COAL MINE METHANE DEVELOPMENTS IN THE UNITED STATES

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ABSTRACT

Methane (CH_4) is a potent greenhouse gas, accounting for 15 percent of all global greenhouse gas emissions in 2005. Since methane has a much shorter atmospheric lifetime than carbon dioxide (CO_2), reducing methane emissions can achieve considerable climate benefits over the next 25 years. Coal seams often contain significant quantities of methane and CH_4 released to the atmosphere from gassy mines during coal extraction is a major source of greenhouse gas emissions. Methane (CH_4) emissions from coal mining activities constitute approximately 6% of total global human-related methane emissions.

Coal mines around the world have recognized that methane is a clean energy resource that can be captured and used productively. Coal mine methane (CMM) is currently utilized for power generation, natural gas pipeline injection, vehicle fuel, industrial process feed stocks, on-site mine boilers, mine heating, and home heating distribution systems. Upgrading mine degasification systems can often improve gas quality and create favorable project economics.

The United States has been a leader in coal mine methane (CMM) recovery and use since the 1990's. There are now 15 projects at active underground mines in the U.S., as well as 26 abandoned mine methane projects. Recovery and use projects at active underground U.S. mines reduced methane emissions by approximately 49 Billion cubic feet in 2010. In an exciting new development, a ventilation air methane (VAM) mitigation project at the CONSOL McElroy mine in West Virginia was installed by Verdeo. Operational since September 2012, this is the first commercial-scale VAM project in the U.S. and the project will reduce methane emissions by an estimated 920 MMCF/yr.

As part of the U.S. Greenhouse Gas Reporting Program, actual data on methane emissions from underground coal mines was collected for the first time in 2011 and reported to U.S. EPA in September 2012. The data collected will help inform stakeholders, particularly the underground coal mining industry, of CMM emission sources on public and private lands. The detailed data will also shed light on the specific sources of methane from active underground coal mines and highlight project opportunities for the U.S. coal industry.

The paper will cover U.S. coal mine methane emissions, U.S. CMM utilization and destruction projects, Federal policies and State incentives for CMM capture and utilization. 2011 CMM data from the U.S. Greenhouse Gas Reporting Program Subpart FF will be analyzed and compared with previous U.S. Greenhouse Gas Inventory estimates. Other developments, including the voluntary carbon market, will be discussed.

KEYWORDS

coal mine methane recovery and utilization, ventilation air methane, clean energy, degasification

Overview of Coal Mine Methane Emissions in the U.S.

The term coal mine methane (CMM) refers to methane from surface or underground coal mines that is released to the atmosphere or captured in advance of, during, or following physical coal mining activities. The release of CMM from active and abandoned mining operations is a major source of GHG emissions. Globally, CMM accounts for approximately 6% of anthropogenic methane emissions[1].

CMM emissions management is important for several reasons, including enhanced mine safety, mitigation of greenhouse gas (GHG) emissions, and the potential supply of a local clean energy source. Used in practical and profitable ways, the recovery and utilization of CMM can lead to improved worker safety and mine profitability, as well as reduced GHG emissions. Most CMM projects recover and use methane from coal mine gas drainage systems, which include pre-mine degasification, in-mine horizontal

[1] Methane to Markets http://www.methanetomarkets.org/documents/coal_fs_eng.pdf

boreholes, and post-mining gob gas recovery. In 2011, nearly 60% of all U.S. CMM emissions were released through underground mine ventilation fans. The concentration of ventilation air methane (VAM) is extremely low; typically below 1%. This low concentration gas has proven to be a barrier to VAM recovery and destruction/utilization in the past, but recent technological advancements with oxidation equipment and the growth of carbon markets have made it possible to deploy profitable VAM mitigation projects.

The U.S. coal emissions inventory consists of five different sub-source categories (emissions from abandoned mines are treated separately). Figure 1 shows the breakdown of each sub-source category by emissions. Total emissions from U.S. coal mines were 4,767 million cubic meters (MCM) of methane. Sources include methane released through underground mine ventilation fans, gas drainage systems at underground coal mines that employ vertical and/or horizontal wells, fugitive emissions from abandoned coal mines, coal seams that are exposed to the atmosphere through surface mining operations, and post-mine emissions that are released from the handling and transportation of coal following mining activities.

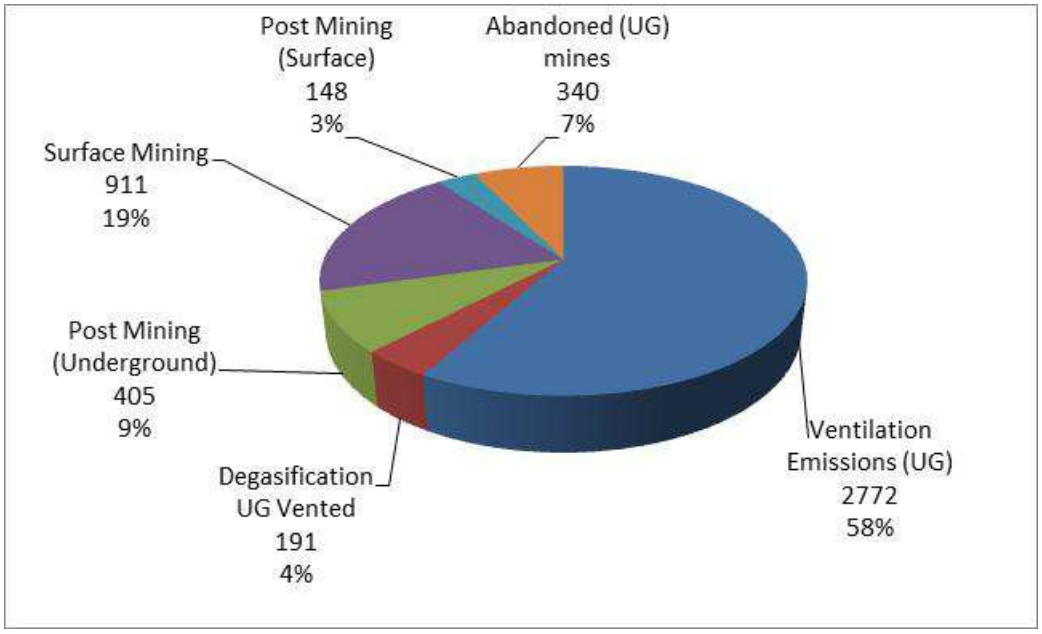

Figure 1 - 2011 U.S. Coal Mine Methane Emissions (MCM) [2]

The majority of emissions from coal mining are attributed to underground coal mining operations. In 2011, the EPA estimates that approximately 71% or 3,368 MCM of methane emissions associated with coal mining were attributable to underground coal mining operations most (2,772 MCM) originate from VAM. Post mining operations and degasification systems are also significant sources of emissions from underground coal mining operations.

Emissions from surface coal mining are small compared to the emissions of underground coal mining. The gas content of coal seams that are mined at the surface contain less methane than the gas content of coal seams that are deep underground. Surface mines also contribute to methane emissions from overburden piles and release emissions through uncontrolled combustion and low temperature oxidation.

[2] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011
http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf

Approximately 22% of 2011 emissions from coal mining were attributable to surface mining and post-surface mining operations.

Figure 2 below shows active underground coal mine production and CMM in the U.S. from 2000 to 2011. While underground coal production has steadily declined over the past decade, CMM liberated from mines has increased. This trend reflects the increased gas content of the coal being mined. In 2000, underground coal production was approximately 411 million metric tonnes and total CMM liberated was 3,805 MCM. In 2011, underground coal production declined slightly to 380 million metric tonnes (-8%), however total CMM liberated from underground coal mines increased to 4,133 MCM (+8%). A mine-by-mine review of MSHA data on liberated methane confirmed that there is a recent net decline in the gassiness of underground mined coals. The recovery and utilization of methane liberated from coal mine degasification systems has averaged 83% since 2000. This is due primarily to the deployment of large scale pipeline injection projects located in the eastern U.S. The remaining portion of the liberated CMM is vented and accounts for the 191 MCM presented in Figure 1 for degasification emissions.

Overall emissions from underground CMM decreased from 2010 to 2011 by 22%. Total U.S. emissions in 2010 from CMM were approximately 3627 MCM. Total U.S. emissions in 2011 from CMM were approximately 2967 MCM. This was due to a steep decline in VAM emissions (-21%) and a drop in methane produced from degasification systems (-22%). This is partly due to the closure of approximately 36 gassy underground coal mines.

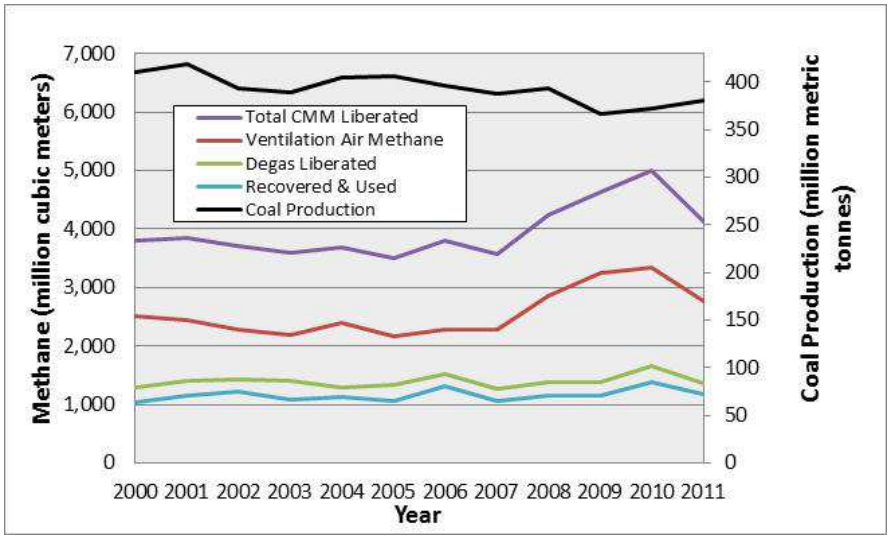

Figure 2 - Active Underground Coal Mine Production and CMM Emissions in the U.S. 2000-2011[3]

Abandoned mines contribute the smallest percentage of CMM emissions (approximately 7%). After mining operations have ceased and a mine has been sealed, emissions of methane can be released to the atmosphere. These emissions are attributed to cracks and fissures in overlying geological layers, boreholes and vent pipes. An exception to abandoned mines emitting significant amounts of methane include mines that are completely flooded; emissions from these mines are small and can be disregarded.

Due to a large number of underground coal mines closing in the early 1990's, abandoned mine methane emissions peaked in 1997 (see Figure 3). In 2008, recovery of abandoned mine methane peaked

[3] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011
http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf

following the closure of two large underground coal mines that had existing recovery projects already in place from when the mines were active.

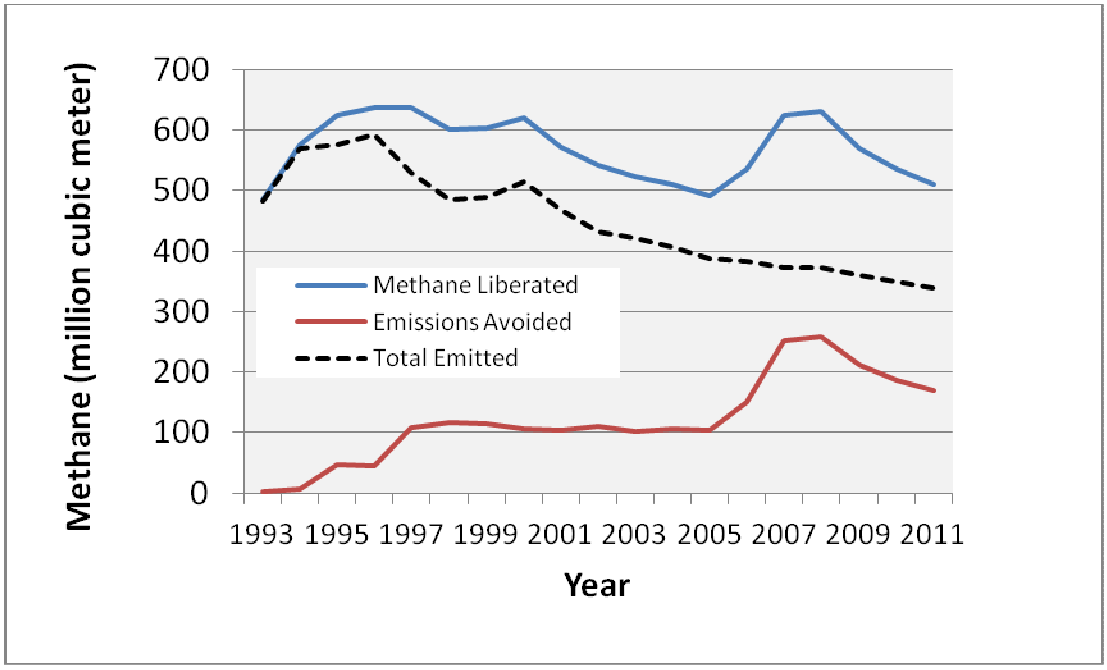

Figure 3 – Methane Emissions from Abandoned Mines[4]

U.S. CMM Utilization and Destruction Projects

In the U.S., coal mining accounts for nearly 11 percent of all man-made methane emissions[5]. CMM recovery and use is continuing to develop and grow. In 2005, methane recovery from active and abandoned coal mines was an estimated 1161 MCM and now, in 2011 has increased to over 1331 MCM. As a primary constituent of natural gas, methane can be an important energy source. Efforts to prevent and utilize methane emissions from coal mines can provide economic, environmental, and energy benefits and provide improved worker safety. Coal mine methane utilization and destruction projects involve six project types in the U.S.: pipeline sales, electric generation, heater, boiler/dryer, flaring, degasification pumps, and ventilation air methane (VAM) oxidation. There are several mines that have multiple project types.

Injection of CMM into pipelines is the most common project type. Pipeline projects are feasible when there is a pipeline near the mine with the capacity to handle the available quantity of gas expected to be produced. Methane from a coal mine must also meet pipeline standards in order to be injected, which may involve upgrading the methane gas to natural gas pipeline specifications. There are currently 13 pipeline projects at active mines and 13 pipeline projects at abandoned mines in the U.S. Some of these projects also employ other destruction devices.

CMM can be used as a fuel for electricity generation. The electricity generated may be used to meet the mine's own on-site needs or sold to utilities. Unlike pipeline injection, CMM for power generation does not require high quality methane. U.S. projects are typically in the 1-10 Megawatt range. Electric power generation projects are less common than pipeline projects, and there are currently only

[4] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011
http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf
[5] Same as above

three operating in the U.S.—two at abandoned mines and one at an active mine. The active mine project, which began operation at the end of 2012, is discussed below.

Flaring of CMM—either in open or enclosed systems—converts the methane to carbon dioxide, which is a less potent GHG than methane. There is no beneficial use associated with flaring but it is a relatively cheap option for destroying methane compared with the other destruction technologies. CMM flare projects have been implemented with the goal of reducing methane emissions and earning offset credits for those emission reductions. Currently, there are three flare projects in the U.S., all of which are used in conjunction with other project destruction devices.

As mentioned previously, VAM is unsuitable for use with most destruction technologies such as engines and flares. Because methane is explosive at concentrations ranging from 5 to 15 percent in air, mine safety regulations require gassy underground coal mines to assure that methane concentrations in the mine are maintained at safe levels well below the lower explosive limit. Therefore, fresh air is circulated through underground coal mines using ventilation systems to dilute methane to levels which typically range from 0.1 to 1.0 percent. VAM is vented to the atmosphere at most mines. VAM projects oxidize the methane in mine exhaust air and destroy the methane before it is released to the atmosphere. Two frequently investigated technologies are oxidizing VAM in a thermal oxidizer and using VAM as combustion air in combustion devices using other fuel sources. Currently, there are only two VAM projects in the U.S., with a third project scheduled be deployed in 2013.

Current U.S. Projects

At the end of 2012 there were 17 active mines operating 22 methane recovery and use projects in the U.S. Most of the projects (13) involve upgrading methane for injection into a commercial pipeline. However, the projects include four types of other end utilization and methane destruction via flares and thermal oxidizers. Table 1 shows a summary of the various types of end utilizations deployed at the mines.

At the end of 2012 there were 16 abandoned mine methane (AMM) projects operating at 38 abandoned mines in the U.S. All of these mines are located east of the Mississippi River in the Central Appalachian, Northern Appalachian, Illinois, and Warrior coal basins with the exception of two western mines, one in Colorado and one in Utah. One project, (the Corinth Project located in southern Illinois) recovers methane from 14 mines that were abandoned between 1926 and 1998.

Table 1 – Summary of U.S. Mine Methane Recovery & Destruction Projects

	Number of Mines with Projects	Number of Projects	Types of End Utilizations					
			Pipeline	Electric Generation	Heater	Boiler/dryer	Flare	VAM
Under-ground	17	22	13	1	2	2	2	2
Abandoned Under-ground	38	16	13	2	0	0	1	0
Surface	1	0*	2	0	0	0	0	0

*There were two projects at the North Antelope Rochelle Mine which were shut-in in 2011.

There were several new projects deployed in 2012, as well as new end utilizations added to existing projects. The Elk Creek Coal Mine project located at Oxbox's Elk Creek Mine in Gunnison County, Colorado is the second active underground coal mine in the U.S. to generate electricity from CMM and the first at a western coal mine. The planned three-Megawatt plant is currently operating one engine with two additional engines to be installed in the future. The project also utilizes a flare and

Figure 4. Elk Creek CMM Electric Power Project

heaters. In addition to selling electricity to a local utility, the project is expected to generate offset credits in the voluntary carbon market and is listed with the Climate Action Reserve.

The VAM project at Consol's McElroy Mine in Marshall County, West Virginia began destroying methane in May 2012 and is the largest VAM project in the U.S. The project consists of three regenerative thermal oxidizers (RTO) which convert methane to carbon dioxide and water vapor. At startup of the RTO, the ceramic medium bed in the RTO is heated with a propane burner. VAM is then forced through the bed, methane is oxidized, and the released heat is recovered by the ceramic bed medium and the air flow is reversed. The heat recovered from the first cycle heats the incoming VAM and the process repeats. The methane concentration in the VAM ranges between 0.6 and 1.5 percent. The project is listed with the Climate Action Reserve and is projected to reduce emissions by 322,000 metric tonnes of CO_2e per year.

Figure 5. McElroy VAM Project RTOs

The Green River Trona Mine Methane Destruction and Utilization Project at the Solvay Chemicals trona mine near Green River, Wyoming has been destroying waste mine methane in an enclosed flare. In 2012, Solvay began injecting gas directly into existing boiler equipment at their on-site trona processing plant.

Federal Policies and State Incentives for CMM Capture and Utilization

Voluntary Carbon Markets

CMM offset projects are eligible for carbon credits through a number of voluntary GHG Registries located in the U.S., namely the Verified Carbon Standard (VCS), the Climate Action Reserve (CAR), and the American Carbon Registry (ACR). Whether a CMM project is eligible for carbon credits depends on a number of project specifics, such as project start-up date, end use technology (i.e. electricity generation vs. pipeline sales), and origin of methane (i.e. active vs. abandoned mines, surface vs. underground mines). In addition, each GHG Registry has its own rules governing project eligibility, additionality, and registration.

Currently, CMM projects at underground coal mines are eligible to some degree in all three GHG registries, the exception being that CAR does not accept CMM pipeline sales projects. AMM projects are accepted only by VCS, and SMM projects are accepted only by VCS and ACR.

Climate Action Reserve (CAR)

CAR, a nonprofit registry and trading system based in California, was launched in 2008 and is the newest voluntary offset program within the U.S. carbon market. The program establishes standards to develop, quantify, and verify GHG emission reduction projects in the United States, as well as livestock and landfill projects in Mexico. CAR also issues offset credits for these projects (Climate Reserve Tonnes or CRTs) and monitors the trading of these credits, which are publicly accessible in its online registry.
CAR's latest CMM protocol, the *Coal Mine Methane Project Protocol Version 1.1*, issued on October 26, 2012, covers projects that use CMM for electricity generation and flaring and projects destroying VAM. This version was revised from the original Version 1.0, to update quantification, project monitoring, and QA/QC requirements but does not make any changes to eligibility or regulatory compliance requirements.

CAR currently has five CMM projects listed—two flaring projects, two VAM projects, and one electricity generation project. At the end of 2012, two of the CAR projects have been registered and issued credits for a total of 238,954 CRTs[6]. In addition to projects at coal mines, CAR also accepts projects reducing emissions at MSHA Category III gassy underground trona mines. One of the projects registered with CAR is the Solvay Chemicals project at their trona mine in Wyoming which began flaring mine methane in 2010 and recently began injecting the gas directly into existing boiler equipment at the on-site trona processing plant.

Verified Carbon Standard (VCS)

The VCS (formerly the Voluntary Carbon Standard), launched in 2006 as a pilot program, sets a global standard and provides a framework to verify voluntary GHG emission reductions. Unlike other U.S. registries, VCS follows the Clean Development Mechanism (CDM) methodologies and includes all six GHGs. The full-scale VCS standard was released on November 19, 2007. The VCS Registry System is the first multiple registry system within the voluntary carbon market. It includes three international registries: APX Inc., in North America; Caisse des Depots in Europe; and Markit in the United States, United Kingdom, and Asia Pacific region. These registries work with the VCS Project Database to issue, hold, transfer, and retire Verified Carbon Units (VCUs).

For CMM projects, VCS uses methodology elements from CDM and CAR as well its own methodology. VCS will accept CMM projects including pipeline sales, boiler use, electricity generation, flaring, and VAM. VCS approved modifications (VMR0001) to the CDM methodology ACM0008 to accept surface mine methane (SMM) projects in March 2009 and a modification to the methodology (VMR0002) in July 2010 to accept abandoned mine methane (AMM) projects. VCS has registered CMM, VAM, SMM, and AMM projects but only SMM and AMM projects in the U.S. VCS has five registered CMM projects in the U.S.—three AMM projects and two SMM projects. The AMM projects are located in Pennsylvania, Illinois, and Utah and have been issued a total of 348,191 VCUs. The SMM projects are located in Wyoming and have been issued a total of 1,458,735 VCUs[7].

American Carbon Registry (ACR)

Launched in 1996, ACR is a voluntary offset program and was the first private voluntary GHG registry in the United States. ACR partners with Environmental Resources Trust (ERT–Winrock), an organization that provides carbon technical services. ACR considers methodologies from other standards and systems that are consistent with the ACR Technical Standard, including CDM, VCS, and U.S. EPA Climate Leaders. The registry accepts CMM projects, but has not yet done so because no projects have been submitted.

Table 2 – Greenhouse Gas Registries

GHG Registry	CMM Protocol Launch Date	Eligibility	Project Types	Project Locations	Earliest Project Start Date	Additionality	Offset Units	U.S. Offsets Issued (as of Jan. 2012)
Verified Carbon Standard (VCS)	Nov. 2007	CMM SMM AMM	Pipeline Electricity Flare VAM	Worldwide	Project validation completed within 2 years of start date	Additionality Tool	Verified Carbon Unit (VCU)	1,806,926
Climate Action Reserve (CAR)	Oct. 2009	CMM	Electricity Flare VAM	U.S.	Projects submitted to CAR within 6 months of start date	Performance Standard	Climate Reserve Tonne (CRT)	238,954

[6] Climate Action Reserve https://thereserve2.apx.com/myModule/rpt/myrpt.asp?r=111
[7] The VCS Project Database https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?tc=1&Tab=Projects&a=1

American Carbon Registry (ACR)	Does not have stand-alone CMM protocol	CMM SMM	Pipeline Electricity Flare VAM	Worldwide	January 1, 2000 or later	Additionality Tool or Hybrid Additionality Approach	Emission Reduction Ton (ERT)	0

Alternative and Renewable Energy Incentives for CMM

As evidenced by a growing body of state legislation, CMM is increasingly being considered an important alternative or renewable energy resource. Many states in the U.S. have developed renewable energy portfolio standards (RPS) or clean energy goals (CEG) which direct electricity providers to generate or obtain minimum percentages of their power from "eligible energy resources" by certain dates. Out of 15 major coal producing states[8], only five states - Pennsylvania, West Virginia, Ohio, Utah, and Indiana – currently include CMM in their renewable or alternative energy standards, one of which is strictly voluntary.

Generally, the term renewable energy refers to sources such as solar-electric, solar thermal energy, wind power, hydropower, geothermal energy, fuel cells, and certain biomass energy and biologically derived fuels. However, Utah legislation defines CMM from abandoned mines and coal degasification operations produced with a state-approved mine permit as a "renewable energy resource." Pennsylvania, West Virginia, and Ohio each designate CMM as an "alternative" energy resource rather than a "renewable" energy resource, and Indiana does not specifically address CMM but defines coal bed methane as a clean energy technology. Where CMM is included as part of a state's renewable or alternative energy portfolio standards, there are state alternative energy incentives for development.

Table 3 – State CMM Incentives

State	Definition of CMM	Incentives and Programs
Pennsylvania	CMM an alternative energy resource	Alternative Energy Portfolio Standard • Alternative energy certificates and tax credits (15% of net cost, $1 million per taxpayer) State Grant Programs • $21 million available
West Virginia	CMM an alternative energy resource	Alternative Energy Standard • Alternative energy credits (AECs)
Ohio	CMM an advanced energy resource; AMM a renewable energy resource	Alternative Energy Resource Standard • Renewable energy certificates (RECs) Advanced Energy Program • Forgivable and non-forgivable loans
Utah	CMM a renewable energy resource	Alternative Energy Portfolio Standard • Renewable energy certificates (RECs)
Indiana	CBM is defined as an alternative energy source and clean energy resource	Voluntary Clean Energy Portfolio Standard • Incentives to help pay for compliance projects

Pennsylvania was the first state to define CMM in its Alternative Energy Portfolio Standard (AEPS) which took effect on February 28, 2005. The AEPS requires each electric distribution company and electric generation supplier to retail customers in Pennsylvania to supply 18 percent of its electricity using alternative energy resources by 2020. The portfolio standard offers a variety of incentives for the recovery and use of CMM, including alternative energy credits (AECs), alternative energy tax credits, and

[8] Alabama, Ohio, Pennsylvania, Illinois, Indiana, Maryland, Tennessee, West Virginia, Virginia, Kentucky, Oklahoma, Colorado, Wyoming, Utah, and New Mexico

state grant programs[9]. AEPS does not designate any energy resource as renewable energy but rather designates all sources as alternative energy resources.

West Virginia includes CMM as an alternative energy resource in their Alternative and Renewable Energy Portfolio Standard (AREPS), which allows for regulated entities to use CMM to help meet their AREPS obligations. In West Virginia, "alternative energy resources" include sources such as advanced coal technology, coal bed methane, coal mine methane from operating mines, natural gas, fuel produced by a coal gasification or liquefication facility, and waste heat recovery. The portfolio standard requires investor-owned utilities with more than 30,000 residential customers to supply 25 percent of retail electric sales from eligible alternative and renewable energy resources by 2025. West Virginia's portfolio standard is similar to those in other eastern states, except that it does not require a minimum contribution from renewable energy sources.

The state of **Ohio** has an Alternative Energy Resource Standard (AERS) which requires utilities to provide 25 percent of their retail electricity supply from alternative energy sources by 2025. It sets annual renewable energy benchmarks but not overall alternative energy benchmarks. At least 50 percent of the renewable energy requirement must be met by in-state facilities, and the remaining 50 percent can be provided from renewable energy resources shown to be deliverable into the state. A distinct nuance of Ohio's AERS is that all renewable energy resources and all advanced energy resources are categorized together as alternative energy resources. Ohio's definition of advanced energy resources is similar to other states' definition of alternative energy resources. Methane gas emitted from abandoned coal mines is defined as a renewable energy resource and methane gas emitted from an operating or abandoned coal mine as an advanced energy resource[10]. The amended definition of "advanced energy project" now states that a qualifying project is not limited to just generation or use of electricity. As a result, CMM pipeline sales projects can qualify as an advanced energy project.

Utah established a renewable portfolio goal which is similar to renewable portfolio standards in other states except that it is a goal rather than a standard. So long as it is cost-effective to do so, investor-owned utilities, municipal utilities, and cooperative utilities must use eligible renewables to account for 20 percent of their 2025 adjusted retail electric sales. Utilities may meet their targets by producing electricity with an eligible form of renewable energy or by purchasing RECs. The Utah legislature amended the definition of "renewable energy source" to include waste gas and waste heat capture or recovery that is used as an energy source for an electric generation facility to include "methane gas from an abandoned coal mine or a coal degassing operation associated with a state-approved mine permit."[11]

Indiana has a voluntary clean energy portfolio standard (CPS) program, the Comprehensive Hoosier Option to Incentivize Cleaner Energy (CHOICE). CHOICE establishes incentives for public utilities or electricity suppliers (excluding municipally owned utilities and electric cooperatives). The goal of each participating electricity supplier is to obtain 10 percent of the total electricity supplied to its Indiana retail customers from clean energy sources by 2025 and will be phased in from 2013 to 2025 in three periods: 4 percent or more by the end of 2018, 7 percent or more by the end of 2024 and 10 percent or more by the end of 2025. Participating utilities must obtain at least 50 percent of qualifying clean energy from within Indiana and generated from among 21 clean energy resources or alternative technologies which include coal bed methane (CBM).

CMM data from the U.S. Greenhouse Gas Reporting Program Subpart FF

Greenhouse Gas Reporting Program Overview

[9] Pennsylvania AEPS Alternative Energy Credit Program http://paaeps.com/credit/
[10] The 128th General Assembly of the State of Ohio http://www.legislature.state.oh.us/analysis.cfm?ID=128_HB_1&ACT=As%20Enrolled&hf=analyses128/09-hb1-128.htm#_Toc238543778
[11] Utah H.B. 192 http://le.utah.gov/~2010/bills/hbillamd/hb0192.htm

In 2009, the U.S. EPA issued the Mandatory Reporting of Greenhouse Gases Rule which requires reporting of greenhouse gas (GHG) data and other relevant information from large sources and suppliers throughout the United States. The information gathered by the GHG Reporting Rule allows the EPA to have a better understanding of the relative emissions of specific industries and of individual facilities within those industries. This allows for a better understanding of factors that influence GHG emission rates and actions facilities can take to reduce emissions, although it does not require the control of GHG. The purpose of the rule is to collect accurate and timely GHG data to inform future policy decisions.

In addition to source categories which emit GHG directly into the atmosphere, the GHG Reporting Rule covers suppliers of certain products that would result in GHG emissions if released, combusted or oxidized, and facilities that inject CO_2 underground for geologic sequestration or any purpose other than geologic sequestration. In general, facilities that emit 25,000 metric tons or more per year of GHGs are required to submit annual reports to EPA. In the case of underground coal mines, facilities that liberate 14,400 metric tons CO2e (1,033,700 m^3 of methane) or more per year must report.

The first categories ("Track 1") subject to Part 98 began reporting their yearly emissions with the 2010 reporting year. 2010 emissions were reported to EPA via the electronic greenhouse gas reporting tool (e-GGRT) in September 2011. Underground coal mines began reporting their 2011 emissions with the "Track 2" categories in September 2012. Reporting Year 2012 emission reports are due April 1, 2013 and future reporting years will follow a similar annual timeline.

In January 2012, EPA made the first year of GHG reporting data available to the public through its interactive Data Publication Tool (http://ghgdata.epa.gov/ghgp/main.do). EPA will continue to update the tool and release additional data with each reporting year. The underground coal mine data for reporting year 2011 was released to the public in February 2013.

Coal Mine Reporting Requirements

Prior to the GHG Reporting Rule, the estimate of mine emissions shown earlier in Figure 1 was created annually using publically available data from the Mine Safety and Health Administration (MSHA). Surface mines, abandoned mines and post-mining emissions as well as underground mining methane emissions are included in this inventory. The results of this estimate show ventilation and degasification sources accounted for 62% of U.S. CMM emissions in 2011, as shown in Figure 1.

The GHG Reporting Rule requires underground coal mines to report methane liberated through ventilation streams and degasification systems. The mines report the net ventilation and drainage flows along with the portion of that flow that is emitted and the portion recovered for utilization or flaring. If the recovered methane is flared, the CO_2 from methane destruction is also reported. Methane utilized in an engine or other useful combustion device requires that the facility reports CO_2 emissions under the subpart covering combustion devices, if it is a size and type that fits the subpart requirements.

The GHG Reporting Rule allows mines to use one of two approaches to calculating emissions. Mines may choose to measure flow rates and emission concentrations directly to calculate total emissions. Mines may also choose to use the air sampling results from the quarterly inspections conducted by MSHA. MSHA regulates in-mine concentrations of ventilation air using well-defined procedures to ensure that the methane is well below explosive levels. Mines can access that data for use in calculating overall emissions.

Results of 2011 Data Collection

According to the Department of Labor, there were 508 active underground mines in 2011. Using the U.S. GHG Inventory and the publically available MSHA data described previously, EPA estimated 128 of those mines to be above the reporting threshold of the GHG Reporting Rule. The results of the Reporting Year 2011 data collection showed reports from 175 mines with a total of 1,315,868.9 metric tons

(MT) of methane. However, 83 of them reported emissions below the reporting threshold, with many of them reporting no or extremely low emissions for 2011. Of the 175 reporters, 101 of the facilities reported emissions above the reporting threshold. Outreach efforts led to the contact of many facilities which had previously been identified as potential reporters but which had not provided reports. Of those, some had already reported under a different name, and others were found to have lower emissions than previously estimated and were not required to report. Another 25 facilities are still actively being contacted to determine if the rule is applicable to them, and to educate them about the need to report if this is the case.

Next Steps

Next steps following the recent GHG Reporting Rule data release include further efforts to contact any facilities that have not reported, but may have emissions above the reporting threshold. One aspect of this research includes a mine-by-mine comparison of the emissions estimated using the MSHA data from 2011 and the results of the reporting year 2011 GHG Reporting Rule data collection. The total emissions from ventilation and degasification estimated from the MSHA data are 2,017,100 MT of methane, which is nearly 35% more than the data resulting from the GHG Reporting Rule. The GHG Reporting Rule data shows a total of 1,315,868.9 MT of methane. A difference is expected between the two data sources for a few reasons. First, 2012 was the first year of reporting for underground mines and it is likely that some of the facilities misunderstood or incorrectly completed the reporting forms or did not report at all. The EPA is continuing to communicate with facilities regarding potential mistakes in their reports, or for whom no report was submitted. Also, many facilities may have used more rigorous measurement methods, such as CEMS for ventilation emissions rather than the less precise measurement methods typically used by MSHA. Another difference is that the GHG Reporting Rule collects detailed data on degasification as well as ventilation, rather than relying on voluntary estimates based on unspecified methods and default recovery efficiency values. Finally, the mines may have adjusted their data using their actual operating schedule and production rates throughout each quarter, while the estimate based on MSHA data assumes the same rates each day of the quarter in which a sample was taken.

Summary

Methane is a potent greenhouse gas with a much shorter atmospheric lifetime than carbon dioxide. As a result, reducing methane emissions has the potential to achieve considerable climate benefits in just a few decades. Globally, CMM accounts for approximately 6% of anthropogenic methane emissions and in the U.S., that number grows to 7.6%. [12]The management of CMM emissions not only decreases GHG emissions, it can also improve worker safety and mine profitability. Since 2000 the recovery and utilization of CMM from coal mine degasification systems has averaged 83%, and new projects are coming online every year. A number of voluntary GHG Registries in the U.S. also recognize CMM offset projects as eligible for carbon credits. CMM is also increasingly being considered an important alternative or renewable energy resource by individual states. This recognition can provide benefits such as alternative energy credits, alternative energy tax credits and eligibility for state grant programs. The Mandatory Reporting of Greenhouse Gases Rule as it develops will provide accurate new information to assist in understanding the emissions being created by underground coal mines and the actions facilities may take to reduce emissions and utilize CMM.

[12] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011
http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf