Barriers and Opportunities for Reducing Methane Emissions from Coal Mines

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Founded in 1996, Clean Air Task Force is a non-profit environmental organization with offices throughout the United States and in China that works to protect the earth's atmosphere by improving air quality and reducing global climate change through scientific research, public advocacy, technological innovation and private sector collaboration.

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Coal mining is responsible for 8 percent of total global methane emissions. Reducing these emissions will improve mine safety, local air quality, reduce global warming and provide a cleaner burning fuel for use at the mine or for sale.

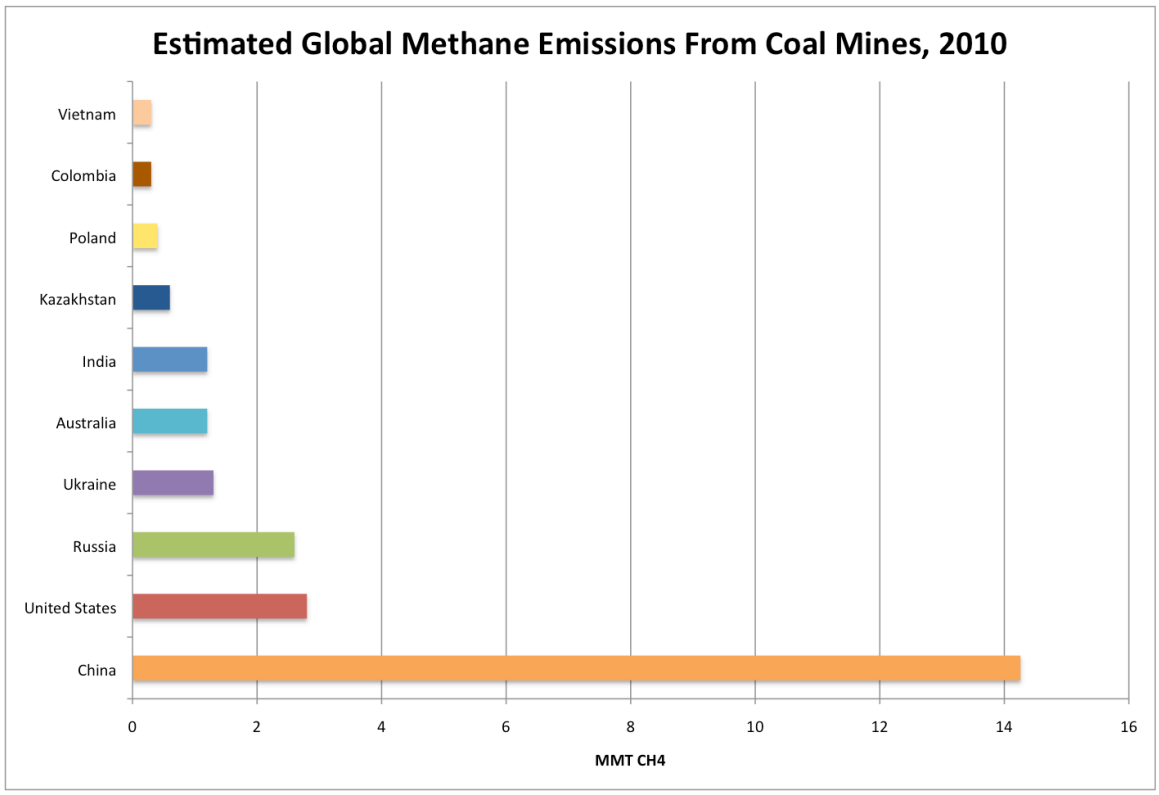
Executive Summary

It is well understood that emissions from fossil fuel combustion are responsible for the majority of earth's global warming emissions. Less appreciated, though, is that emissions from fossil fuel production and transport — especially methane released from oil and gas wells, processing and transport of natural gas, and coal mines — account for a great deal of climate-warming pollution. For example, producing and transporting the coal and natural gas for US power plants emits about a quarter of the climate warming pollution as the power plants themselves. As global fossil fuel production, expands, vented and leaked methane will exacerbate the CO2-driven warming effect if nothing is done. Globally, coal mining is responsible for 8 percent of total methane emissions. Reducing these emissions will improve mine safety, local air quality, reduce global warming and provide a cleaner burning fuel for use at the mine or for sale.

Methane in coal seams is created as part of the same geological process that leads to the formation of coal. Large quantities of methane are typically trapped in or near the coal seams and are released during mining operations. Both underground and surface mines emit methane during production. In 2010, according to the US EPA, global methane emissions from coal mines were estimated to be approximately 27.8 MMT CH_4, or about 8 percent of total global methane emissions.

Methane is emitted from a number of sources and operations:

- Degasification systems at underground coal mines;
- Ventilation of air from underground mines;
- Abandoned or closed mines;
- Surface mines; and
- Fugitive emissions from post-mining operations.

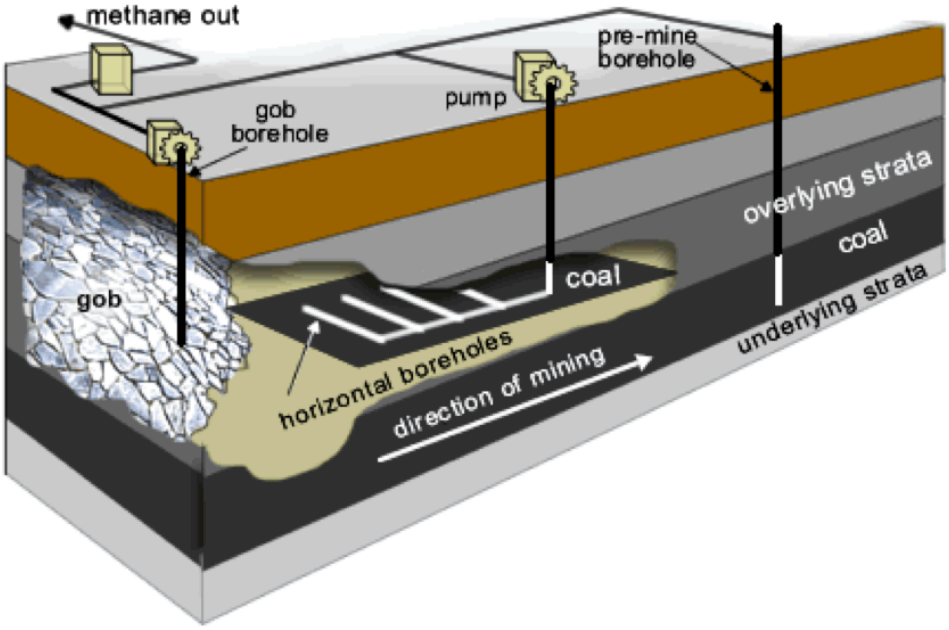


Source: Adapted from Global Methane Initiative

Underground coal mines are the single largest source of coal mine methane (CMM) emissions. In these mines, methane is removed to maintain safety for the miners. Methane concentrations between 5 and 15% in the air of a coal mine represents an explosion hazard. Mines can be made safe through the use of large-scale ventilation systems that move massive quantities of air through the mines. These systems also release large amounts of very- low-concentration ventilation air methane (VAM) into the atmosphere. Capturing these low concentrations of methane from VAM and utilizing it rather than venting has in the past proven difficult, but new technologies have recently been developed and deployed to oxidize the methane in ventilation air.[1] In addition, substantial reductions in total methane release can be achieved by pre-draining the methane from the coal seam, known as degasification, prior to the coal being mined and also draining methane from post-mining operations, known as "gob". This reduces the amount of methane that will be released into the mine that would need to be vented through a VAM process, and produces a very high quality gas that can be sold.

[1] Global Methane Initiative. Coal Mine Methane Fact Sheet www.globalmethane.org/documents/coal_fs_eng.pdf

Methane Drainage In an Underground Coal Mine



Source: US EPA

If the methane is captured and used (or destroyed) there are a number of benefits, including:

- Reduction of greenhouse gas emissions;
- Enhanced mine safety;
- Separate cash stream for the mine (if the captured gas is sold);
- On-site power production;
- Coal drying;
- Heat source for mine.

How each mine uses CMM depends on the gas quality, the concentration of methane and the presence of other contaminants. The most common use is for power generation, district heating, boiler fuel, or direct sales to pipelines.

Around the world, a number of barriers exist that hinder methane abatement from coal mines. These barriers can be policy related, financial, knowledge based, or technology based. Each country faces different barriers and it is important to understand what stands in the way of greater methane abatement. In this paper we analyze CMM in several key coal mining countries, China, India, Russia, Poland, Ukraine, and the United States and the available data on the following areas:

- Current Coal Mine Methane Abatement Activities
- Barriers to Coal Mine Methane Abatement
- Financing Coal Mine Methane Abatement
- Policies that Can Support Coal Mine Methane Abatement
- Existing Policies for Coal Mine Methane Abatement

Current CMM Activities

One CMM project at one mine has the potential to reduce emissions by as much as 7 to 70 million cubic meters. Thus there is significant global potential:

- Total global emissions from CBM: 33.2-52.5 billion m^3 (BCM)/Year
- Short-term reductions: 5.9-10.5 BCM/Year
- Longer-term reductions: 10.5-21 BCM/Year[2]

While the potential is quite large, real data at a country-by-country level varies in its accuracy and coverage. Some coal countries have extensive inventories of emissions, studies on abatement potential by basin and mine, and a number of existing methane drainage and utilization projects. In other countries, data on emissions are lacking, no CMM resource assessment has been done, and very few if any projects are up and running that utilize CMM. Below we summarize the available data on current practices and the potential for CMM abatement and utilization by country.

China[3,4,5]

- 36.81 trillion m^3 of coal-related methane at depths of 300 -2,000 meters.
- 46 percent of China's coal mines are considered highly gassy or prone to outbursts.
- 45 key state-owned coal mining companies have potential for serious gas accidents.
- Ventilation air constitutes about 60 to 70 percent of all CMM that is released to the atmosphere.
- Drained and recovered CMM increased from less than 2 BCM in 1994 to 4.7 BCM in 2007.
- Of the methane drained and recovered from Chinese coal mines in 2007, more than 2 BCM of gas was drained in Shanxi Province alone, accounting for 44 percent of the country's total. About 0.2 BCM was recovered in each of the following provinces: Shaanxi, Liaoning, Anhui, Henan, Guizhou and Chongqing.
- Over 200 mines have drainage systems.
- In 2008, 5.67 BCM of CMM was recovered and 6.17 BCM in 2009 with utilization of 1.72 billion m^3 in 2009.
- While drainage has increased by almost an order of magnitude since 2000, utilization has roughly tripled.

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[2] Schultz (2003): CMM/CBM Technologies and Activities in Russia. Karl Schultz. US Environmental Protection Agency. Presented at US Russia Energy Working Group Third Meeting, April 8, 2003.
[3] Huang (2009): Recovery and Utilization of CBM/CMM in China. Huang Shengchu, China Coal Information Institute. Presented at the CMM Recovery and Utilization and Methane Mitigation Workshop. April 7-8, 2009. Chengdu, China.
[4] IEA (2009.1): Coal Mine Methane in China: A Budding Asset with the Potential to Bloom, An Assessment of Technology, Policy and Financial Issues Relating to CMM in China, Based on Interviews Conducted at Coal Mines in Guizhou and Sichuan Provinces. International Energy Agency. IEA Information Paper, February 2009.
[5] Huang (2010): Great Potential for CBM/CMM Recovery and Utilization and Preferential Policies. Huang Shengchu, China Coal Information Institute. Presented at the Methane to Markets Partnership Expo. March 3, 2010. New Delhi, India.

India[6,7,8]

- No CMM resource assessment has been done.
- A CMM demonstration project is under implementation at Sudamdih and Moonidih mines of Bharat Coking Coal Limited (BCCL), in the Jharia Coalfield, Jharkhand State of India. The project is anticipated to be 5 years long and was approved by the Government of India.
- India's Central Mine Planning and Design Institute Limited (CMPDI) has invited expression of interest for five blocks identified by Central Coalfields Limited and BCCL for CMM in East Bokaro and Jharia coalfields respectively.
- 18 underground coal mines are considered highly gassy (greater than 10 m^3 of methane /metric ton of coal mined).
- 85 percent of mining is open cast.

Russia[9]

- Russian experts project CMM emissions to grow as much as 4 percent per year, if no action is taken to enhance CMM recovery and use in Russia.
- In 2006, 1.9 billion m^3 of methane was released from Russian mines. However, only about 317 million m^3 was recovered by degasification or methane drainage systems in 2008. The volume of methane that is actually used at mine sites or for local electricity and heat generation is much smaller, totaling only 40 million m^3 per year.
- Only 25 percent of active mines in Russia have installed degasification systems. In 2009, 25 mines were using degasification – a modest improvement over the last few years.
- The lack of degasification systems is one of the key factors leading to explosions at Russian coal mines. Another key factor is the sometimes poor installation and inefficient operation of degasification and drainage equipment, which means that less methane is captured than should be possible.
- If all gassy mines were equipped with the appropriate degasification technology, the rate of methane recovery would increase to 35-40 percent in the Kuznetsk Basin and to 45-50 percent in the Pechora Basin. Currently, degasification removes around 30 percent of methane from the mines.
- The minimum concentration of methane in gas captured by degasification systems allowed to be utilized by regulations in Russia is quite low, often below 25 percent. With the exception of mines in the Pechora Basin (Vorkuta) and a few mines in the Kuznetsk Basin where the concentration of methane in recovered gas is above 50 percent, mines in other Russian regions need to renovate and possibly replace existing degasification systems. This is because, in the past, Russian systems were

[6] Singh (2010): Development of CBM in India: An Overview. A.K. Singh. Presented at Methane to Markets Partnership Expo. March 4, 2010. New Delhi, India.
[7] Franklin and Jemelkova (2005): Opportunities to Reduce Coal Mine Methane Emissions in India. Pamela Franklin and Barbora Jemelkova. US EPA. Presented at US – India Energy Dialogue Coal Working Group, November 22, 2005.
[8] Sawhney (2010): Coal Mine Methane Project Development Status and Trends for the Methane to Markets Expo: Developments in India - CMM/CBM. Prem Sawhney. Essar Exploration & Production Ltd. Presented at Methane to Markets Partnership Expo. March 3, 2010. New Delhi, India.
[9] IEA (2009.3): Coal Mine Methane in Russia: Capturing the Safety and Environmental Benefits. International Energy Agency. December, 2009.

built to meet mine safety requirements and did not envisage the utilization of recovered CMM. The Vorkuta mines located in the Pechora Basin are the only ones where CMM is utilized on an industrial scale. Most other degasification systems in Russian mines produce CMM with concentrations much lower than 25 percent.

- If all of the 1.9 billion m^3 of CMM emissions released annually in Russia could be recovered and used, there would be a potential value of about USD 130 million at 2008 regulated wholesale natural gas prices in Russia.

Poland[10]

- As of 1997, about 300 million m^3 of methane was being drained from Polish coal mines annually, with 65 to 70 percent of drainage being used at the mine sites or sold to outside consumers, and the rest vented. By 2007, 690 million m^3 of methane being removed through ventilation systems was not usable and was vented due to low methane content, while 145 million m^3 was utilized.
- Poland has approved 15 Joint Implementation (JI) projects, including one CMM project: Coal Mine Methane Capture and Utilization at KWK Borynia Coal Mine, Poland.

Ukraine

- It is estimated that the methane resource at the coalfields in Ukraine ranges from 432 to 560 billion m^3. Ukraine produces coal at mines in Donetsk, Lugansk, Lviv and Volyn where an estimated 2 billion m^3 of methane is emitted annually.[11]
- In 2004, 1,221 million m^3 of CMM was emitted by underground coal mines, 357 million m^3 of which was drained by degasification systems and 179 million m^3 of which was utilized.[12]
- A feasibility study funded by the US Trade and Development Agency (USTDA) in 2005 and completed in 2008 identified and highlighted the following CMM project areas in the Donetsk Basin of Ukraine[13]:
    - Yuzhno-Donbasskaya #3 Mine: total methane resource is approximately 4.9 billion m^3. Degasification system as of 2008 capturing up to 25 million m^3 annually of over 28 percent quality methane.
    - Bazhanov Mine: in 2007, 9.9 million m^3 of methane was extracted from the mine, with 5.5 million m^3 from that total used to fire the mine's boiler.

United States

In 2008, active underground mines emitted 3.1 billion m^3 of CMM (45 million tCO_2e), of which 2.9 billion m^3 (41 million tCO_2e) was VAM and 280 million m^3 (4 million tCO_2e) was drained. Abandoned mines emitted 410 million m^3 (6 million tCO_2e) surface mines 1.0 billion m^3 (14 million tCO_2e)

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[10] USEPA (2009.1): Global Overview of CMM Opportunities. US Environmental Protection Agency Coalbed Methane Outreach Program in Support of the Methane to Markets Partnership. January, 2009.
[11] UNDP (2007): Sustainable Development of Lugansk Oblast. Project Document. Government of Ukraine, United Nations Development Program. 2007.
[12] USEPA (2009.1): Global Overview of CMM Opportunities. US Environmental Protection Agency Coalbed Methane Outreach Program in Support of the Methane to Markets Partnership. January, 2009.
[13] USTDA (2008): Coal Mine Methane and Coalbed Methane Development in the Donetsk Region, Ukraine. Funded by the US Trade and Development Agency, prepared by Advanced Resources International in association with Ecometan, Donetsk Geological Company, Bazhanov Mine and South Donbass #3 Mine. May, 2008.

and post mining emissions were 600 million m^3 (9 million tCO_2e). 20 MMTCO_2e of CMM emissions were avoided by CMM recovery and utilization projects.[14]

As of 2006, at least 23 mines operated drainage systems, with drainage efficiencies in the range of 3 percent to 88 percent. Twelve of these mines already sell recovered methane, and two mines consume methane onsite for power generation and to heat mine ventilation air. Mines that already use drainage systems may be especially good candidates for the development of cost-effective methane recovery and use projects.[15]

[14] Franklin (2010.2): EPA Activities to Promote Coal Mine Methane Recovery. Pamela Franklin. US EPA. Presented at US Coal Mine Methane Conference. October 5, 2010. Birmingham, Alabama.
[15] USEPA (2009.2): Identifying Opportunities for Methane Recovery at US Coal Mines: Profiles of Selected Gassy Underground Coal Mines 2002-2006. US Environmental Protection Agency. January 2009.

Barriers to CMM Abatement

A number of studies have looked at barriers to methane abatement and utilization at a country-by-country level. Barriers can be government policies, ownership issues, technological issues, and financial. These barriers can also be perceived ones versus real. It is important to understand both, so that the right programs can be designed to overcome these barriers. Below we summarize the current studies on CMM barriers and where possible, provide some ways around them.

China[16]

In China the legal framework presents a number of issues that can hinder coal mine methane abatement, such as:

- Central government owns the rights to CMM.
- CMM is considered an associated mineral of coal, so CMM rights are included with coal exploration and production.
- For CDM projects, foreign ownership is limited to 49 percent.
- Central government requires fee: 2 percent of carbon credits for any CDM project.

Another issue in China is the belief that standards governing the use of methane in China must fit Chinese conditions. This has led to the currently unenforced standard established by the Ministry of Environmental Protection, which requires use, or flaring of CMM with methane concentrations greater than 30 percent. The "Emission Standard of Coalbed Methane/Coal Mine Gas", was issued by the Chinese Ministry of Environmental Protection on 2 April 2008 and became effective on 1 July 2008 for newly built mines and on 1 January 2010 for existing coal mines. This standard has brought up the concern for the potential for mine safety to be compromised through the dilution and transport of lower concentration methane to avoid compliance. The explosive range of methane is 5-15 percent methane in air. The drive to dilute drainage gas would also result in more venting limiting the intended climate change benefits. Should the mine owner/operators choose to dilute methane – which is the least-cost option for meeting the emission standard – this practice would drive concentrations toward, rather than away from, the explosive range. This contradicts common safety principles, which recommend that mine gas should be drained, transported, and used at a concentration well above the upper explosive limit.[17] This standard has also brought into question the additionality of CMM projects utilizing drained gas with concentrations above 30 percent, thus making them ineligible under CDM to produce carbon credits.

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[16] IEA (2009.1): Coal Mine Methane in China: A Budding Asset with the Potential to Bloom, An Assessment of Technology, Policy and Financial Issues Relating to CMM in China, Based on Interviews Conducted at Coal Mines in Guizhou and Sichuan Provinces. International Energy Agency. IEA Information Paper, February 2009.

[17] Report of the Ad Hoc Group of Experts on Coal Mine Methane on its sixth session. United Nations Economic Commission for Europe Committee on Sustainable Energy Ad Hoc Group of Experts on Coal Mine Methane Sixth session. October 11-12, 2010. Geneva, Switzerland.

India[18]

Barriers identified in India:

- Lack of inventory and assessment of resources.
- Ownership issue of recovered gas is not settled and thus ownership of any resulting carbon credits remains unclear.
- Lack of gas infrastructure.

Suggested steps forward:

- Policy to curb methane volume release
- Mandatory policy for pre-mining degasification
- Transparent dissemination of information for evaluating commercial viability
- Expediting private participation
- Market creation for clean energy technology
- Reliable cost recovery mechanism
- Channel finance through international cooperation
- Financing using government subsidies/incentives
- Adapting technology to smaller scale and to suit Indian conditions

Russia[19]

IEA suggested a number of policy recommendations and issues that should be focused on in Russia:

- Both Russian and foreign investors are concerned that any amendments to license requirements be based on a performance-based approach and not too prescriptive. This could support the most economic and cost-effective investment, appropriate for each mine condition.
- Russia has been very slow in approving Joint Implementation projects, especially when in comes to coal mine methane. As of July 2012 only one JI for CMM has been registered.
- A range of supporting regulations, amplifying important framework legislation passed in early January 2009. These regulations should provide more clarity on the specific requirements for power utilities that choose to obtain a certain share of power production from CMM to meet their renewable energy obligations.
- A system needs to be established to allow the transfer of rights for the use of recovered CMM.
- Licensing of CMM activities is not a clear or easy-to-follow process. When gas is used within the mine, there is no need to obtain any additional licenses and the procedure is straightforward. However, once CMM (or heat and power generated from it) is to be sold to another party, then new mineral extraction licenses are needed.
- It may also be useful for the Russian government to assess the feasibility of raising environmental payments on industry for pollutant emissions (including methane). These penalties should be set at a level that would provide the incentive for companies to undertake investments to enhance the recovery and use of CMM.

[18] Dube (2010): Coal Mine Methane Projects and Opportunities in India. Sanjay Dube. Presented at the Methane to Markets Partnership Expo. March 2, 2010. New Delhi, India.
[19] IEA (2009.3): Coal Mine Methane in Russia: Capturing the Safety and Environmental Benefits. International Energy Agency. December, 2009.

- Another option for consideration by the Russian government to stimulate the use of CMM is the possibility of providing tax credits or benefits.
- Government could encourage the flaring of suitably recovered coal mine methane as opposed to venting the methane to atmosphere.
- An effective and proactive national coordinating body should have the stature and ability to bring together representatives of relevant organizations: federal authorities, research institutes and companies. Such a body could focus attention on the key barriers and challenges to enhancing CMM recovery and use in Russia and promote better international dialogue with key international organizations and companies.

Ukraine[20]

The Project Document for the Sustainable Development Programme of Lugansk Region identifies the following barriers to CBM/CMM development in Ukraine:

- Legal and Regulatory Issues
  - Investors need to see clear legal norms regulating the agreements on the division of products and gas ownership rights; well-boring rights; re-registration of a license for exploration and license for production; arguments regulation mechanism; payments and procedures to take issues into court and means of legal protection in case of non-payment and contract violations.
- Taxation Problems
  - Taxation problems are related to legal and regulatory issues because taxes are collected by the governmental bodies, or by their assignment, and are usually specified in some legal or regulatory act. However, tax bodies, in addition to the earlier mentioned barriers, create their own obstacles. A confusion created by an unclear and inconsistent application of the tax legislation can lead to excessive taxation, which, in its turn, directly contributes to the reduction of investment profitability.
- Financial Problems
  - The most important financial problems are related to a desire to perform transactions in hard currency with the use of internal country capital and fixes prices on gas for the forecasted income flow. The following should be taken into account here:
    - Hard currency risk – which is a typical financial problem;
    - Leadership of the local structures is evidence of the fact that the project is supported and that country-based individuals and/or organizations are ready to take certain portion of risks;
    - Energy prices, including prices for gas, can fluctuate and are sometimes subsidized.
- Technological Problems
  - There are certain obstacles for the transfer of technologies to the developing countries and for the transfer of technologies from the industrially developed countries. The reasons for the existence of technological obstacles are numerous and may, in particular, include:
    - Laws that limit the use of foreign equipment;

[20] UNDP (2007): Sustainable Development of Lugansk Oblast. Project Document. Government of Ukraine, United Nations Development Program. 2007.

        - Certification of equipment at the developing countries;
        - Lack of capital to purchase equipment;
        - Insufficiently developed infrastructure to transport the equipment to the destination point, or its inadequate maintenance after the installation;
        - Lack of appropriate training and skills.
- Infrastructure and Immaturity of Markets
    - Material and technical basis in many developing countries is insufficient to support the projects for the use of CMM/CBM at the same scale as in the industrially developed countries.

United States[21]

In the United States, there are a number of barriers that reduce the viability of CMM abatement projects:

- The U.S. is not a signatory to Kyoto Protocol.
- Congress has considered but has not passed federal legislation to limit national greenhouse gas emissions. Some proposals include CMM as potential offsets under a "cap and trade" program.
- Federal tax incentives for CBM/CMM gas production expired.
- On Federal lands (much of western US), federal government owns mineral leases (coal, oil, gas).
    - Oil & gas estates are separate from coal estate, so the right to use CMM is not automatically granted to the coal mine.
    - Currently, no regulatory policy requires or encourages CMM to be used or destroyed (flared).
    - Extensive coal bed methane production and surface mining co-exist in Wyoming's Powder River Basin, creating conflicts.
        - US government agency (Bureau of Land Management) created an incentive (reduced royalty payments to the US government) to encourage pre-mine gas drainage prior to surface mining.
- On private ("fee") lands, ownership of coal seam gas depends on laws of each state.
    - Several states have enacted legislation to clarify ownership.
    - In general, the coal mine has the right to the gas.
    - Many disputes are resolved through legal challenges and negotiations.

In the United States, it is still often believed that regulatory obstacles for CMM projects on federal lands are too prohibitive. As 40 percent of 2008 coal production in the US was from federal lands, thus it is important to assess this perception and clarify issues where possible. In the past, the split estates of coal and gas meant that in order to obtain rights to CMM at an existing mine, the area would have to be nominated for separate gas leasing through a competitive process under the Mineral Leasing Act of 1920 (MLA). Coal mines were reluctant to nominate the areas where they had coal leases for fear of competing interests obtaining leases and disrupting their mining

[21] Global Overview of Policies Affecting Coal Mine Methane (CMM) Recovery and Utilization. Pamela Franklin. US EPA. Presented at Methane to Markets Partnership – Mongolia CMM Project Development Workshop, Ulaanbaatar, Mongolia, August 30-31, 2010.

activities. There have been recent developments to indicate treatment of CMM on federal lands may change.

In 2008, the Interior Board of Land Appeals (IBLA) resolved a dispute in *Vessels Coal Gas Inc., 175 IBLA 8 (2008) (Vessels)* concerning the Bureau of Land Management's (BLM) issuance of a federal oil and gas lease under the MLA primarily to recover gob gas at Aberdeen Mine in east-central Utah. The IBLA determined gob gas and other CMM released due to mining was not a leasable mineral under MLA because it was not a naturally occurring deposit, and CMM projects protect miners as required by MSHA, minimize environmental pollution as sought by USEPA, and permit use of additional energy resources as promoted by national policy. BLM has never reacted to this decision so it is unclear how these cases will be treated in the future.[22] Finally, BLM has setup an incentive in Wyoming's Powder River Basin that encourages pre-mine gas drainage prior to surface mining in return for reduced natural gas royalty payments to the US government. The areas in which this incentive applies are called Conflict Administration Zones (CAZ). The CAZs were established with BLM Instruction Memorandum No. 2003-253 in 2003 and were recently re-delineated in December of 2010.[23]

[22] Coal Mine Methane: The True Unconventional Gas: A Survey of Issues Concerning Ownership, Control, and Development of Emission Reduction Projects. Collon Kennedy. Presented at the US Coal Mine Methane Conference. October 5, 2010. Birmingham, Alabama. Online, http://www.epa.gov/cmop/docs/cmm_conference_oct10/Kennedy.pdf

[23] Coal & Coalbed Natural Gas Conflict Administration Zone. United States Bureau of Land Management. Updated January 06, 2011. Online, http://www.blm.gov/wy/st/en/programs/energy/CAZ.html

Finance

A recurring issue and topic of discussion amongst the CMM community focuses on the potential to finance various emission reduction projects. Clearly there are mechanisms in use, which have allowed development of world-class CMM projects because they will reduce significant quantities of methane, which would have otherwise been emitted to the atmosphere. The most notable CMM projects financed by multilateral banks are located in China. In addition to the projects in China, commercially financed VAM projects hosted by BHP Billiton in Australia have served as bellwether models of corporate responsibility and sustainability. Other levers have been used to bring about project development, such as the approach taken by US EPA over the last several years, where EPA funds prefeasibility and feasibility studies. Some of these studies have led directly to project development; and in cases where direct action has not been taken, the reports have clearly provided alternative approaches for counterpart professionals and management to consider and assimilate.

These CMM recovery projects are designed to use large volumes of gas that would otherwise be released to the atmosphere; but these projects may not be representative of CMM projects that must be undertaken to achieve significant emission reductions. A review of marginal abatement costs can lead one to believe that there are plenty of "low hanging fruit" ripe for the taking in China. Under the CDM, relatively few projects have passed from design and development to operational. In part, this is due to a lag that forms as many of these projects pass through the multi-step CDM process – some are just now making it to the registration phase. Moreover, many projects hosted by Chinese coal mines are funded at least in part by Chinese coal mining companies and other commercial China entities. Therefore revenue flow from credit generation to international private sector groups has not been as voluminous as expected and to a surprising extent, interest in pursuing additional CDM projects within China is waning. Regardless, many opportunities to reduce emissions at coal mines remain.
The obvious question becomes what prevents substantially more CMM projects in China and elsewhere from developing. More often than not, the most persistent barrier to implementation is not the lack of huge sums of money for investment, but the lack of small sums of money for design and demonstration. It is useful to explore the potential of developing new vehicles for financing CMM project development activities. Three types of funding vehicles could have significant impact:

- A revolving fund that is used for funding implementation of demonstration projects. Projects that are selected for funding do not have to meet commercial hurdle rates, but merely re-pay the loan with at a low interest in a timely fashion so that capital is conserved for distribution to future borrowers. This fund could be set up to loan in tranches of $1-5 million USD.

- Micro-loans to small businesses located in CMM project host countries that serve as the entrepreneurial catalysts to take a good idea, develop business plans and market them to project developers with outside help and support. Payments can be direct cash payments or as a form of royalty from gas produced or carbon credits created.
- Grants for feasibility studies that are not performed solely by outside experts but have the requirement to be a project that is designed by experts and a host country partner. The goal is not only to develop projects, but to also build in-country capacity. The US Trade and Development Agency limits the amount that can be non-US based expertise or product, EPA makes it difficult for the host country partner to freely choose the best partner, and UNDP or GEF project design grants are too difficult to obtain.

One of the most common excuses for not using methane produced during coal mining used by coal producers in the western United States is that economic barriers are too great. In fact economics are only one of the issues. In general most mines in the western US have been reluctant to address the need to use the gas that is liberated during mining: and if a coal mine operator is interested in concomitant development of coal and CMM resource development, it may be stymied by ownership issues, access to pipelines, and lack of market for CMM-fueled power generation. Nevertheless, a comprehensive review has shown time and again that there are no insurmountable barriers to CMM usage at western coal mines – except in the minds of coal company management.

Policies to support CMM recovery and utilization[24]

- Set regulatory requirements - options include:
  - Require mitigation of CMM emissions (e.g., require oxidization or flaring)
  - Require recovery and use of CMM for energy
  - Require use of a certain drainage and capture technology
  - Set an emissions or recovery standard (i.e., "best practices")
- Include CMM under a greenhouse gas emissions "cap"
  - Emissions limit for total greenhouse gases at a state, regional, or national level
  - A market-based system could allow trading of emissions reductions
- Include CMM as a possible "offset" under an emissions trading program.
- Sources required to reduce greenhouse gas emissions could pay for emissions reductions from CMM projects.
- Establish financial incentives:
  - Provide subsidies for CMM-generated power and/or CMM gas that is recovered and used
  - Provide tax breaks to CMM gas producers or project developers
  - Provide price guarantees or other incentives, such as:
    - Price guarantee for CMM-generated electricity
    - "Renewable" energy portfolio standard requiring certain percentage of energy to be provided from mix of sources, where CMM qualifies
- Provide research and development funding
- Support technology demonstration projects
- Support development of infrastructure, e.g., natural gas pipelines or LNG facilities
- Ownership of coal seam gas must be clarified before, during, and after mining. Potential parties with a claim to the gas include:
  - Mine operator
  - Owner / lessee of coal estate
  - Owner / lessee of gas estate
  - Surface owner
- Ownership of carbon emission reduction credits must also be clarified and legally established. Statutes or regulations may be silent about carbon credits because they pre-date the existence of a carbon market.
- Legal oversight or regulation of a CMM project may depend on other factors:
  - End use: Ventilation, flaring, and energy recovery of CMM may all be considered distinct activities or covered under different statutes or regulatory agencies.
  - Status of mine: Operating (active) mines or abandoned (closed) mines.

[24] Global Overview of Policies Affecting Coal Mine Methane (CMM) Recovery and Utilization. Pamela Franklin. US EPA. Presented at Methane to Markets Partnership – Mongolia CMM Project Development Workshop, Ulaanbaatar, Mongolia, August 30-31, 2010.

Current Policies on Coal Mine Methane

Mine safety has typically been the focal point of regulations and policies in coal mining countries concerning CMM. These policies vary considerably both in their mechanics as well as their effectiveness. More recently, countries have started to implement programs to incentivize CMM abatement and utilization projects. These policies have in some cases bolstered CMM development, but each nation has unique issues that either hinder or advance CMM abatement. Below we summarize what we know about the current policies.

China[25]

- June 2006, the State Council issued Opinions on Speeding up CBM/CMM Extraction and Utilization, which requires local land and planning authorities to ensure that coal mines implement a safety first approach, focusing on prevention, safety standards and oversight by the government, and the use of technology when extracting gas prior to coal mining.
- On April 2007, China's National Development and Reform Commission (NDRC) issued a Notice on CBM/CMM Price Management to increase CMM output and address market barriers. It specifies that the price of gas that is not distributed via city pipeline networks can be determined freely through negotiations, while the price of gas distributed via city pipeline networks and operations under government control should be determined according to its heating value (compared to substitute fuels such as natural gas, coal gas and liquefied gas).
- NDRC issued a Notice on Executing Opinions on Generating Electricity with CBM/CMM. This encourages the deployment of power generation projects with CBM/CMM. The notice requires that electricity generated by CBM/CMM power plants should be given priority by grid operators who should purchase surplus electricity at a subsidized price. CBM/CMM power plant owners were also exempted from market price competition and did not have responsibility for grid stability. This notice has not been observed in practice, however.
- The Ministry of Finance issued Executing Opinions on Subsidizing CBM/CMM Development and Utilization Enterprises, whereby any enterprise engaged in CBM/CMM extraction within China is entitled to financial subsidies, if it is used on site or marketed for residential use or as a chemical feedstock. CBM/CMM used to generate power does not benefit from this subsidy.
- 11th Five Year Plan encouraged CBM / CMM Development:
    - National output to reach 10 billion cubic meters by 2010
    - Price management for CMM transported via city pipelines
    - Electricity from CMM prioritized for the grid and a subsidized price
    - Financial subsidies for onsite use, residential use, chemical feedstock
- State Council requires CMM drainage at coal mines
- Ministry of Environmental Protection establishes emission standard for CBM / CMM (April 2008)

[25] IEA (2009.1): Coal Mine Methane in China: A Budding Asset with the Potential to Bloom, An Assessment of Technology, Policy and Financial Issues Relating to CMM in China, Based on Interviews Conducted at Coal Mines in Guizhou and Sichuan Provinces. International Energy Agency. IEA Information Paper, February 2009.

    - Prohibits emission of methane from CBM drainage systems
    - CMM drainage systems with greater than 30 percent methane concentration must use or flare the gas (Note: this conflicts with safety regulation)
- Existing programs have built capacity:
    - USEPA development of China Coalbed Methane Clearinghouse beginning in 1994.
    - Also, Guizhou Coal Mine Methane Initiative: promotes CMM recovery and utilization among gassy coal mines in Guizhou Province, China. The project began when the Guizhou International Cooperation Center for Environmental Protection received a grant from USEPA in support of its Methane to Markets Program.

India[26]

- Capacity building has begun through USEPA with establishment of CMM/CBM clearinghouse.
- CBM is regulated through CBM policy of Government of India formulated in 1997. CMM regulatory framework under formulation by Government of India.

Russia[27]

Current policies:

- The Russian government enacted a decree for renewable energy in January 2009 that sets targets for the increase in the share of electricity generated by renewable energy sources; CMM qualifies for this incentive.
- The Federal Law of the Russian Federation on Subsoil: It regulates the exploration, use and protection of subsoil in Russia, including waste management in the mining sector. It sets the framework for comprehensive and sustainable subsoil management and protection, and guarantees the rights of the state and Russian citizens as well as license holders. The uncertainty currently surrounding the legal status of recovered CMM and its usage in this law hampers the activity of third party investors who are interested in the utilization of the recovered gas.
- The Federal Law on State Regulation in the Field of Extraction and Use of Coal, and on Social Protection of Workers in Coal Industry Enterprises: This law sets the framework for state policy in extraction and use of coal and regulates relationships in this area. It refers to coal and the products of its treatment as to the most reliable and socially significant energy sources, the extraction of which is especially dangerous and difficult. It also recognizes the high capital intensity of coal mining and its negative impact on the environment. This law includes provisions on control of safety during mining.
- The Federal Law of the Russian Federation on Industrial Safety of Hazardous Industrial Facilities. This federal law sets out the legal, economic and social framework whereby hazardous facilities can be operated in a safe manner. It aims to prevent accidents at hazardous facilities and to provide for emergency preparedness and efficient management in the event of accidents.

[26] Dube (2010): Coal Mine Methane Projects and Opportunities in India. Sanjay Dube. Presented at the Methane to Markets Partnership Expo. March 2, 2010. New Delhi, India.
[27] IEA (2009.3): Coal Mine Methane in Russia: Capturing the Safety and Environmental Benefits. International Energy Agency. December, 2009.

- Mine Safety Regulations (ПБ 05-618-03): These detailed regulations, obligatory for all organizations working in mines, set out requirements to ensure the safety of all aspects of mining. They specify the documentation that must be in place for the proper functioning of a mine, its transportation system and equipment. They set out accident prevention and management procedures, including those to avoid methane explosions. They define methane limits in mine ventilation air and set out monitoring procedures. They regulate degasification and ventilation and set out the procedure for closing mines and subsequent after care. Given the recent catastrophic mine explosions in 2007, there is a clear need for more effective enforcement of mine safety standards related to coal mine methane.
- The Decree On Payments for Emissions of Pollutants into the Atmosphere from Stationary and Mobile Sources, Pollutant Discharge into Surface and Underground Water, and Disposal of Production and Consumption Waste.
- Under this decree methane is defined as a pollutant. This decree sets out formulas and regional emission limits and defines the amounts of payments that companies are to be charged annually for emissions of pollutants into the atmosphere and water.
- Guidelines on Coal Mine Degasification (РД-15-09-2006): These guidelines are obligatory for all organizations dealing with design, construction and exploitation of coal mine degasification systems. Degasification is obligatory for all mines where the methane content is above 13 m^3 per metric ton of dry ash-free coal and for gassy mines when ventilation alone is insufficient to keep methane concentrations at safe levels. The guidelines cover planning and performance of degasification systems, monitoring of the captured methane-air mixtures, defining achievable CMM recovery in mines and ensuring its efficient use. They also set the minimum methane concentrations of mine gas that can be used as a fuel or substitute for natural gas: 25 percent for industrial purposes and 50 percent for nonindustrial purposes.
- In July 2008, the Ministry of Energy, the Ministry of Natural Resources, the Ministry of Economic Development and RosTechNadzor were commissioned by the Russian government to develop mandatory requirements on degasification of coal seams prior to mining as well as proposals to encourage coal companies to carry out pre-drainage of coal seams. These requirements were to be incorporated into license requirements and a system of indicators of gas content in coal seams was to be established, dependent on geological and mining conditions. In addition, during the related Duma hearings on 18 December 2008, it was suggested that regulations be developed to encourage methane recovery from coal deposits. More specifically, the proposals:
    - developed national standards to regulate the system of coal mine methane recovery and set up a registry system for recovered methane;
    - included a new type of product (recovered coal mine methane) and a new type of economic activity (coal mine methane recovery) into the national classification system of types of economic activity, products and services (a system used by business and government to classify and measure economic activity, products and services);
    - established a zero percent taxation rate for coal mine methane recovery;
    - reduced/abolished customs duty for imported equipment used for CMM recovery and utilization.

- A related amendment proposed by Russian State Duma deputies concerns the Federal Law on Subsoil and aims at creating a new image of CMM among license holders. Its goal is to change the perception of methane as just an explosive and lethal gas to seeing its potential as a valuable and clean energy source that can be cost-effectively exploited. This should not detract however from the rigorous enforcement of safety standards, given the history in Russia of lax monitoring of mine safety. The aim of these legislative amendments is to orient producers towards ensuring greater safety by means of pre-mining degasification and CMM recovery, together with utilization. In this way the legislative changes could contribute to solving a number of important issues: improving safety of mining personnel; introducing technologies for CMM recovery and utilization in mines; and providing the Russian energy sector with a clean and high-quality fuel and Russian industry with a raw material for producing methanol, petrol, ammonia, diesel fuel and other valuable products. The adoption of such regulations would encourage coal companies to recover and use CMM. As of the publication of this report, there was no information available on the first hearing on this issue. Since the onset of the economic crisis in Russia, there has been little further focus on CMM by the Russian State Duma.

Poland[28]

- Green Investment Scheme (GIS) introduced by the Act of 17 July 2009 - system of managing emissions of greenhouse gases and other substances.
- Under Article 17, the Kyoto Protocol created the possibility of international emissions trading – using the so-called AAUs (Assigned Amount Units). Within this framework, Poland can use about 500 million tonnes of CO2 equivalent. Poland has a sizable surplus of AAUs. Under the GIS, revenues from trading the AAUs in the years 2009-2012 shall be allocated for funding domestic measures, such as fuel switching projects and projects avoiding or reducing methane emissions through recovery and use in the mining sector, solid waste and wastewater management and farming as well as through use for generating energy.

Ukraine[29]

- Green Tariff Law: Electricity generated from alternative sources must be purchased at the Wholesale Electricity Market (the Green Tariff). The Law provides a guaranteed feed-in tariff for renewable energy, including CMM, for 20 years. Zasyadko mine has received a license for a green tariff for power produced with its CMM. The license gives the right to use the special green tariff to sell power to the power pool.

[28] Ministry of the Environment (2009): The Green Investment Scheme in Poland. The Ministry of the Environment, Poland. July, 2009.
[29] Evans (2010): Developments in Ukraine and "Best Practices" for Regulatory Policies. Meredydd Evans. Presented at Methane to Markets Partnership Expo, New Delhi, India. March 3, 2010.

United States

US Federal Government Role[30]:

- Earthjustice has petitioned the Environmental Protection Agency to directly regulate CMM through New Source Performance Standards, section 111 of the Clean Air Act.
- EPA, through its Greenhouse Gas Reporting Rule, requires CMM emissions to be reported.
- EPA promotes cost-effective recovery and use of coal mine methane through voluntary industry outreach (CMOP).
- Funded technology demonstration of ventilation air methane project
- Supports pre-feasibility and feasibility studies; technical, economic analyses
- Supports capacity building and project development abroad through Methane to Markets Partnership

Conclusion

Coal mine methane emissions play an important role in global climate change. However, around the world a number of barriers exist that prevent greater abatement of CMM emissions. As seen above, these barriers can often be policies that have unintended consequences that may hinder methane abatement. Substantial CMM abatement could be achieved by simply eliminating or modifying policies to better incentivize methane abatement. Even more emission reductions could be achieved by moving to mandated reductions in methane emissions, for either safety or environmental reasons. Financing these projects will continue to be an issue, but a number of innovative programs could be established to overcome the hurdles of financing methane abatement for coal mines. CMM abatement should be a key tool that policy makers use to combat global warming, one that can pay near term benefits both for climate but also for public health, safety, and energy diversity.

[30] Global Overview of Policies Affecting Coal Mine Methane (CMM) Recovery and Utilization. Pamela Franklin. US EPA. Presented at Methane to Markets Partnership – Mongolia CMM Project Development Workshop, Ulaanbaatar, Mongolia, August 30-31, 2010.