Carbon Offset Opportunities for Coal Mine Methane Projects in the Climate Action Reserve

Coal Mine Methane Protocol Overview

Morgantown WV, November 9, 2010

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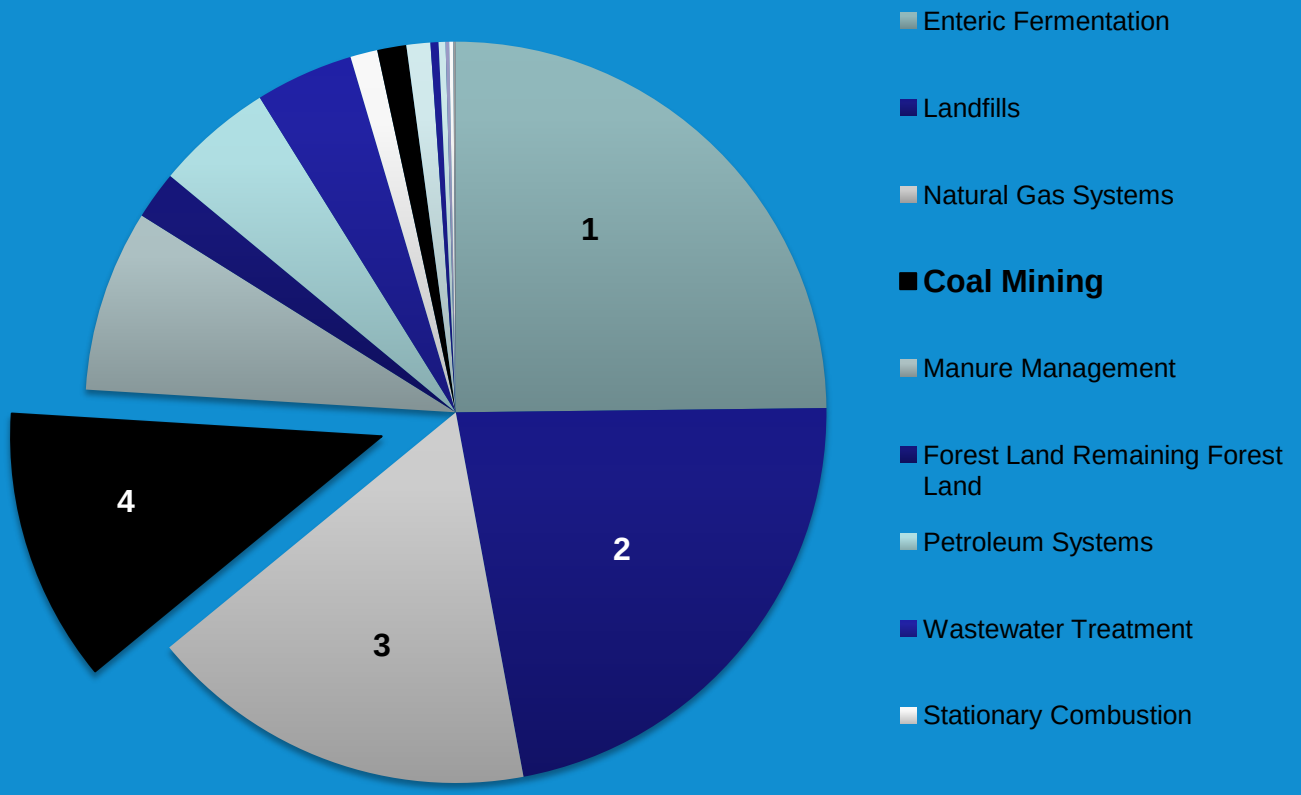
Emissions from Coal Mining

- 2008 US coal production: 1.06 billion metric tons
- 2008 US underground CMM emissions
  - 4th largest source of methane emissions
  - 8% of US methane emissions
- VAM = 60% of underground CMM emissions
- CMM from drainage systems = 40%

Source: EPA *DRAFT Inventory of US GHG Emissions and Sinks: 1990-2008 (March 2010)*

Methane Sources in US



CMM Protocol Development Goals

- Develop a standardized approach for quantifying, monitoring and verifying GHG reductions from CMM projects
  - Active underground coal mines in the US
  - Drainage and ventilation system projects
- Maintain consistency with or improve upon existing methodologies
- Ensure accuracy, credibility and practicality of projects
- Initialized development in February 2009
- Adopted by Reserve Board in October 2009

Protocol Development Process

- Internal protocol scoping
- Form multi-stakeholder workgroup
- Draft protocol
- Send draft through workgroup process
  - Workgroup provides feedback, consensus is built
  - Can be iterative process
- Draft protocol released for public review
- Public comments incorporated
- Protocol submitted to Reserve board for adoption

Protocol Timeline 2009

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Public Scoping Meeting	*February 10*
WG Meeting 1	*May 8*
Draft protocol to workgroup	*June 3*
WG Meeting 2	*June 17*
WG Meeting 3	*July 22*
Public comment period	August 17 - September 11
Public workshop	August 25
WG Meeting 4, if needed	*Mid-September*
Protocol adoption by Reserve Board	October 7

Principles of Reserve Project Accounting

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- **Real:** Reductions have actually occurred, and are quantified using complete, accurate, transparent, and conservative methodologies
- **Additional:** Reductions result from activities that would not happen in the absence of a GHG market
- **Permanent:** Reductions verified ex-post, risk of reversals mitigated
- **Verified:** Emission reports must be free of material misstatements, confirmed by an accredited verification body
- **Owned unambiguously:** Ownership of GHG reductions must be clear
- **Not harmful:** Negative externalities must be avoided
- **Practicality:** Project implementation barriers should be minimized

The Standardized Approach

Benefits to a top-down approach:

- Low up-front costs to project developers
- Efficient review and approval of projects
- Transparency and consistency
- Same approach applies across projects
- Prescriptive guidance to eliminate judgment calls

But...high initial resource investment to program

Workgroup Participants

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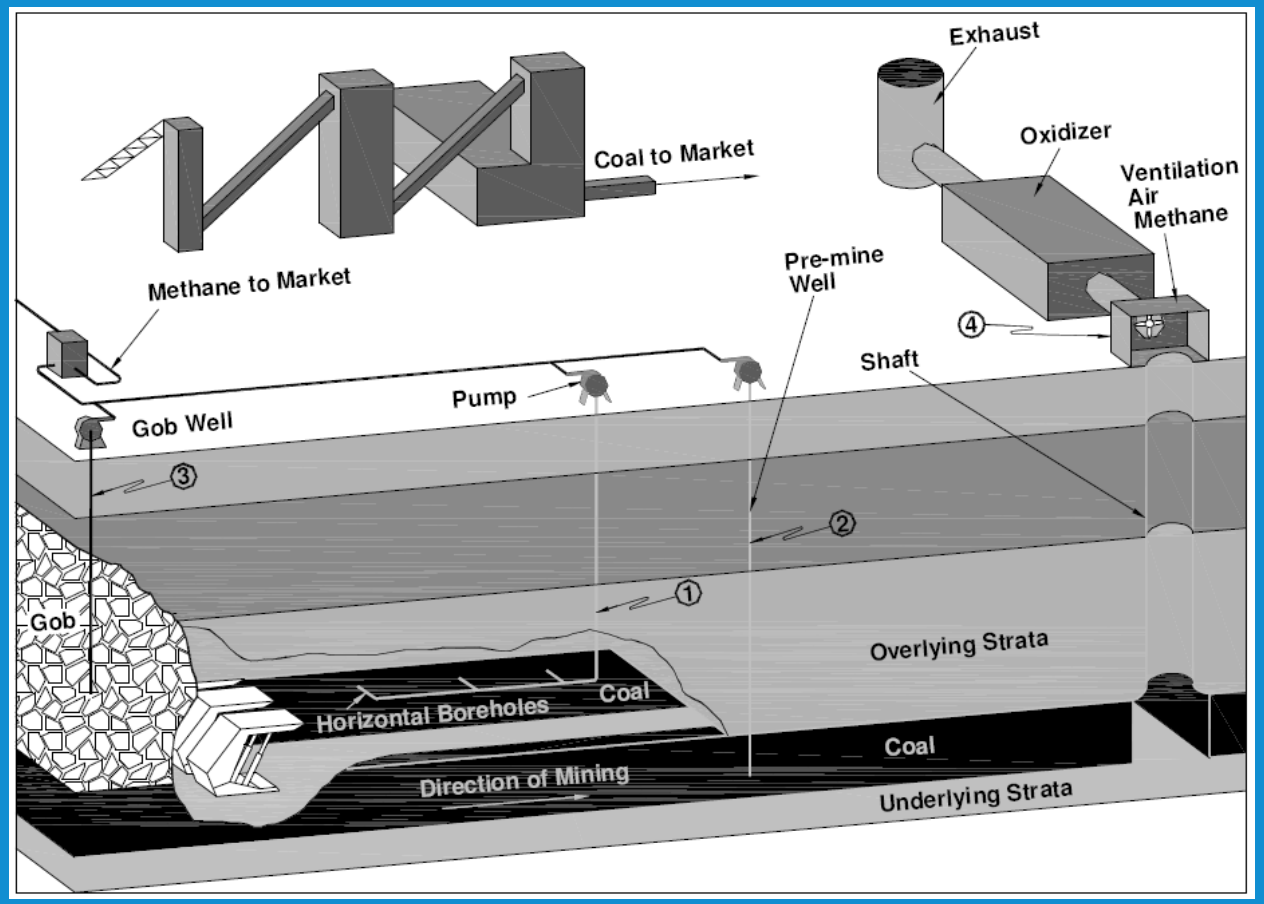
Coal Mine Degasification



1. Horizontal pre-mining
2. Surface pre-mining
3. Post-mining
4. VAM

Source: US EPA *Identifying Opportunities for Methane Recovery at U.S Coal Mines* 2009

Project Definition

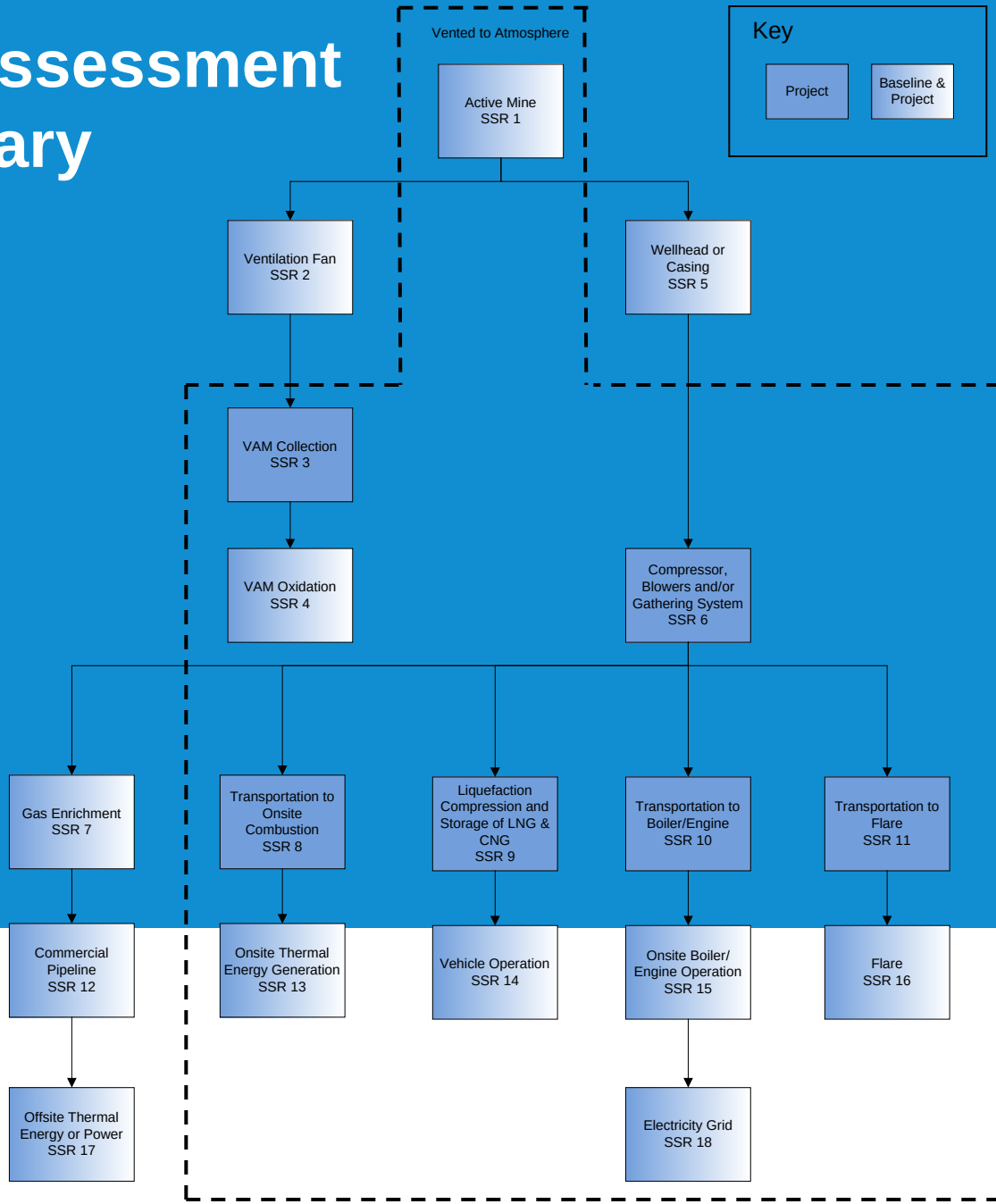
The installation and operation of any device, or set of devices, that result in the destruction of methane gas that would otherwise have been emitted to the atmosphere from an active underground mine.

- Coal mines and MSHA Category III trona mines are eligible
- Two defined project types: drainage projects and VAM projects

Excludes:

- Surface mines
- Abandoned mines
- Coal bed methane
- Mines that use fluid/gas to enhance CMM drainage

GHG Assessment Boundary



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Drainage Project Definition

- Specifies allowable drainage activities
- Boreholes, destruction devices (DD) and any non-qualifying devices that make up project are defined by project developer
  - Opportunity for multiple drainage projects at a single mine site

Once project is defined:

- New boreholes + existing DD = project expansion
- New DD + existing boreholes = project expansion
- New boreholes + new DD = new project

VAM Project Definition

- Definition tied to a single ventilation shaft
- Shaft, VAM destruction devices (VAM) and any non-qualifying devices that make up project are defined by project developer
  - Opportunity for multiple VAM projects at a single mine site

Once project is defined:

- New VAM + existing shaft = project expansion
- VAM + new shaft = new project

Eligibility Rules

1. Location	U.S. and its territories
2. Project Start Date	Within 6 months prior to project submission (back to October 7, 2007 for initial 12 month grace period)
3. Additionality	Exceed legal requirements
	Meet performance standard
4. Regulatory Compliance	Compliance with all applicable laws
Crediting Period	10 years, renewable one time

Regulatory Test

- Regulatory analysis identified no regulations that obligate coal mines to destroy methane
- Project developers required to submit signed Regulatory Attestation for each verification cycle
- If regulation is passed during crediting period, emission reductions can be reported up until date methane is legally required to be destroyed
  - Similar treatment if source is subject to cap-and-trade

Performance Standard Test

- Performance standard based on end use destruction device
  - Drainage projects: any end use destruction other than injection into a natural gas pipeline for off-site consumption
  - All VAM projects are eligible
- Performance Standard Test is applied once at the beginning of each crediting period

Quantifying Emission Reductions

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Baseline emissions = an estimate of emissions within GHG Assessment Boundary that would have happened in the absence of the project

- CO_2 from methane destruction of non-qualifying devices (if any)
- Methane released into atmosphere

Project emissions = actual emissions that occur within the GHG Assessment Boundary

- CO_2 from additional fossil fuel and grid electricity consumption
- CO_2 from destruction of captured methane
- CH_4 emissions from uncombusted methane

Project Emission Reductions

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Equation 5.2: Emission Reductions

$$ER_y = BE_y - PE_y$$

Where,

ER_y	=	Emission reductions during the year y
BE_y	=	Baseline emissions during the year y
PE_y	=	Project emissions during the year y

Baseline Emissions

Equation 5.3: Baseline Emissions

$$BE_y = BE_{MD,y} + BE_{MR,y}$$

Equation 5.4: CO_2 from Methane Destruction of Non-Qualifying Devices

$$BE_{MD,y} = \left(CEF_{CH_4} + r \times CEF_{NMHC}\right) \times \sum_i \left(SMM_{BL,i,y} + VAM_{BL,i,y} + HMM_{BL,i,y} + PMM_{BL,i,y}\right)$$

Equation 5.5: Methane Released into Atmosphere

$$BE_{MR,y} = GWP_{CH_4} \times \left[\begin{array}{l} \sum_i \left(SMMe_{i,y} - SMM_{BL,i,y}\right) + \sum_i \left(HMM_{PJ,i,y} - HMM_{BL,i,y}\right) \\ + \sum_i \left(PMM_{PJ,i,y} - PMM_{BL,i,y}\right) + \sum_i \left(VAM_{PJ,i,y} - VAM_{BL,i,y}\right) \end{array}\right]$$

Project Emissions

Equation 5.7: Project Emissions

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM}$$

Equation 5.8: CO_2 from Fossil Fuel and Grid Electricity

$$PE_{ME} = \left(CONS_{ELEC,PJ} \times CEF_{ELEC} \right) + \frac{\left(CONS_{HEAT,PJ} \times CEF_{HEAT} + CONS_{FossFuel,PJ} \times CEF_{FossFuel} \right)}{1000}$$

Equation 5.9: CO_2 from Destruction of Captured Methane

$$PE_{MD} = \left(MD_{OX} + MD_i \right) \times \left(CEF_{CH_4} + r \times CEF_{NMHC} \right)$$

Equation 5.13: Emissions from Uncombusted Methane

$$PE_{UM} = \left[GWP_{CH_4} \times \sum_i MM_i \times \left(1 - Eff_i \right) \right] + PE_{OX} \times GWP_{CH_4}$$

Project Documentation

Required project documentation includes:

- Completed Project Submittal form
- Project diagram*: diagram of boreholes, eligible destruction devices and non-qualifying destruction devices within project's GHG assessment boundary
- Current mine plan
- Signed Attestation of Title document
- Verification Report
- Verification Opinion
- Signed Regulatory Attestation

* Must be updated if a project expands or if non-qualifying device is added to project

Monitoring, Reporting & Verification

- Detailed requirements on monitoring frequency and instrumentation QA/QC, including:
  - Cleaning, inspection, field checks and calibration schedule
  - Procedure for failed calibration
  - Procedure for missing data
- Record-keeping requirements
- Reporting period/verification cycle = maximum of 12 months; can choose to verify more frequently
- Verify each reporting period with ISO-accredited and Reserve-trained verification body

Version 2.0

- Version 1.0 performance standard analysis based on available data (end use and methane drainage rates)
- Working with industry to collect data at the well level to refine analysis
- Add performance standard to allow for CMM-to-pipeline projects
- Expected to be completed in 2010/2011

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Appendix

Project Emission Reductions

Equation 5.2: Emission Reductions

$$ER_y = BE_y - PE_y$$

Where,

ER_y	=	Emission reductions during the year y
BE_y	=	Baseline emissions during the year y
PE_y	=	Project emissions during the year y

Baseline Emissions

Equation 5.3: Baseline Emissions

$$BE_y = BE_{MD,y} + BE_{MR,y}$$

Equation 5.4: CO_2 from Methane Destruction of Non-Qualifying Devices

$$BE_{MD,y} = \left(CEF_{CH_4} + r \times CEF_{NMHC}\right) \times \sum_i \left(SMM_{BL,i,y} + VAM_{BL,i,y} + HMM_{BL,i,y} + PMM_{BL,i,y}\right)$$

Equation 5.5: Methane Released into Atmosphere

$$BE_{MR,y} = GWP_{CH_4} \times \left[\begin{array}{l} \sum_i \left(SMMe_{i,y} - SMM_{BL,i,y}\right) + \sum_i \left(HMM_{PJ,i,y} - HMM_{BL,i,y}\right) \\ + \sum_i \left(PMM_{PJ,i,y} - PMM_{BL,i,y}\right) + \sum_i \left(VAM_{PJ,i,y} - VAM_{BL,i,y}\right) \end{array}\right]$$

Calculating Baseline SMM, VAM, HMM and PMM

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Calculate:

- Average annual value destroyed over 3 year period prior to project implementation AND
- Actual metered annual value
- Use higher number
  - If non-qualifying DD was shut down within one year of project start date, accounted for
  - If DD shut down more than one year before, ignore

Calculating $SMMe_{i,y}$

Equation 5.6:

Calculating Eligible CMM from Surface Pre-mining Boreholes

$$SMMe_{i,y} = SMMpre_{e,y} + SMMpost_{e,y}$$

Where,

$SMMpre_{e,y}$	=	CMM from surface pre-mining destroyed by the project for year y from boreholes mined through in current year
$SMMpost_{e,y}$	=	CMM from surface pre-mining destroyed by the project in year y from boreholes previously mined through