

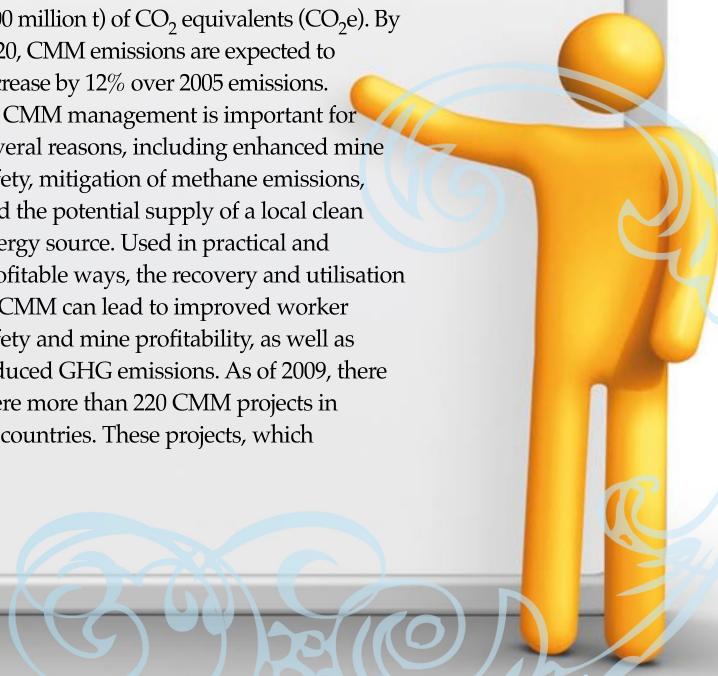
Managing methane

Jayne Somers, US Environmental Protection Agency, and Michael Cote, Ruby Canyon Engineering, US, discuss new developments with coal mine methane projects in the US.

Methane is a powerful greenhouse gas (GHG), with a global warming potential 21 times that of carbon dioxide (CO_2) over a 100 year period. The term coal mine methane (CMM) refers to methane that is released or captured in advance of, during, or following physical coal mining activities at either surface or underground mines. 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 In 2005, CMM

emissions accounted for about 30 billion m^3 (400 million t) of CO_2 equivalents (CO_2e). By 2020, CMM emissions are expected to increase by 12% over 2005 emissions.

CMM management is important for several reasons, including enhanced mine safety, mitigation of methane emissions, and the potential supply of a local clean energy source. Used in practical and profitable ways, the recovery and utilisation of CMM can lead to improved worker safety and mine profitability, as well as reduced GHG emissions. As of 2009, there were more than 220 CMM projects in 14 countries. These projects, which



VAMOX System at
Jim Walters Resources mine
No. 4 (photo courtesy of
Biothermica Technologies).



contributed to the avoidance of nearly 3.8 billion m³/year of methane emissions, include a variety of end uses such as pipeline injection, electric power production, co-firing in boilers, district heating, mine heating, coal drying, vehicle fuel, flaring and manufacturing/industrial feedstock. Nearly all of the CMM projects recover and use methane from coal mine gas drainage systems, which include pre-mine degasification, in-mine horizontal boreholes and gob gas recovery. Since 2006, Kyoto-based carbon market incentives (through the clean development mechanism [CDM]) have contributed to the development of approximately 26 new projects at Chinese coal mines.²

Over 60% of all CMM emissions are released through mine ventilation air. The concentration of ventilation air methane (VAM) is extremely low, typically below 1%. This situation has proven to be a barrier to VAM recovery and destruction/ utilisation, but recent technological

advancements with oxidation equipment, and the growth of the carbon market, have made it possible to deploy profitable VAM mitigation projects. Four of the 26 registered CDM CMM projects include a VAM component.

CMM projects

In the US, there are currently 13 CMM recovery and use projects located at active underground coal mines. These projects account for 1.04 billion m³ of methane emissions avoided (14.8 million t of CO₂e).³ In nearly all cases, the projects upgrade the CMM and sell it into local natural gas pipeline systems. Most of the projects are located in the Appalachian coal basins in Pennsylvania, West Virginia, Virginia and Alabama. One project is located in the Rocky Mountain West in Colorado. In addition, there are nearly 30 abandoned mine methane (AMM) recovery projects, which account for an additional 0.77 billion m³ of methane emissions avoided (3.1 million t of CO₂e). AMM projects are

geographically dispersed across 10 states and the project types are quite varied (including pipeline sales, electric power generation, and flaring).

In 2008, Consol Energy Inc., with funding from the US Department of Energy and US Environmental Protection Agency (EPA), successfully demonstrated a VAM mitigation project at an abandoned underground coal mine in Pennsylvania. A final report of the work performed was released in September 2009. The first VAM demonstration project at an active coal mine was launched in March 2009. This project is operating at the Jim Walter Resources Inc. Blue Creek mine No. 4 in Alabama and employs the Biothermica Technologies' Vamox technology. The project is eligible for voluntary carbon offsets in the US and is currently being registered with the Climate Action Reserve. More recently (December 2009), Green Holdings Corp. entered into an agreement with Consol Energy to develop the largest US

underground coal mine VAM mitigation project later this year.

Alternative and renewable energy incentives for CMM

Many states in the US have developed renewable energy portfolio standards and/or alternative energy portfolio standards. Out of 15 major coal-producing states, only three states – Pennsylvania, West Virginia and Ohio – currently include CMM in their renewable/alternative energy standards.⁴ In addition, Utah has drafted legislation to include CMM and Colorado is considering including CMM in their standard. Table 1 summarises each US state's programmes and incentives that include CMM as an energy resource.

Pennsylvania, West Virginia, and Ohio designate CMM as an "alternative" energy resource as opposed to a "renewable" energy resource. Utah designates CMM (from abandoned mines) as renewable energy. Generally, each state defines renewable energy sources as sources such as solar electric, solar thermal, wind power, hydropower, geothermal, fuel cells, and certain biomass energy and biologically-derived fuels. However, alternative energy sources can vary from state to state and may include sources such as waste coal, advanced coal technology, coal gasification, demand side management, energy improvement projects and solid waste conversion technologies.

Pennsylvania was the first state to define CMM as an alternative energy fuel in their Alternative Energy Portfolio Standard (AEPS).⁵ The AEPS offers a

variety of incentives for the recovery and use of CMM. The incentives to capture and use CMM include alternative energy credits, alternative energy tax credits, and state grant programmes. In July 2008, Pennsylvania enacted the Alternative Energy Investment Fund Act, where it provides a tax credit of 15% of the net cost of alternative energy production projects (including CMM) located in the state of Pennsylvania.⁶ There was a limit of US\$ 1 million/taxpayer and US\$ 5 million for the programme year 2009.

West Virginia includes CMM as an alternative energy resource in its Alternative and Renewable Energy Portfolio Standard (AREPS), which allows regulated entities to use CMM to help meet their AREPS obligations.⁷ In West Virginia, "alternative energy resources" include sources such as advanced coal technology, coalbed methane (CBM), CMM from operating mines, natural gas, fuel produced by a coal gasification or liquefaction facility, and waste heat recovery. Compliance to the AREPS is based upon the generation and purchasing of alternative energy credits (AECs) created by renewable or alternative energy production. One credit is equal to 1 MWh of alternative or renewable electricity generation.

Ohio has an Alternative Energy Resource Standard (AERS) that was created in May 2008.⁸ A distinct nuance of Ohio's AERS is that all renewable energy resources and all advanced energy resources are categorised together as alternative energy resources.

Alternatively, Pennsylvania defines all

categories as renewable energy resources, and West Virginia separates the renewable energy resources and alternative energy resources into two separate categories. Additionally, Ohio's definition of advanced energy resources is similar to other states' definition of alternative energy resources. In 2009, the Ohio legislature added methane gas emitted from an abandoned coal mine as a renewable energy resource and methane gas emitted from an operating or abandoned coal mine as an advanced energy resource under Ohio law. The amended definition of "advanced energy project" now states that a qualifying project is not limited to just generation or use of electricity, but can also include: "... any technologies, products, activities, management practices or strategies that facilitate the use of energy that supports the reduction of energy consumption or support the production of clean, renewable energy." As a result, CMM pipeline sales projects can qualify as an advanced energy project.

Recently, the state of Utah has been making efforts to amend its definitions of renewable energy resources to include CMM gas. In February 2010, the Utah State Legislature proposed a bill that addresses the inclusion of electricity generated by certain methane gas sources as renewable energy resources. Initially, H.B. 192 stated "waste gas and waste heat capture or recovery whether or not it is renewable, including methane gas from: an abandoned or working coal mine; or a coal degassing operation associated with a state-approved mine permit."⁹ However, in February the

Table 1. State CMM incentives

State	Incentives and programmes
Pennsylvania	<p>Alternative Energy Portfolio Standard:</p> <ul style="list-style-type: none">• Alternative energy certificates.• Alternative energy tax credits. <p>Tax credit of 15% of the net cost of alternative energy production projects located in the state of Pennsylvania:</p> <ul style="list-style-type: none">• Limit of US\$ 1 million/taxpayer and US\$ 5 million for the programme year of 2009. <p>State grant programmes that include Pennsylvania Energy Development Authority (PEDA)-Grants:</p> <ul style="list-style-type: none">• Solicitation offers US\$ 21 million in total funding to support in-state projects.• April 2009 solicitation was US\$ 1.5 million.
West Virginia	<p>Alternative Energy Standard:</p> <ul style="list-style-type: none">• Alternative energy certificates.
Ohio	<p>Alternative Energy Resource Standard:</p> <ul style="list-style-type: none">• Renewable energy certificates. <p>Advanced Energy Program:</p> <ul style="list-style-type: none">• Forgivable and non-forgivable loans that range from US\$ 50,000 to US\$ 2 million.
Utah (pending)	<p>The Energy Resource and Carbon Emission Reduction Initiative (ER&CERI):</p> <ul style="list-style-type: none">• Renewable energy credits (pending H.B. 192 passage).

Senate Committee struck working mines as an eligible resource for collecting methane gas. To date, a final draft of H.B. 192 has not been voted on or approved. However, if the latest draft is passed, methane gas “captured from abandoned coal mines or from coal degassing operations associated with a state-approved mine” may be added to the state’s list of eligible renewable energy sources.

Voluntary carbon markets

CMM offset projects are eligible for carbon credits through a number of voluntary GHG registries located in the US, namely the Voluntary Carbon Registry (VCS), the Chicago Climate Exchange (CCX), 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), 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 four GHG registries. The major exceptions are that the CCX

protocol does not include VAM projects, and CAR does not currently accept CMM pipeline sales projects. Currently, AMM projects are only accepted at CCX, although VCS is in the final stages of developing an AMM methodology (which it expects to release in spring 2010). Finally, VCS is the only GHG registry that accepts methane recovery and use projects from surface mines.

Future of CMM projects

The relative number of CMM projects at active coal mines in the US has remained fairly constant for the past decade. On the other hand, the number of AMM projects has increased steadily and VAM project development is starting to take off. Voluntary carbon market incentives have been in place since 2006, allowing several US projects to register their emission reductions. However, downward pressure on carbon prices in 2009 and uncertainty regarding legislation have made their long-term value added to CMM projects unknown. Renewable energy incentives are relatively new since 2008 and should result in an increase of non-pipeline sales CMM projects.

Globally, there is growing pressure on coal companies to reduce their methane emissions. The good news is that emerging technologies and incentives are encouraging CMM recovery and

utilisation project development throughout many coal-producing countries. 

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Table 2. Summary of voluntary GHG registries that accept CMM offset projects

CCX	April 2006	CMM, AMM	Pipeline, electricity, flare	US, non-Annex 1 countries	Project start date must be on or after 1 January 2003	Performance standard	Carbon Financial Instrument (CFI)
VCS	November 2007	CMM, SMM	Pipeline, electricity, flare, VAM	Worldwide	For projects grandfathered in from VCS version 1, project start date must be after 1 January 2002 and project validation and verification must be completed by 1 October 2010. For current projects, VCS 2007.1 validation shall be completed within two years of the project start date	CDM additionality tool	Voluntary Carbon Unit (VCU)
CAR	October 2009	CMM	Electricity, flare, VAM	US	Projects must be registered with CAR within 6 months of start date. Until 7 October 2010, the following exceptions apply: 1) 7 October 2007 for projects not previously registered in a GHG registry; 2) 1 January 2001 for projects previously listed with another GHG registry if the project was registered after 7 October 2007	Performance standard	Climate Reserve Ton (CRT)
ACR	Currently does not have stand-alone CMM protocol	CMM, SMM	Pipeline, electricity, flare, VAM	Worldwide	Project start date must be on or after 1 January 2000	CDM additionality tool or ACR hybrid additionality approach	Emission Reduction Tons (ERTs)