,i} + AWRe_{post,i}$$

Where,

$AWRe_i$	=	Volume of MG from abandoned wells that are reactivated sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period using Equation 5.28 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying devices
$AWRe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from abandoned wells that are reactivated that were mined through during the current reporting period (scf)
$AWRe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the current reporting period captured from abandoned wells that are reactivated that were mined through during earlier reporting periods (scf)

Equation 5.32: Eligible MG from Converted Dewatering Wells that are Reactivated

$$CDWe_i = CDWe_{pre,i} + CDWe_{post,i}$$

Where,

$CDWe_i$	=	Volume of MG from converted dewatering wells sent to qualifying devices for destruction through use i that is eligible for quantification in the reporting period using Equation 5.28 (scf)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying devices
$CDWe_{pre,i}$	=	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from converted dewatering wells that were mined through during the current reporting period (scf)

$CDWe_{post,i}$	=	Volume of MG sent to qualifying destruction devices in the current reporting period captured from converted dewatering wells that were mined through during earlier reporting periods (scf)

§ 5.3.2 Quantifying Project Emissions.

(a) Project emissions must be quantified on an annual basis.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in Table 4.3 and using Equation 5.33.

(c) SMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.33: Project Emissions

$$PE = PE_{EC} + PE_{MD} + PE_{UM}$$

Where,

PE	=	Project emissions during the reporting period (tCO_2e)
PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)
PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)
PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (tCO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities, the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using Equation 5.34.

(e) If the total electricity generated by project activities is greater than the additional electricity consumed for the capture and destruction of methane, then the $CONS_{ELEC}$ term may be omitted from Equation 5.34.

Equation 5.34: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)

$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from Appendix A (tCO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{HEAT}	=	CO_2 emission factor of heat used from Appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from Appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(f) Project emissions from the destruction of methane (PE_{MD}) must be quantified using Equations 5.35 and 5.36.

(g) Project emissions must include the CO_2 emissions resulting from the destruction of SMM that took place during the reporting period regardless of whether or not the well is mined through by the end of the reporting period.

Equation 5.35: Project Emissions from Destruction of SMM

$$PE_{MD} = \sum_{i} MD_{P,i} \times CEF_{CH4}$$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying devices
$MD_{P,i}$	=	Methane destroyed by use i during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

(h) The amount of mine methane destroyed (MD_i) must be quantified using Equation 5.36.

(i) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in Appendix B or site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.36: Methane Destroyed

$$MD_{P,i} = \sum_i MM_{P,i} \times DE_i$$

Where,

$MD_{P,i}$	=	Methane destroyed by use i during the reporting period (tCH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying devices
$MM_{P,i}$	=	Methane measured sent to qualifying and non-qualifying devices for destruction through use i during the reporting period corrected to standard conditions, if applicable, for pressure and temperature; calculated separately for each device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)

With:

$$MM_{P,i} = \sum_i (PSW_{P,all,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + ECW_{P,all,i} \times C_{CH4} + AWR_{P,all,i} \times C_{CH4} \times CDW_{P,all,i,} \times C_{CH4}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{P,all,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$ECW_{P,all,i}$	=	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)
$AWR_{P,all,i}$	=	Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)

$CDW_{P,all,i}$	=	Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(j) Project emissions from uncombusted methane (PE_{UM}) must be quantified using Equation 5.37.

(k) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in Appendix B or site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.37: Uncombusted Methane Emissions

$$PE_{UM} = \sum_i MM_{P,i} \times (1 - DE_i) \times GWP_{CH4}$$

Where,

PE_{UM} = Project emissions from uncombusted methane during the reporting period (tCO_2e)

i = Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying devices

$MM_{P,i}$ = Methane measured sent to qualifying anod non-qualifying devices for destruction through use i during the reporting period; calculated separately for each device (tCH_4)

DE_i = Efficiency of methane destruction device i, either site-specific or from Appendix B (%)

GWP_{CH4} = Global warming potential of methane (tCO_2e/tCH_4)

With,

$$MM_{P,i} = \sum_i (PSW_{P,all,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + ECW_{P,all,i} \times C_{CH4} + AWR_{P,all,i} \times C_{CH4} \times CDW_{P,all,i,} \times C_{CH4}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{P,all,i}$ = Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)

$PIB_{P,i}$ = Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

$ECW_{P,all,i}$ = Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)

$AWR_{P,all,i}$ = Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)

$CDW_{P,all,i}$ = Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified (scf)

C_{CH4} = Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)

0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(l) If gas flow metering equipment does not internally correct for temperature and pressure, use Equation 5.38 to determine the amount of mine gas sent to each qualifying and non-qualifying device during the reporting period.

Equation 5.38: MG Corrected for Temperature and Pressure

$$MG_{corrected,i,y} = MG_{meas,i,y} \times \frac{520}{T_{MG,y}} \times \frac{P_{MG,y}}{1}$$

Where,

$MG_{corrected,i,y}$	=	Corrected flow rate or total volume of MG collected for the time interval y at utilization type i, adjusted to 60°F and 1 atm (scf/unit of time)
$MG_{meas,i,y}$	=	Measured flow rate or total volume of MG collected for the time interval y at utilization type i (scf/unit of time)
$T_{MG,y}$	=	Measured temperature of the MG for the time interval y, °R=°F+460 (°R)
$P_{MG,y}$	=	Measured pressure of the MG for the time interval y (atm)

§ 5.4. Abandoned Underground Mine Methane Recovery Activities.

(a) GHG emission reductions for a reporting period (ER) must be quantified by subtracting the project emissions for that reporting period (PE) from the baseline emissions for that reporting period (BE) and applying an uncertainty deduction (UD) using Equation 5.39.

(b) Abandoned underground mine methane recovery activities that meet the following conditions are not subject to an uncertainty deduction and should calculate GHG emission reductions for a reporting period (ER) using an uncertainty deduction (UD) equal to 1:

(1) The project uses hyperbolic decline curve coefficients derived from mine-specific data measured from pre-exisiting wells or boreholes open to the atmosphere according to the provisions of section 5.4.1(s); or

(2) The project extracts methane exclusively from mines that utilized methane drainage systems when active.

Equation 5.39: GHG Emission Reductions

$ER = (BE - PE) \times UD$

Where,

ER	=	Emission reductions achieved by the project during the reporting period (tCO_2e)
BE	=	Baseline emissions during the reporting period (tCO_2e)
PE	=	Project emissions during the reporting period (tCO_2e)
UD	=	Uncertainty deduction; UD = 0.8 if using default hyperbolic decline curve coefficients and the mine did not utilize a methane drainage system when active, UD = 1 if using default hyperbolic decline curve coefficients and the abandoned mine utilized a methane drainage system when active, UD = 1 if using hyperbolic decline curve coefficients derived from measured data from pre-existing wells or boreholes open to the atmosphere

§ 5.4.1 Quantifying Baseline Emissions.

(a) Baseline emissions for a reporting period (BE) must be estimated by summing the baseline emissions for all SSRs identified as included in the baseline in Table 4.4 and using Equation 5.40.

(b) The emission reductions in any given reporting period must be equal to or less than the baseline emissions for that reporting period.

Equation 5.40: Baseline Emissions

$BE = BE_{MD} + BE_{MR}$

Where,		
BE	=	Baseline emissions during the reporting period (tCO_2e)
BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)

(c) Baseline emissions from the destruction of AMM (BE_{MD}) must be quantified using Equations 5.41 and 5.42.

(d) BE_{MD} must include the estimated CO_2 emissions from the destruction of AMM in non-qualifying devices.

(e) Mine gas (MG) can originate from four distinct sources for abandoned underground mine methane recovery activities: pre-mining surface wells drilled into the mine during active mining operations, pre-mining in-mine boreholes drilled into the mine during active mining operations, post-mining gob wells drilled into the mine during active mining operations, and newly drilled surface wells. MG from these sources must be measured and accounted for individually per the equations in this section.

(f) For each eligible methane source, the volume or mass of MG that would have been sent to a non-qualifying device for destruction during the reporting period in the baseline must be the determined by calculating and comparing:

(1) The volume or mass of MG captured and sent to non-qualifying devices during the reporting period, adjusted for temperature and pressure using Equation 5.51, if applicable; and

(2) The volume of MG captured and sent to non-qualifying devices during the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than three years), adjusted for temperature and pressure using Equation 5.51, if applicable and averaged according to the length of the reporting period.

(3) The volume or mass of MG sent to non-qualifying devices during the time period a law, regulation, or legally binding mandate, in place for less than three years prior to offset project commencement, was in effect, adjusted

for temperature and pressure using Equation 5.51, if applicable, and averaged according to the length of the reporting period.

(g) For each methane source, the largest of the three above quantities must be used in Equation 5.42.

(h) If using a quantity from calculation (2) or (3) above and the project does not have data on the concentration of the methane to use in Equation 5.42, the highest single-day average methane concentration measured for that methane source during the reporting period must be used in its place.

(i) For the purpose of baseline quantification, only non-qualifying devices that were operating during the year prior to offset project commencement should be taken into account.

(j) If there is no destruction of methane in the baseline, then $BE_{MD} = 0$.

Equation 5.41: Baseline Emissions from Destruction of Methane

$$BE_{MD} = MD_{B,i} \times CEF_{CH4}$$

Where,

BE_{MD}	=	Baseline emissions from destruction of methane during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.)
$MD_{B,i}$	=	Methane destroyed by non-qualifying devices through use i during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

(k) The amount of mine methane destroyed ($MD_{B,i}$) must be quantified using Equation 5.42.

(l) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in Appendix B or site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.42: Methane Destroyed in Baseline

$$MD_{B,i} = \sum_{i} MM_{B,i} \times DE_i$$

Where,

$MD_{B,i}$	=	Methane destroyed by use i during the reporting period (tCH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by non-qualifying devices
$MM_{B,i}$	=	Methane measured sent to use i during the reporting period corrected to standard conditions, if applicable, for pressure and temperature; calculated separately for each device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)

With:

$$MM_{B,i} = \sum_{i} (PSW_{B,i} \times C_{CH4} + PIB_{B,i} \times C_{CH4} + PGW_{B,i} \times C_{CH4} \times NSW_{B,i} \times C_{CH4}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{B,i}$	=	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{B,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{B,i}$	=	Volume of MG from post-mining gob wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)
$NSW_{B,i}$	=	Volume of MG from newly drilled surface wells sent to non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$ = Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)

DV_t = Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(m) Baseline emissions from the release of methane (BE_{MR}) must be quantified using Equations 5.43 and 5.44. Calculations include the application of a hyperbolic emissions rate decline curve. The function is directly related the gassiness of the mine, which is reflective of physical parameters of the coal mine such as the mine size, gas content of the coal, permeability of the coal to the flow of gas.

(n) The decline curve estimates the emission rate of an abandoned mine over time by taking into account the time elapsed since mine closure, the average methane emission rate calculated using available data collected by MSHA over the life of the mine, and whether the mine is sealed or venting. The decline curve for a given mine is initialized at the date of abandonment and extrapolated through the crediting period.

(o) The amount of AMM released (tCH_4) must be determined by calculating and comparing:

(1) The emissions of methane for that reporting period calculated by the decline curve using Equation 5.44; and

(2) The quantity of methane destroyed by qualifying and non-qualifying devices during that reporting period calculated using Equation 5.49.

(p) The lesser of the two above quantities must be used in Equation 5.43

(q) AMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.43: Baseline Emissions from Release of Methane

$$BE_{MR} = \left[\min\left(AMM_{DC}, \sum_i MD_{B,i}\right) - \sum_i MD_{B,i}\right] \times GWP_{CH4}$$

Where,

BE_{MR}	=	Baseline emissions from release of methane into the atmosphere avoided by the project during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying devices
AMM_{DC}	=	Emissions of methane during the reporting period as calculated by the decline curve (tCH_4)
$MD_{P,i}$	=	Methane sent to all qualifying and non-qualifying devices for destruction through use i during the reporting period (tCH_4)
$MD_{B,i}$	=	Methane sent to non-qualifying devices for destruction through use i during the reporting period (tCH_4)
GWP_{CH4}	=	Global warming potential of methane (tCO_2e/tCH_4)

Equation 5.44: Methane Emissions Derived from the Hyperbolic Emission Rate Decline Curve

$$AMM_{DC} = ER_{AMM} \text{ x } S \text{ x } (1 + b \text{ x } D_i \text{ x } t)^{\left(\frac{-1}{b}\right)} \text{ x } RP_{days} \text{ x } 0.0423 \text{ x } 0.000454$$

Where,

AMM_{DC}	=	Emissions of methane from the decline curve during the reporting period (tCH_4)
ER_{AMM}	=	Average methane emission rate over the life of the mine (mscf/d)
S	=	Default effective degree of sealing; S = 1 for venting mines and 0.5 for sealed mines
b	=	Dimensionless hyperbolic exponent
D_i	=	Initial decline rate (1/day)
t	=	Time elapsed from the date of mine closure to midpoint of the reporting period (days)
RP_{days}	=	Days in reporting period
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

(r) The decline curve relies upon hyperbolic decline curve coefficients. Offset Project Operators or Authorized Project Designees may elect to:

(1) use the default hyperbolic decline curve coefficients presented in Table 5.1 based upon whether the mine is venting or sealed; or

Table 5.1: Default Hyperbolic Decline Curve Coefficients

Variable	Venting	Sealed
b	1.886581	2.016746
D_i (1/day)	0.003519	0.000835

(2) use hyperbolic decline curve coefficients derived from measured data from pre-existing wells or boreholes open to the atmosphere that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default hyperbolic decline curve coefficients upon written approval by the Executive Officer.

(s) To derive hyperbolic emission rate decline curve coefficients using measured data from pre-existing wells or boreholes open to the atmosphere an Offset Project Operator or Authorized Project Designee must do the following:

(1) Obtain average methane emission rate calculated using available data collected by MSHA over the life of the mine.

(2) After mine closure, three parameters must be monitored:

(A) MG flow rates;

(B) local barometric pressure; and

(C) methane concentration of MG

(3) Measurements must be of natural flow only with no assist from vacuum pumps or compressors.

(4) If gas flow metering equipment does not internally correct for temperature and pressure, apply Equation 5.45 to the flow rate of mine gas venting from pre-existing wells or boreholes open to the atmosphere

Equation 5.45: Emissions Rate Corrected for Temperature and Pressure

$$ERcorrected,y = ER_{meas,y} \times \frac{520}{T_{MG,y}} \times \frac{P_{MG,y}}{1}$$

Where,

$ER_{corrected,y}$	=	Emissions rate of MG venting from pre-existing wells or boreholes open to the atmosphere during time interval y adjusted to 60°F and 1 atm (scf/unit of time)
$ER_{meas,y}$	=	Measured emission rate of MG venting from pre-existing wells or boreholes open to the atmosphere during time interval y (scf/unit of time)
$T_{MG,y}$	=	Measured temperature of the MG for the time interval y, °R=°F+460 (°R)
$P_{MG,y}$	=	Measured pressure of the MG for the time interval y (atm)

(5) The monitored data must be used to develop a correlation between barometric pressure and methane flow rate. Annual average barometric pressure at the site must then be used to normalize the annual methane flow rate.

(6) This normalized flow rate must then be plotted against the time since mine closure in order to derive the hyperbolic emission rate decline curve by fitting the data to a curve in the form of Equation 5.44.

§ 5.4.2. Quantifying Project Emissions.

(a) Project emissions must be quantified on an annual basis.

(b) Project emissions for a reporting period (PE) must be quantified by summing the emissions for all SSRs identified as included in the project in Table 4.4 and using Equation 5.46.

(c) AMM that is still vented in the project scenario is not accounted for in the project emissions or baseline emissions, since it is vented in both scenarios.

Equation 5.46: Project Emissions

$$PE = PE_{EC} + PE_{MD} + PE_{UM}$$

Where,

PE	=	Project emissions during the reporting period (tCO_2e)
PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)
PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)
PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (tCO_2e)

(d) If the project uses fossil fuel or grid electricity to power additional equipment required for project activities, the resulting CO_2 emissions from the energy consumed to capture and destroy methane (PE_{EC}) must be quantified using Equation 5.47.

(e) If the total electricity generated by project activities is greater than the additional electricity consumed for the capture and destruction of methane, then the $CONS_{ELEC}$ term may be omitted from Equation 5.47.

Equation 5.47: Project Emissions from Energy Consumed to Capture and Destroy Methane

$$PE_{EC} = (CONS_{ELEC} \times CEF_{ELEC}) + \frac{(CONS_{HEAT} \times CEF_{HEAT} + CONS_{FF} \times CEF_{FF})}{1000}$$

Where,

PE_{EC}	=	Project emissions from energy consumed to capture and destroy methane during the reporting period (tCO_2e)
$CONS_{ELEC}$	=	Additional electricity consumption for the capture and destruction of methane during the reporting period (MWh)
CEF_{ELEC}	=	CO_2 emission factor of electricity used from Appendix A (tCO_2e/MWh)
$CONS_{HEAT}$	=	Additional heat consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{HEAT}	=	CO_2 emission factor of heat used from Appendix A (kg CO_2/volume)
$CONS_{FF}$	=	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period (volume)
CEF_{FF}	=	CO_2 emission factor of fossil fuel used from Appendix A (kg CO_2/volume)
1/1000	=	Conversion of kg to metric tons

(f) Project emissions from the destruction of methane (PE_{MD}) must be quantified using Equations 5.48 and 5.49.

Equation 5.48: Project Emissions from Destruction of Captured Methane

$$PE_{MD} = \sum_i MD_{P,i} \times CEF_{CH4}$$

Where,

PE_{MD}	=	Project emissions from destruction of methane during the reporting period (tCO_2e)

i	=	Use of methane (flaring, power generation, heat generation production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying devices
$MD_{P,i}$	=	Methane destroyed by qualifying and non-qualifying devices through use i during the reporting period (tCH_4)
CEF_{CH4}	=	CO_2 emission factor for combusted methane (2.75 tCO_2e/tCH_4)

(g) The amount of mine methane destroyed ($MD_{P,i}$) must be quantified using Equation 5.49.

(h) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in Appendix B or site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.49: Methane Destroyed

$$MD_{P,i} = \sum_i MM_{P,i} \times DE_i$$

Where,

$MD_{P,i}$	=	Methane destroyed by qualifying and non-qualifying devices through use i during the reporting period (tCH_4)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline, etc.) by all qualifying and non-qualifying devices
$MM_{P,i}$	=	Methane measured sent to qualifying and non-qualifying devices for destruction through use i during the reporting period corrected to standard conditions, if applicable, for pressure and temperature; calculated separately for each device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)

With:

$$MM_{P,i} = \sum_i (PSW_{P,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} + NSW_{P,i} \times C_{CH4}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{P,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period.
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{P,i}$	=	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$NSW_{P,i}$	=	Volume of MG from newly drilled surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(i) Project emissions from uncombusted methane (PE_{UM}) must be quantified using Equation 5.50.

(j) Offset Project Operators and Authorized Project Designees may choose to use default methane destruction efficiencies (DE_i) provided in Appendix B or site-specific methane destruction efficiencies. Site-specific methane destruction efficiencies that are demonstrated to the satisfaction of the Executive Officer to be equally or more accurate than the default methane destruction efficiencies may be used upon written approval by the Executive Officer.

Equation 5.50: Uncombusted Methane Emissions

$$PE_{UM} = \sum_i MM_{P,i} \times (1 - DE_i) \times GWP_{CH4}$$

Where,

PE_{UM}	=	Project emissions from uncombusted methane during the reporting period (tCO_2e)
i	=	Use of methane (flaring, power generation, heat generation, production of transportation fuel, injection into natural gas pipeline etc.) by all qualifying and non-qualifying devices
$MM_{P,i}$	=	Methane measured sent to qualifying and non-qualifying devices for destruction through use i during the reporting period; calculated separately for each device (tCH_4)
DE_i	=	Efficiency of methane destruction device i, either site-specific or from Appendix B (%)
GWP_{CH4}	=	Global warming potential of methane (tCO_2e/tCH_4)

With:

$$MM_{P,i} = \sum_i (PSW_{P,i} \times C_{CH4} + PIB_{P,i} \times C_{CH4} + PGW_{P,i} \times C_{CH4} + NSW_{P,i} \times C_{CH4}) \times 0.0423 \times 0.000454$$

Where,

$PSW_{P,i}$	=	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PIB_{P,i}$	=	Volume of MG from pre-mining in-mine boreholes sent to by qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$PGW_{P,i}$	=	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)
$NSW_{P,i}$	=	Volume of MG from newly drilled surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period (scf)

C_{CH4}	=	Weighted average of measured methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
0.0423	=	Density of methane (lb CH_4/scf CH_4)
0.000454	=	tCH_4/lb CH_4

With:

$$C_{CH4} = \frac{\sum_t DV_t \times C_{CH4,t}}{\sum_t DV_t}$$

Where,

$C_{CH4,t}$	=	Daily average methane concentration of mine gas captured from methane source; calculated separately for each methane source (scf CH_4/scf)
DV_t	=	Daily volume of mine gas sent to destruction device; calculated separately for each methane source (scf/day)

If a thermal mass flow meter is used to monitor gas flow instead of a volumetric flow meter, the volume and density terms must be replaced by the monitored mass value and the methane concentration must be in mass percent.

(k) If gas flow metering equipment does not internally correct for temperature and pressure, use Equation 5.51 to determine the amount of mine gas sent to each qualifying and non-qualifying device during the reporting period.

Equation 5.51: MG Corrected for Temperature and Pressure

$$MG_{corrected,i,y} = MG_{meas,i,y} \times \frac{520}{T_{MG,y}} \times \frac{P_{MG,y}}{1}$$

Where,

$MG_{corrected,i,y}$	=	Corrected flow rate or total volume of MG collected for the time interval y at utilization type i, adjusted to 60°F and 1 atm (scf/unit of time)
$MG_{meas,i,y}$	=	Measured flow rate or total volume of MG collected for the time interval y at utilization type i (scf/unit of time)
$T_{MG,y}$	=	Measured temperature of the MG for the time interval y, °R=°F+460 (°R)
$P_{MG,y}$	=	Measured pressure of the MG for the time interval y (atm)

Chapter 6. Monitoring

§ 6.1. General Monitoring Requirements.

(a) The Offset Project Operators or Authorized Project Designees is responsible for monitoring the performance of the offset project and operating each component of the collection and destruction system(s) in a manner consistent with the manufacturer's specifications.

(b) Operational activity of the methane drainage and ventilation systems and the destruction devices must 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.

(1) For flares, operation is defined as thermocouple readings above 500°F.

(2) For all other destruction devices, the Offset Project Operator or Authorized Project Designee must demonstrate the destruction device was operational, and this demonstration is subject to the review and verification of an ARB-approved third party offset project verification body.

(c) If gas flow metering equipment does not internally correct for temperature and pressure, flow data must be corrected according to the appropriate quantification methodologies in Chapter 5.

(d) If a project uses elevated amounts of atmospheric gases in extracted mine gas as evidence of a pre-mining well being mined through, nitrogen and oxygen concentrations must be determined for each well at the time of offset project commencement and when the Offset Project Operator or Authorized Project Designee reports a pre-mining well as eligible. Gas samples must be collected by a third-party technician and amounts of nitrogen and oxygen concentrations determined by a full gas analysis using a chromatograph at an ISO 17025 accredited lab or a lab that has been certified by accreditation body conformant with ISO 17025 to perform test methods appropriate for atmospheric gas content analysis.

(e) Data substitution is allowed for limited circumstances where a project encounters flow rate or methane concentration data gaps. Offset Project Operators or Authorized Project Designees may apply the data substitution methodology provided in Appendix C. No data substitution is permissible for data gaps resulting from inoperable equipment that monitors the proper functioning of destruction devices and no emission reductions will be credited under such circumstances.

§ 6.2. Instrument QA/QC.

Instruments and equipment used to monitor the destruction of mine methane or the temperature and pressure used to correct data measurements to STP must be inspected, cleaned and calibrated according to the following:

(a) All gas flow meters and methane analyzers must be:

  (1) cleaned and inspected on a quarterly basis, with the activities performed and "as found/as left condition" of the equipment documented;

  (2) field checked by a trained professional for calibration accuracy with the percent drift documented, using either a portable instrument (such as a pitot tube) or manufacturer specifications, no more than 24 hours after and up to two months prior to the end date of the reporting period; and

  (3) calibrated by the manufacturer or a certified calibration service per manufacturer's specifications or every 5 years, whichever is more frequent.

(b) Additionally, flow meter calibrations must be documented to show that the meter was calibrated and methane analyzer calibrations must 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.

(c) If the field check on a piece of equipment reveals accuracy outside of a +/- 5% threshold, calibration by the manufacturer or a certified service provider is required for that piece of equipment.

(d) For the interval between the last successful field check and any calibration event confirming accuracy below the +/- 5% threshold, all data from that meter or analyzer must be scaled according to the following procedure. These adjustments must be made for the entire period from the last successful field check until such time as the meter is properly calibrated.

(1) For calibrations that indicate the flow meter was outside the +/- 5% accuracy threshold, the project developer shall estimate total emission reductions using

(A) the metered values without correction; and

(B) the metered values adjusted based on the greatest calibration drift recorded at the time of calibration.

(e) The lower of the two emission reduction estimates shall be reported as the scaled emission reduction estimate. 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.

(f) If a portable instrument is used (such as a handheld methane analyzer), the portable instrument must be calibrated according to manufacturer's specification prior to each use.

§ 6.3. Document Retention.

(a) The Offset Project Operator or Authorized Project Designee is required to keep all documentation and information outlined in the Regulation and this protocol. Record retention requirements are set forth in section 95976 of the Regulation.

(b) Information that must be retained by the Offset Project Operator or Authorized Project Designee must include:

(1) All data inputs for the calculation of the project baseline emissions and project emission reductions;

(2) Emission reduction calculations;

(3) Mine operating permits, leases (if applicable), and air, water and land use permits;

(4) Notices of Violations (NOVs), and any administrative or legal consent orders related to project activities dating back at least three years prior to offset project commencement and for each year of project operation;

(5) Copies of mine plans and mine ventilation plans submitted to MSHA throughout the project life;

(6) Gas flow meter information (model number, serial number, manufacturer's calibration procedures);

(7) Methane analyzer information (model number, serial number, calibration procedures);

(8) Cleaning and inspection records for all gas meters;

(9) Field check results for all gas meters and methane analyzers;

(10) Calibration results for all gas meters and methane analyzers;

(11) Corrective measures taken if meter does not meet performance specifications;

(12) Gas flow data (for each flow meter);

(13) Methane concentration monitoring data;

(14) Gas temperature and pressure readings (only if flow meter does not correct for temperature and pressure automatically);

(15) Destruction device information (model numbers, serial numbers, installation date, operation dates);

(16) Destruction device monitoring data (for each destruction device);

(17) All maintenance records relevant to the methane collection and/or destruction device(s) and monitoring equipment;

(18) If using a calibrated portable gas analyzer for CH_4 content measurement the following records must be retained:

(A) Date, time, and location of methane measurement;

(B) Methane content of biogas (% by volume or mass) for each measurement;

(C) Methane measurement instrument information (model number and serial number);

(D) Date, time, and results of instrument calibration; and

(E) Corrective measures taken if instrument does not meet performance specifications

§ 6.4. Active Underground Mine Ventilation Air Methane Activities.

(a) The total inlet flow entering the destruction device must be measured continuously and recorded every two minutes to calculate average flow per hour.

(b) The methane concentration of the ventilation air entering the destruction device and of the exhaust gas must be measured continuously and recorded every two minutes to calculate average methane concentration per hour.

(c) If required in order to standardize the flow rate, volume or mass of VAM, the temperature and pressure in the vicinity of the flow meter must be measured continuously and recorded at least every hour to calculate hourly pressure and temperature.

(d) Offset Project Operators and Authorized Project Designees must monitor the parameters prescribed in Table 6.1.

Table 6.1. Active Underground Mine VAM Activity Monitoring Parameters – Quantification Methodology

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c), Measured (m), Operating Records (o)	Comment
5.4 5.5	$VAM_{B,i}$	Volume of VAM that would have been sent to a non-qualifying device for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.1.1(d)
5.4 5.5 5.9	$C_{CH4,t}$	Hourly average methane concentration of ventilation air sent to destruction device	scf CH_4 / scf	Continuously	c,m	Readings taken every two minutes to calculate average methane concentration per hour
5.4 5.5 5.9	$VAM_{flow,t}$	Hourly average flow of ventilation air sent to destruction device	(scf/hour)	Continuously	c,m	Readings taken every two minutes to calculate average flow per hour
5.4 5.9 5.10	$VAM_{FLOW,y}$	Average flow rate of ventilation air entering the destruction device during period y corrected to	scfm	Continuously	m, c	Readings taken every two minutes to calculate average hourly flow; adjusted if

		standard conditions, if applicable, for inlet flow gas pressure and temperature				applicable using Equation 5.11
5.4 5.9 5.10	$TIME_y$	Time during which the destruction device is operational during period y	m	Continuously	m	
5.4 5.9 5.10	$C_{CH4,exhaust,t}$	Hourly average methane concentration of ventilation air in ventilation air exhaust	scf CH_4 / scf	Continuously	m, c	Readings taken every two minutes (either average over two minutes or instantaneous) to calculate average methane concentration per hour
5.5	$VAM_{P,i}$	Volume of ventilation air sent to qualifying and non-qualifying devices for destruction through use i during the project during the reporting period	scf	Continuously	m	Adjusted if applicable using Equation 5.11
5.5 5.9	$MG_{SUPP,i}$	Volume of mine methane extracted from a methane drainage system and sent to destruction device with	scf	Every reporting period	m	Adjusted if applicable using Equation 5.11
5.5 5.9	$C_{CH4,MG,t}$	Hourly average methane concentration of mine gas sent to destruction device	(scf CH_4/scf)	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day
5.5 5.9	$DV_{MG,t}$	Daily volume of mine gas sent with ventilation air to destruction device	(scf /day)			Readings taken every 15 minutes to calculate average flow

						per day.
5.7	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.7	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From purchased heat records
5.7	$CONS_{FF}$	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From fuel use records
5.11	$VAM_{FLOWmeas,y}$	Uncorrected average flow rate of ventilation air entering the destruction device as measured during period y	scf/unit of time	Continuously	m, c	Readings taken every two minutes to calculate average hourly flow; adjusted, if applicable, to $VAM_{FLOW,y}$ using Equation 5.11
5.11	$T_{VAMinflow,y}$	Measured temperature of ventilation air entering the destruction device for the time period y, °R=°F+460	°R	Continuously	m, c	Readings taken at least every hour to calculate hourly temperature
5.11	$P_{VAMinflow,y}$	Measured pressure of ventilation air entering the destruction device for the time period y	atm	Continuously	m, c	Readings taken at least every hour to calculate hourly pressure

§ 6.5. Active Underground Mine Methane Drainage Activities.

(a) Mine gas from each methane source (i.e., pre-mining surface wells, pre-mining in-mine boreholes, or post-mining gob wells) must be monitored separately prior to interconnection with other MG sources. The volumetric or mass gas flow, methane concentration, temperature, and pressure must be monitored and recorded separately for each methane source.

(b) Mine gas from each methane source (i.e., pre-mining surface wells, pre-mining in-mine boreholes, or post-mining gob wells) must be measured continuously. Offset Project Operators must record the mine gas flow rate every 15 minutes, adjusted for temperature and pressure, and record the totalized mine gas volume or mass at least daily, adjusted for temperature and pressure.

(c) Mine gas delivered to a destruction device must be measured continuously. Offset Project Operators must record the mine gas flow rate every 15 minutes, adjusted for temperature and pressure, and record the totalized mine gas volume or mass at least daily, adjusted for temperature and pressure. The flow of gas to each destruction device must be monitored separately for each destruction device, unless:

(1) a project consists of destruction devices that are of identical efficiency and verified to be operational throughout the reporting period; then a single flow meter may be used to monitor gas flow to all destruction devices; or

(2) a project consists of destruction devices that are not of identical efficiency, in which case the destruction efficiency of the least efficient destruction device must be used as the destruction efficiency for all destruction devices monitored by that meter.

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

(1) The destruction efficiency of the least efficient downstream destruction device in operation must be used as the destruction efficiency for all destruction devices downstream of the single meter; and

(2) 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

(3) For any period of time 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.

(e) The methane concentration of the mine gas extracted from each methane source must be measured continuously, recorded every 15 minutes and averaged at least daily.

(f) If required in order to adjust the flow rate, volume, or mass of mine gas, the temperature and pressure of the mine gas from each methane source must be measured continuously and recorded at least every hour to calculate hourly temperature and pressure.

(g) Offset Project Operators and Authorized Project Designees must monitor the parameters prescribed in Table 6.2.

Table 6.2. Active Underground Mine Methane Drainage Activity Monitoring Parameters – Quantification Methodology

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c), Measured (m), Operating Records (o), Reference (r)	Comment
5.15 5.21 5.22	DE_i	Efficiency of methane destruction device i	%	Annually	r or m	Default methane destruction efficiencies provided in Appendix B or site-specific methane destruction efficiencies approved by the Executive Officer

5.15 5.16	$PSW_{B,i}$	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.2.1(e).
5.15 5.16	$PIB_{B,i}$	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.2.1(e)
5.15 5.16	$PGW_{B,i}$	Volume of MG from post-mining gob wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.2.1(e)
5.15 5.21 5.22	$C_{CH4,t}$	Hourly average methane concentration of mine gas sent to destruction device	(scf CH_4/scf)	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day
5.15 5.21 5.22	DV_t	Daily volume of mine gas sent to destruction device	(scf /day)			Readings taken every 15 minutes to calculate average flow per day.

5.16 5.21 5.22	$PIB_{P,i}$	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.23
5.16 5.21 5.22	$PGW_{P,i}$	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.23
5.16	$PSWnqd_i$	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.23
5.16 5.21 5.22	$MG_{SUPP,i}$	Volume of mine methane extracted from a methane drainage system and combusted with VAM	scf	Every reporting period	m	Adjusted if applicable using Equation 5.23
5.16 5.21 5.22	$C_{CH4,MG,t}$	Hourly average methane concentration of mine gas sent to destruction device	(scf CH_4/scf)	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day
5.16 5.21 5.22	$DV_{MG,t}$	Daily volume of mine gas sent with ventilation air to destruction device	(scf /day)			Readings taken every 15 minutes to calculate average flow per day.

5.17	$PSWe_{pre,i}$	Volume of MG destroyed by qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from pre-mining surface wells that were mined through during the current reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.23
5.17	$PSWe_{post,i}$	Volume of MG destroyed by qualifying destruction devices in the current reporting period captured from pre-mining surface wells that were mined through during earlier reporting periods	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.23
5.19	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.19	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From purchased heat records
5.19	$CONS_{FF}$	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From fuel use records

5.21 5.22	$PSW_{P,all,i}$	Volume of MG from pre-mining surface wells captured and destroyed by qualifying and non-qualifying devices through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.23
5.23	$MG_{meas,i,y}$	Measured volume of MG collected for the time interval y at utilization type i	(scf/unit of time)	Continuously	m	Adjusted, if applicable, to STP using Equation 5.23
5.23	$T_{MG,y}$	Measured temperature of MG for the time interval y, °R=°F+460	°R	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y
5.23	$P_{MG,y}$	Measured pressure of MG for the time interval y	atm	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y

§ 6.6. Active Surface Mine Methane Drainage Activities.

(a) SMM from the drainage system must be measured continuously. Offset Project Operators must record the SMM flow rate every 15 minutes, adjusted for temperature and pressure, and record the totalized SMM volume or mass at least daily, adjusted for temperature and pressure.

(b) SMM delivered to a destruction device must be measured continuously. Offset Project Operators must record the SMM flow rate every 15 minutes, adjusted for temperature and pressure, and record the totalized SMM volume or mass at least daily, adjusted for temperature and pressure. The flow of gas to each destruction device must be monitored separately for each destruction device, unless:

(1) a project consists of destruction devices that are of identical efficiency and verified to be operational throughout the reporting period; then a single flow meter may be used to monitor gas flow to all destruction devices; or

(2) a project consists of destruction devices that are not of identical efficiency, in which case the destruction efficiency of the least efficient destruction device must be used as the destruction efficiency for all destruction devices monitored by that meter.

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

(1) The destruction efficiency of the least efficient downstream destruction device in operation must be used as the destruction efficiency for all destruction devices downstream of the single meter; and

(2) 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

(3) For any period of time 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.

(d) The methane concentration of the SMM extracted from each methane source must be measured continuously, recorded every 15 minutes and averaged at least daily.

(e) If required in order to adjust the flow rate, volume, or mass of mine gas, the temperature and pressure of the SMM must be measured continuously and recorded at least every hour to calculate hourly temperature and pressure.

(f) Offset Project Operators and Authorized Project Designees must monitor the parameters prescribed in Table 6.3.

Table 6.3. Active Surface Mine Methane Drainage Activity Monitoring Parameters – Quantification Methodology

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c), Measured (m), Operating Records (o), Reference (r)	Comment
5.27 5.36 5.37	DE_i	Efficiency of methane destruction device i	%	Annually	r or m	Default methane destruction efficiencies provided in Appendix B or site-specific methane destruction efficiencies approved by the Executive Officer
5.27 5.28	$PSW_{B,i}$	Volume of MG from pre-mining surface wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.3.1(e).
5.27 5.28	$PIB_{B,i}$	Volume of MG from pre-mining in-mine boreholes that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.3.1(e).

5.27 5.28	$ECW_{B,i}$	Volume of MG from existing coalbed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.3.1(e).
5.27 5.28	$AWR_{B,i}$	Volume of MG from abandoned wells that are reactivated that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.3.1(e).
5.27 5.28	$CDW_{B,i}$	Volume of MG from converted dewatering wells that would have been sent to non-qualifying devices for destruction through use i during the reporting period in the baseline scenario	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.3.1(e).
5.27 5.28 5.36 5.37	$C_{CH4,t}$	Hourly average methane concentration of mine gas sent to destruction device	(scf CH_4/scf)	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day

5.27 5.28 5.36 5.37	DV_t	Daily volume of mine gas sent to destruction device	(scf /day)			Readings taken every 15 minutes to calculate average flow per day.
5.28	$PSW_{P,i}$	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.29 in accordance with sections 5.3.1(k), (l), and (m) must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.28 5.36 5.37	$PIB_{P,i}$	Volume of MG from pre-mining in-mine boreholes sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.28	$ECW_{P,i}$	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.27 in accordance with sections 5.3.1(k), (l), and (m) must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.28	$AWR_{P,i}$	Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.31 in accordance with sections 5.3.1(k), (l), and (m) must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.28	$CDW_{P,i}$	Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, only the eligible amount per Equation 5.29 in accordance with sections 5.3.1(k), (l), and (m) must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.28	$PSWnqd_i$	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.28	$ECWnqd_i$	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.28	$AWRnqd_i$	Volume of MG from abandoned wells that are reactivated sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.28	$CDWnqd_i$	Volume of MG from converted dewatering wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.29	$PSWe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from pre-mining surface wells that were mined through during the current reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.29	$PSWe_{post,i}$	Volume of MG sent to qualifying destruction devices in the current reporting period captured from pre-mining surface wells that were mined through during earlier reporting periods	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.30	$ECWe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during the current reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.30	$ECWe_{post,i}$	Volume of MG sent to qualifying destruction devices in the current reporting period captured from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining that were mined through during earlier reporting periods	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.31	$AWRe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from abandoned wells that are reactivated that were mined through during the current reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.31	$AWRe_{post,i}$	Volume of MG sent to qualifying destruction devices in the current reporting period captured from abandoned wells that are reactivated that were mined through during earlier reporting periods	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.32	$CDWe_{pre,i}$	Volume of MG sent to qualifying destruction devices, from the offset project commencement date through the end of the current reporting period, captured from converted dewatering wells that were mined through during the current reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.32	$CDWe_{post,i}$	Volume of MG sent to qualifying destruction devices in the current reporting period captured from converted dewatering wells that were mined through during earlier reporting periods	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.34	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.34	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From purchased heat records
5.34	$CONS_{FF}$	Additional fossil fuel consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From fuel use records
5.36 5.37	$PSW_{P,all,i}$	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.36 5.37	$ECW_{P,all,i}$	Volume of MG from existing coal bed methane wells that would otherwise be shut-in and abandoned as a result of encroaching mining sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.36 5.37	$AWR_{P,all,i}$	Volume of MG from abandoned wells that are reactivated sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38

5.36 5.37	$CDW_{P,all,i}$	Volume of MG from converted dewatering wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period. For qualifying devices, all MG, whether from a mined through well or not, must be quantified	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.38
5.38	$MG_{meas,i,y}$	Measured volume of MG collected for the time interval y at utilization type i	(scf/unit of time)	Continuously	m	Adjusted, if applicable, to STP using Equation 5.38
5.38	$T_{MG,y}$	Measured temperature of MG for the time interval y, °R=°F+460	°R	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y
5.38	$P_{MG,y}$	Measured pressure of MG for the time interval y	atm	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y

§ 6.7. Abandoned Underground Mine Methane Recovery Activities.

(a) AMM from the drainage system must be measured continuously. Offset Project Operators must record the AMM flow rate every 15 minutes, adjusted for temperature and pressure, and record the totalized mine gas volume or mass at least daily, adjusted for temperature and pressure.

(b) AMM delivered to a destruction device must be measured continuously. Offset Project Operators must record the AMM flow rate every 15 minutes, adjusted for temperature and pressure, and record the totalized mine gas volume or mass at least daily, adjusted for temperature and pressure. The flow of gas to each destruction device must be monitored separately for each destruction device, unless:

(1) a project consists of destruction devices that are of identical efficiency and verified to be operational throughout the reporting period; then a single flow meter may be used to monitor gas flow to all destruction devices; or

(2) a project consists of destruction devices that are not of identical efficiency, in which case the destruction efficiency of the least efficient destruction device must be used as the destruction efficiency for all destruction devices monitored by that meter.

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

(1) The destruction efficiency of the least efficient downstream destruction device in operation must be used as the destruction efficiency for all destruction devices downstream of the single meter; and

(2) 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

(3) For any period of time 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.

(d) The methane concentration of the MG extracted from each methane source must be measured continuously, recorded every 15 minutes and averaged at least daily.

(e) If required in order to adjust the flow rate, volume, or mass of AMM, the temperature and pressure of the AMM must be measured continuously and recorded at least every hour to calculate hourly temperature and pressure.

(f) Offset Project Operators or Authorized Project Designees that elect to derive mine-specific hyperbolic emission rate decline curve coefficients using measured data from pre-existing wells or boreholes open to the atmosphere must adhere to adhere to the following:

(1) Offset Project Operators and Authorized Project Designees must monitor the:

(A) MG flow rates;

(B) local barometric pressure; and

(C) methane concentration of MG

(2) Data must be monitored over a 72 hour period on at least three separate occasions each separated by a minimum of 90 days.

(3) MG flow rate and the barometric pressure must be monitored continuously and recorded at least on an hourly basis.

(4) Methane concentration must be measured at least daily.

(g) Offset Project Operators and Authorized Project Designees must monitor the parameters prescribed in Table 6.4.

Table 6.4. Abandoned Underground Mine Methane Recovery Activity Monitoring Parameters – Quantification Methodology

Eq. #	Parameter	Description	Data Unit	Measurement Frequency	Calculated (c), Measured (m), Operating Records (o), Reference (r)	Comment
5.42 5.49 5.50	DE_i	Efficiency of methane destruction device i	%	Annually	r or m	Default methane destruction efficiencies provided in Appendix B or site-specific methane destruction efficiencies approved by the Executive

						Officer.
5.42	$PSW_{B,i}$	Volume of MG from pre-mining surface wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.4.1(f).
5.42	$PIB_{B,i}$	Volume of MG from pre-mining in-mine boreholes sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.4.1(f).
5.42	$PGW_{B,i}$	Volume of MG from post-mining gob wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.4.1(f).
5.42	$NSW_{B,i}$	Volume of MG from newly drilled surface wells sent to non-qualifying devices for destruction through use i during the reporting period	scf	Estimated at offset project commencement; calculated annually if non-qualifying device continues to operate after project start	c, m	The largest of the three values calculated per section 5.4.1(f).
5.42 5.49 5.50	$C_{CH4,t}$	Hourly average methane concentration of mine gas sent to destruction device	(scf CH_4/scf)	Continuously	m, c	Readings taken every 15 minutes to calculate average methane concentration per day
5.42 5.49 5.50	DV_t	Daily volume of mine gas sent to destruction device	(scf /day)			Readings taken every 15 minutes to calculate average flow per day.

5.44	ER_{AMM}	Average emission rate of AMM over the life of the mine calculated using available data collected by MSHA	scf/d	At offset project commencement	o	Available from MSHA
5.44	t	Time elapsed from the date of mine closure to midpoint of the reporting period	days	At offset project commencement	o	Available from public agency (i.e., MSHA, EPA, etc.)
5.44	RP_{days}	Days in reporting period	days	Annually	o	
5.45	$ER_{meas,y}$	Measured emission rate of MG venting from pre-existing wells or boreholes open to the atmosphere during time interval y	(scf/unit of time)	Continuously	m	Adjusted, if applicable, to STP using Equation 5.45
5.45 5.51	$T_{MG,y}$	Measured temperature of MG for the time interval y, °R=°F+460	°R	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y
5.45 5.51	$P_{MG,y}$	Measured pressure of MG for the time interval y	atm	Continuously	m, c	Readings taken at least every hour to calculate temperature for time interval y
5.47	$CONS_{ELEC}$	Additional electricity consumption for the capture and destruction of methane during the reporting period	MWh	Every reporting period	o	From electricity use records
5.47	$CONS_{HEAT}$	Additional heat consumption for the capture and destruction of methane during the reporting period	Volume	Every reporting period	o	From purchased heat records
5.47	$CONS_{FF}$	Additional fossil fuel consumption	Volume	Every reporting period	o	From fuel use records

		for the capture and destruction of methane during the reporting period				
5.49 5.50	$PSW_{P,i}$	Volume of MG from pre-mining surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.51
5.49 5.50	$PIB_{P,i}$	Volume of MG from pre-mining in-mine boreholes sent to by qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.51
5.49 5.50	$PGW_{P,i}$	Volume of MG from post-mining gob wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.51
5.49 5.50	$NSW_{P,i}$	Volume of MG from newly drilled surface wells sent to qualifying and non-qualifying devices for destruction through use i during the reporting period	scf	Every reporting period	m	Adjusted, if applicable, to STP using Equation 5.51
5.51	$MG_{meas,i,y}$	Measured volume of MG collected for the time interval y at utilization type i	(scf/unit of time)	Continuously	m	Adjusted, if applicable, to STP using Equation 5.51
Monitoring Parameters for Deriving Mine-Specific Hyperbolic Emission Rate Decline Curve Coefficients						
Description			Data	Measurement	Calculated (c),	Comment

	Unit	Frequency	Measured (m)	
MG flow rate	(mscf/d)	Continuously	m, c	Recordings taken at least on an hourly basis during the monitoring period
Local barometric pressure	atm	Continuously	m	Recordings taken at least on an hourly basis during the monitoring period
Measured methane concentration of mine gas captured from methane source	scf CH_4/scf	Continuously	m	Readings taken at least daily during the monitoring period.

Chapter 7. Reporting

In addition to the offset project requirements set forth in sections 95975 and 95976 the Regulation, mine methane capture offset projects must adhere to the project listing and reporting eligibility requirements below.

§ 7.1. Listing Requirements.

(a) Listing information must be submitted by the Offset Project Operator or Authorized Project Designee no later than the date on which the Offset Project Operator or Authorized Project Designee submits the first Offset Project Data Report.

(b) In order for a mine methane capture Compliance Offset Project to be listed, the Offset Project Operator or Authorized Project Designee must submit the information required by section 95975 the Regulation, in addition to the following information:

(1) Offset project name.

(2) Mine methane capture activity type (i.e., active underground mine VAM activity, active underground mine methane drainage activity, active surface mine methane drainage activity, or abandoned underground mine methane recovery activity).

(3) Contact information including name, phone number, mailing address, physical address (if different from mailing address), and email address for the:

(A) Offset Project Operator; and

(B) Authorized Project Designee (if applicable).

(4) CITSS ID number for the:

(A) Offset Project Operator; and

(B) Authorized Project Designee (if applicable).

(5) Contact information including name, phone number, email address and, if applicable, the organizational affiliation for:

(A) the person submitting the information;

(B) technical consultants.

(6) Date of form completion.

(7) *Name and mailing address of mine owner(s) and parent company(ies), if different from owner.

(8) *Name and mailing address of surface owner(s), if different from mine owner.

(9) *Name and mailing address of mine methane owner(s), if different from mine owner.

(10) *Name and mailing address of mine operator(s), if different from mine owner.

(11) *Name and mailing address of methane destruction system owner(s), if different from mine owner.

(12) Other parties with a material interest in the mine methane.

(13) A description of the mine and resource ownership and operation structures.

(14) *Documentation (e.g., title report, coal lease, gas lease, etc.) showing the Offset Project Operator's legal authority to implement the offset project.

(15) *Physical address and latitude and longitude coordinates of mine site.

(16) *Indicate if the project occurs on private or public lands and further specify if the project occurs on any of the following categories of land:

(A) Land that is owned by, or subject to an ownership or possessory interest of a Tribe;

(B) Land that is "Indian lands" of a Tribe, as defined by 25 U.S.C. §81(a)(1); or

(C) Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands.

(17) *If the project is located on one the above categories of land, a description and copies of documentation demonstrating that the land is owned by (or subject to an ownership or possessory interest of) a tribe or private entities.

(18) *MSHA mine identification number.

(19) *MSHA classifications.

(A) coal or metal and nonmetal;

(B) underground or surface; and

(C) active or abandoned.

(20) Mine basin as defined by the American Association of Petroleum Geologists (AAPG) Geologic Note: AAPG-CSD Geological Provinces Code Map: AAPG Bulletin, Prepared by Richard F. Meyer, Laurie G. Wallace, and Fred J. Wagner, Jr., Volume 75, Number 10 (October 1991).

(21) *Mining method(s) employed (e.g., longwall, room and pillar, open-pit, etc.).

(22) *Average annual mineral production (specify mineral produced and unit).

(23) *Year of initial production.

(24) *Year of closure (estimate if mine is not yet closed).

(25) Name of state and/or federal agency(ies) responsible for issuing mine leases and/or permits.

(26) List any permits obtained, or to be obtained, to build and operate the project.

(27) For active underground mine VAM activities, active underground mine methane drainage activities, and active surface mine methane drainage activities, up-to-date mine plan, mine ventilation plan, and mine map

submitted to MSHA and/or appropriate state or federal agency responsible for mine leasing/permitting.

(28) *For abandoned mine methane recovery activities, the final mine maps submitted to appropriate state or federal environmental or mining agencies upon closure.

(29) Offset project commencement date and specification of the action(s) that identify the commencement date.

(30) First reporting period.

(31) A qualitative characterization and quantitative estimate of the baseline emissions at the mine including an explanation of how the quantitative estimate was reached.

(32) Describe any mine methane destruction occurring at the mine prior to the offset project commencement date. List the source of the methane destroyed, destruction device(s) used, and device operation dates.

(33) A description of the project activities that will lead to GHG emission reductions including the methane end-use management option(s), destruction devices, and metering and data collection systems to be employed by the project.

(34) For active underground mine VAM activities, state whether supplemental methane will be used.

(35) Declaration that the project is not being implemented as a result of any federal, state or local law, statute, regulation, court order or other legally binding mandate.

(36) *Disclose if any GHG reductions associated with the offset project have ever been registered with or claimed by another registry or program, or sold to a third party prior to our listing. Identify the registry or program as well as the vintage(s) of credits issued, reporting period(s), and verification bodies that have performed verification services.

(37) State whether the project is transitioning to the Compliance Offset Protocol Mine Methane Capture Projects, after previously being listed as an early action offset project.

(38) *List any programs participated in by the mine owner and operator, either in the past or present, that encourage the capture and destruction of mine methane. If applicable, include programs at mine locations other than the project site. Specify dates of participation for each program

(39) *Bird's-eye view map of the mine site that includes:

(A) Longitude and latitude coordinates.

(B) Governing jurisdictions.

(C) Public and private roads.

(D) Mine permit boundary.

(E) Mine lease boundary, if applicable.

(F) Location of existing ventilation shafts. For active underground mine VAM activities, indicate whether or not the shaft is part of the project.

(G) Planned location of additional ventilation shafts. For active underground mine VAM activities, indicate whether or not the shaft will be part of the project.

(H) Location of existing wells and boreholes. For active underground mine methane drainage activities, active surface mine methane drainage activities, and abandoned underground mine methane recovery activities, assign a number to each existing well/borehole and, on a separate sheet of paper, indicate:

1. the source type (i.e., pre-mining surface well, pre-mining in-mine borehole, post-mining gob well, existing coal bed methane (CBM) well that would otherwise be shut-in and abandoned, abandoned well that is re-activated, and converted dewatering wells);
2. whether or not the well/borehole is part of the project; and
3. for pre-mining surface wells, specify whether or not the well is mined through and when the well was, or is expected to be, mined through.

(I) Location of additional wells and boreholes planned to be drilled prior to offset project commencement. For active underground mine methane drainage activities, active surface mine methane drainage activities, and abandoned underground mine methane recovery activities, assign a number to each well/borehole and, on a separate sheet of paper, indicate:

1. the source type (i.e., pre-mining surface well, pre-mining in-mine borehole, post-mining gob well);
2. whether or not the well/borehole will be part of the project; and
3. for pre-mining surface wells, specify when the well is expected to be mined through.

(J) Location of existing equipment used to collect, treat, store, meter, and destroy mine methane. Assign a number to each piece of equipment and, on a separate sheet of paper, indicate:

1. the manufacturer and name of each piece of equipment;
2. the purpose of each piece of equipment;
3. the installation date of each piece of equipment;
4. for metering equipment, the date of the most recent inspection, cleaning and calibration of each piece of equipment;
5. for destruction devices, whether it is a qualifying or non-qualifying destruction device in accordance with Chapter 2;
6. for non-qualifying destruction devices that were operating at the mine prior to offset project commencement and during the year immediately preceding offset project commencement, provide the volume or mass of VAM/MM/SMM/AMM destroyed by the device in the three-year period prior to offset project commencement (or during the length of time the devices are operational, if less than

three years), averaged according to the length of the reporting period; and

7. for destruction devices that have been source-tested to develop site-specific device destruction efficiency, the date of the test and the resulting destruction efficiency.

(K) Location of additional equipment used to collect, treat, store, meter, and destroy mine methane planned to be installed prior to offset project commencement. Assign a number to each piece of equipment and, on a separate sheet of paper, indicate:

1. the manufacturer, name/model number, and serial number of each piece of equipment;
2. the purpose of each piece of equipment;
3. the expected installation date of each piece of equipment; and
4. for destruction devices, whether it is a qualifying or non-qualifying destruction device in accordance with Chapter 2.

(40) A geologic cross section diagram showing aboveground and underground conditions including:

(A) Mined and unmined coal seam(s) from the surface to 50 meters below the lowest mined seam.

(B) Underground mine extents according to an up-to-date mine plan.

(C) Include the well depth of completion relative to the lowermost mined seam.

(D) Mining progress indicating direction of mining.

(E) Aboveground mine boundary.

(F) For active underground mine VAM activities, all existing and planned ventilation shafts (labeled using the same numbering system as the map).

(G) For active underground mine methane drainage activities, active surface mine methane drainage activities and abandoned underground mine methane recovery activities, all existing and planned wells/boreholes (labeled using the same numbering system as the map). Include the depth and angle of existing pre-mining surface wells.

(H) Existing and planned equipment used to collect, treat, store, meter, and destroy mine methane (labeled using the same numbering system as the map).

(c) Abandoned mine methane recovery activities that are comprised of multiple mines as allowed for by section 2.4 must provide the items marked with an asterisk (*) for each involved mine.

§ 7.2. Offset Project Data Report.

(a) Offset Project Operators or Authorized Project Designees must submit an Offset Project Data Report (OPDR) at the conclusion of each Reporting Period according to the reporting schedule in section 95976 of the Regulation.

(b) Offset Project Operators or Authorized Project Designees must submit the information required by section 95976 of the Regulation, in addition to the following information:

(1) Offset project name.

(2) Mine methane capture activity type (i.e., active underground mine VAM activity, active underground mine methane drainage activity, active surface mine methane drainage activity, or abandoned underground mine methane recovery activity).

(3) Contact information including name, phone number, mailing address, physical address (if different from mailing address), and email address for the:

(A) Offset Project Operator; and

(B) Authorized Project Designee (if applicable).

(4) CITSS ID number for the:

(A) Offset Project Operator; and

(B) Authorized Project Designee (if applicable).

(5) Contact information including name, phone number, email address and, if applicable, the organizational affiliation for:

(A) the person submitting the information;

(B) technical consultants.

(6) Date of form completion.

(7) Reporting period.

(8) Offset project commencement date.

(9) *Physical address and latitude and longitude coordinates of mine site.

(10) Mine basin as defined by the American Association of Petroleum Geologists (AAPG) Geologic Note: AAPG-CSD Geological Provinces Code Map: AAPG Bulletin, Prepared by Richard F. Meyer, Laurie G. Wallace, and Fred J. Wagner, Jr., Volume 75, Number 10 (October 1991).

(11) *Mining method(s) employed (e.g., longwall, room and pillar, open-pit, etc.).

(12) *Mineral production during reporting period (specify mineral produced and unit).

(13) Statement as to whether all the information submitted for project listing is still accurate. If not, provide updates to relevant listing information.

(14) *Statement as to whether the project has met all local, state, or federal regulatory requirements during the reporting period. If not, an explanation of the non-compliance must be provided.

(15) For active underground mine methane drainage activities and active surface mine methane drainage activities, latest mine plan and mine map submitted to appropriate state or federal agency responsible for mine leasing/permitting.

(16) For active underground mine VAM activities, state whether supplemental methane was used.

(17) Baseline emissions during the reporting period (BE), following the requirements of Chapter 5.

(18) Project emissions during the reporting period (PE), following the requirements of Chapter 5.

(19) A calculation of the total net GHG reductions for the reporting period (ER), following the requirements of Chapter 5.

(20) For each methane source:

(A) name the destruction device that captured methane was sent to;

(B) provide the amount of VAM or mine gas (MG) collected during the reporting period and the weighted average of methane concentration of the VAM/MG for the reporting period;

(C) provide the amount of methane (CH_4) sent to each qualifying destruction device during the reporting period;

(D) provide the amount of methane (CH_4) sent to each non-qualifying destruction device during the reporting period; and

(E) for pre-mining surface wells, indicate whether the well is mined through.

(21) For active underground mine methane drainage activities and active surface mine methane drainage activities, identify all pre-mining surface wells that were mined through during the reporting period in accordance with Chapter 5.

(22) For each qualifying and non-qualifying destruction device:

(A) provide the amount of methane destroyed during the reporting period; and

(B) indicate if the gas flow metering equipment for the device internally corrects for temperature and pressure

(23) Indicate whether the project used site-specific methane destruction efficiencies and, if so, provide a description of the process of establishing these destruction efficiencies that includes the identity of any third parties involved.

(24) Declaration that the project is not being implemented as a result of any federal, state or local law, statute, regulation, court order or other legally binding mandate.

(d) Abandoned mine methane recovery activities that are comprised of multiple mines as allowed for by section 2.4 must provide the items marked with an asterisk (*) for each involved mine.

Chapter 8. Verification

(a) All Offset Project Data Reports are subject to regulatory verification as set forth in section 95977 of the Regulation by an ARB accredited offset verification body.

(b) The Offset Project Data Reports must receive a positive or qualified positive verification statement to be issued ARB or registry offset credits.

Appendix A. Emission Factors – Quantification Methodology

Table A.1 CO_2 Emission Factors for Fossil Fuel Use

Fuel Type	Default High Heat Value	Default CO2 Emission Factor	Default CO2 Emission Factor
Coal and Coke	**MMBtu / short ton**	**kg Co_2 / mmBtu**	**kg CO_2 / short ton**
Anthracite	25.09	103.54	2597.819
Bituminous	24.93	93.40	2328.462
Subbituminous	17.25	97.02	1673.595
Lignite	14.21	96.36	1369.276
Coke	24.80	102.04	2530.592
Mixed (Commercial sector)	21.39	95.26	2037.611
Mixed (Industrial coking)	26.28	93.65	2461.122
Mixed (Electric Power sector)	19.73	94.38	1862.117
Natural Gas	**MMBtu / scf**	**kg CO_2 / mmBtu**	**kg CO_2 / scf**
(Weighted U.S. Average)	1.028×10^{-3}	53.02	0.055
Petroleum Products	**MMBtu/gallon**	**kg CO_2 / mmBtu**	**kg CO_2 / gallon**
Distillate Fuel Oil No. 1	0.139	73.25	10.182
Distillate Fuel Oil No. 2	0.138	73.96	10.206
Distillate Fuel Oil No. 4	0.146	75.04	10.956
Distillate Fuel Oil No. 5	0.140	72.93	10.210
Residual Fuel Oil No. 6	0.150	75.10	11.265
Used Oil	0.135	74.00	9.990
Kerosene	0.135	75.20	10.152
Liquefied petroleum gases (LPG)	0.092	62.98	5.794
Propane	0.091	61.46	5.593
Propylene	0.091	65.95	6.001
Ethane	0.069	62.64	4.322
Ethanol	0.084	68.44	5.749
Ethylene	0.100	67.43	6.743
Isobutane	0.097	64.91	6.296
Isobutylene	0.103	67.74	6.977
Butane	0.101	65.15	6.580
Butylene	0.103	67.73	6.976
Naphtha (<401 deg F)	0.125	68.02	8.503
Natural Gasoline	0.110	66.83	7.351
Other Oil (>401 deg F)	0.139	76.22	10.595
Pentanes Plus	0.110	70.02	7.702
Petrochemical Feedstocks	0.129	70.97	9.155
Petroleum Coke	0.143	102.41	14.645
Special Naphtha	0.125	72.34	9.043
Unfinished Oils	0.139	74.49	10.354

Heavy Gas Oils	0.148	74.92	11.088
Lubricants	0.144	74.27	10.695
Motor Gasoline	0.125	70.22	8.778
Aviation Gasoline	0.120	69.25	8.310
Kerosene-Type Jet Fuel	0.135	72.22	9.750
Asphalt and Road Oil	0.158	75.36	11.907
Crude Oil	0.138	74.49	10.280
Other fuels (solid)	**MMBtu / short ton**	**kg CO_2 / mmBtu**	**kg CO_2 / short ton**
Municipal Solid Waste	9.95[1]	90.7	902.465
Tires	26.87	85.97	2310.014
Plastics	38.00	75.00	2850.000
Petroleum Coke	30.00	102.41	3072.300
Other fuels (Gaseous)	**MMBtu / scf**	**kg CO_2 / mmBtu**	**kg CO_2 / scf**
Blast Furnace Gas	0.092×10^{-3}	274.32	0.025
Coke Oven Gas	0.599×10^{-3}	46.85	0.028
Propane Gas	2.516×10^{-3}	61.46	0.155
Fuel Gas[2]	1.388×10^{-3}	59.00	0.082
Biomass Fuels - Solid	**MMBtu / short ton**	**kg CO2 /mmBtu**	**kg CO_2 / short ton**
Wood and Wood Residuals	15.38	93.80	1442.644
Agricultural Byproducts	8.25	118.17	974.903
Peat	8.00	111.84	894.720
Solid Byproducts	25.83	105.51	2725.323
Biomass Fuels - Gaseous	**MMBtu / scf**	**kg CO2 / mmBtu**	**kg CO_2 / scf**
Biogas (Captured methane)	0.841 x 10-3	52.07	0.044
Biomass Fuels - Liquid	**MMBtu / gallon**	**kg CO2 / mmBtu**	**kg CO_2 / gallon**
Ethanol	0.084	68.44	5.749
Biodiesel	0.128	73.84	9.452
Rendered Animal Fat	0.125	71.06	8.883
Vegetable Oil	0.120	81.55	9.786

Table A.2 Emissions & Generation Resource Integrated Database (eGRID) Table

eGRID subregion acronym	eGRID subregion name	Annual output emission rates	
		(lb CO_2/MWh)	(metric ton CO_2/MWH)*
AKGD	ASCC Alaska Grid	1,280.86	0.633
AKMS	ASCC Miscellaneous	521.26	0.257
AZNM	WECC Southwest	1,191.35	0.588
CAMX	WECC California	658.68	0.325
ERCT	ERCOT All	1,181.73	0.584
FRCC	FRCC All	1,176.61	0.581
HIMS	HICC Miscellaneous	1,351.66	0.668
HIOA	HICC Oahu	1,593.35	0.787
MORE	MRO East	1,591.65	0.786
MROW	MRO West	1,628.60	0.804
NEWE	NPCC New England	728.41	0.360
NWPP	WECC Northwest	819.21	0.405
NYCW	NPCC NYC/Westchester	610.67	0.302
NYLI	NPCC Long Island	1,347.99	0.666
NYUP	NPCC Upstate NY	497.92	0.246
RFCE	RFC East	947.42	0.468
RFCM	RFC Michigan	1,659.46	0.820
RFCW	RFC West	1,520.59	0.751
RMPA	WECC Rockies	1,824.51	0.901
SPNO	SPP North	1,815.76	0.897
SPSO	SPP South	1,599.02	0.790
SRMV	SERC Mississippi Valley	1,002.41	0.495
SRMW	SERC Midwest	1,749.75	0.864
SRSO	SERC South	1,325.68	0.655
SRTV	SERC Tennessee Valley	1,357.71	0.671
SRVC	SERC Virginia/Carolina	1,035.87	0.512
U.S.		**1,216.18**	**0.601**

*Converted from lbs CO2/MWh to metric tons CO2/MWH using using conversion factor 1 metric ton = 2,204.62lbs.

Appendix B. Device Destruction Efficiencies – Quantification Methodology

Table B.1 Default Destruction Efficiencies by Destruction Device

Biogas Destruction Device	Biogas Destruction Efficiency (BDE)
Open Flare	0.96
Enclosed Flare	0.995
Lean-burn Internal Combustion Engine	0.936
Rich-burn Internal Combustion Engine	0.995
Boiler	0.98
Microturbine or large gas turbine	0.995
Upgrade and use of gas as CNG/LNG fuel	0.95
Upgrade and injection into natural gas transmission and distribution pipeline	0.98

Equation B.1: Calculating Heat Generation Emission Factor

$$CEF_{heat} = \frac{CEF_{CO2,i}}{Eff_{heat}} \times \frac{44}{12}$$

Where,

CEF_{heat}	=	CO_2 emission factor for heat generation *12*
$CEF_{CO2,i}$	=	CO_2 emission factor of fuel used in heat generation (see table B.1)
Eff_{heat}	=	Boiler efficiency of the heat generation (either measured efficiency, manufacturer nameplate data for efficiency, or 100%
$\frac{44}{12}$	=	Carbon to carbon dioxide conversion factor

Appendix C. Data Substitution Methodology – Quantification Methodology

(a) ARB expects that MMC projects will have continuous, uninterrupted data for the entire reporting period. However, ARB recognizes that unexpected events or occurrences may result in brief data gaps.

(b) This appendix provides a quantification methodology to be applied to the calculation of GHG emission reductions for MMC projects when data integrity has been compromised due to missing data points.

(c) This methodology is only applicable to gas flow metering and methane concentration parameters. Data substitution is not allowed for equipment that monitors the proper functioning of destruction devices such as thermocouples.

(d) 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.

(e) Data substitution is not allowed for data used to calculate mine specific hyperbolic decline curve coefficients for an abandoned underground mine methane recovery activity.

(f) 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.

(g) 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 or engines, 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.

(h) 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 may be applied:

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