



COALBED METHANE EXTRA



Storage of Coal Mine Methane in Abandoned/Closed Mines Increases Profits

A recent study by the U.S. Environmental Protection Agency (U.S. EPA) demonstrated the viability of using the voids created by underground coal mining to store coal mine methane (CMM). U.S. EPA's Coalbed Methane Outreach Program (CMOP) determined that such storage can provide direct economic benefits to both producers and users of CMM. It can allow producers to store a portion of their gas until it can be sold at peak prices, and can be used to stabilize gas flow rates to projects using CMM.

Profits for CMM Producers and Users

The study evaluated a hypothetical CMM storage facility, considering a range of maximum withdrawal days per year and average annual peak gas prices. It revealed that with favorable gas pricing and high gas demand, the conceptual storage facility could earn economic returns and pay for itself in a few operating years. The analysis estimated operating costs for the facility to be between \$0.55 to \$1.22 per MCF of gas sales, which is comparable to lower-cost, conventional facilities that cycle frequently (i.e., frequently inject and withdraw gas). Furthermore, the study predicted

internal rates of return for various operating scenarios of greater than 15 percent, net present values of greater than \$2 million, and project pay-back periods of less than 6 years.

Storage of coal mine methane in abandoned/closed underground coal mines presents CMM producers and users with a number of distinct advantages.

Seasonal weather fluctuations have a substantial effect on natural gas prices. U.S. market demand for gas for heating

normally rises each winter, and unexpectedly harsh or long-lasting winter weather tends to drive up gas prices even more. Gas producers and marketers can profit from that situation if they have gas available in quantities adequate to supply the short-term, high-price demand. Gas storage facilities that can provide high deliverability with flexibility in injection and withdrawal cycles have been constructed, in part, in response to this predictable opportunity.

Such storage also can enhance the ability of CMM producers to meet peak gas demands. That is, a high deliverability storage facility can allow producers injecting CMM into commercial pipelines to hold a portion of their product flow for sale during

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Landmark Greenhouse Gas Emission Trade Worth \$6 Million

Niagara Mohawk Power Corporation (Syracuse, NY) and Canada's Suncor Energy Inc. announced on March 5, 1998 that they have entered into a greenhouse gas emissions trade that potentially is worth \$6 million (U.S.). By this action, the two companies have clearly illustrated the potential economic benefits available to those who can sell emissions credits. Such benefits also

could result from trades involving coal mine methane (CMM). Extrapolating from their experience, greenhouse gas emission offsets deriving from CMM trades could have a potential value of \$12.47 per metric ton of CMM (or \$240.23 per mmcf of CMM).

In this precedent-setting international trade, Suncor made an

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Coal Mine Methane

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periods of peak demand (i.e., peak shaving), thereby improving the producer's profitability. Reliable storage of CMM in underground mines likewise can provide substantial benefits to CMM users by dampening fluctuations in the gas supply stream, thus stabilizing gas feeds and allowing for more consistent product. This should increase the ability of CMM users to operate at an optimum fuel rate and perform more efficiently within designed system tolerances.

Successful Storage of Natural Gas in Mines

Experience both in the United States and in Europe provides examples of successful natural gas storage in sealed mine voids. An abandoned lignite mine near Leyden, Colorado has supplied Public Service of Colorado with peak shaving capacity since 1963. Similarly, the abandoned Peonnes and Anderlues mines have provided storage capacity to meet peak natural gas demands for Distrigaz, a local Belgian gas distribution company.

Technical Challenges

While not all abandoned mines can serve as reliable storage facilities, the large number of abandoned mines in the U.S. makes it likely that a number of candidate sites should exist

within a reasonable distance to an active CMM producer. Certain technical challenges must be met, however, for an abandoned mine to provide for safe and reliable CMM storage:

- When mined voids are located at relatively shallow depths, their ability to withstand high storage pressures to increase storage capacity is limited. This limitation may

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be offset, however, by the ability of CMM to re-adsorb onto exposed coal remaining in the abandoned mine. Such re-adsorption in the Belgian mines increased the effective storage capacity by up to a factor of ten.

- Adequate sealing of the storage facility is necessary to provide reliable gas containment. In wet mines, hydrological conditions may provide a natural water seal for containment.
- Retrieved gas may require processing (e.g., condensed water separation/dehydration, initial enrichment with

propane to offset preferential adsorption of higher hydrocarbons onto the exposed coal surfaces) prior to its injection into the CMM project's gas stream.

- Effective gas losses due to retention of gas in the storage facility, cushion gas requirements (i.e., to provide pressure for gas delivery from the system), and gas solubility in sealing water also need to be considered by a prospective gas storage facility operator.

Gas Ownership Issues

The CMOP study, in collaboration with Elizabeth McClanahan, a noted legal expert on methane ownership, also introduced potential legal issues affecting the ownership of CMM stored in abandoned coal mines, focusing on experience to date in Virginia. These issues revolve around ownership of the CMM itself and ownership of the storage container (the abandoned/closed mine). Since the initial study, U.S. EPA has expanded its legal analysis to identify relevant ownership issues in most states containing gassy coal mines.

Conclusion

Storage of coal mine methane in abandoned/closed underground coal mines presents CMM producers and users with a number of distinct advan-

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Greenhouse Gas Emission Trade

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initial purchase of 100,000 metric tons of CO₂ emission reductions from Niagara Mohawk, with an option to purchase up to an additional 10 million metric tons over a 10-year period. The trade establishes Suncor and Niagara Mohawk as leaders in emissions credit trading. It will help Suncor achieve voluntary emissions reductions while providing Niagara Mohawk with financial resources it plans to use for new projects to further reduce greenhouse gas emissions. With this trade, the two firms have taken a first step

toward demonstrating the economic viability of market-based solutions to global greenhouse gas emissions problems.

The trade constitutes a continuation of a trend in both firms towards implementing practical solutions to climate change problems. While important in and of itself, this trade is even more meaningful because it sets an example for the rest of the world. International greenhouse gas emissions trading is an element of the Kyoto Protocol that is central to its success. Until the Suncor/Niagara Mohawk agreement, however, few precedents had been set to demonstrate that an international market for such offsets existed. The agreement not

only constitutes a concrete example of the practicality of such trading, but also should provide impetus for pursuing similar agreements involving greenhouse gas offsets derived from CMM projects. According to Ron Shewchuk of Suncor, "Industry needs the flexibility to address emissions reductions in this way." It is Suncor's desire that "this action will be the starting point for discussion of an international policy framework that would allow for emissions trading and that would give credit for early action." The ultimate goal is development of a global market for emissions trading that will itself drive affected parties toward the most cost-effective ways to reduce greenhouse emissions.

Recent Publications

U.S. EPA /CMOP recently completed a *Technical and Economic Assessment of Coal Mine Methane in Coal-Fired Utility and Industrial Boilers in Northern Appalachia and Alabama*. Focusing on the use of gob gas as a supplemental fuel, the report reviews the benefits of cofiring, presents a methodology for selecting potentially viable gas markets and cofiring projects, and provides an economic analysis of specific project scenarios.

A white paper on *The Impacts of FERC Order 636 on Coal Mine Gas Projects* is now available from CMOP. The paper explores new opportunities for coal mine methane use resulting from the FERC action. Because the Order put the gas industry on a market-based, competitive basis, market conditions can change rapidly, and gas marketers must be prepared to research and choose a marketing approach that best suits a producer's and/or operator's specific situation and needs.

Copies of both reports can be ordered by calling 1-888-STAR-YES.

A series of *Technical Options* papers addressing a range of coal mine methane uses also is available from CMOP. To request copies, please contact Roger Fernandez at (202) 564-9481.



Upcoming Events

Mine Ventilation Symposium

The University of Missouri-Rolla will host the 8th U.S. Mine Ventilation Symposium on its campus June 7-10, 1999. The symposium will address a host of topics, including methane drainage, and will place equal emphasis on theoretical analysis and practical applications. Paper abstracts are being accepted until July 1, 1998. For more information, contact Dr. J. C. Tien via e-mail at tien@umr.edu, or visit the symposium Web site at <http://www.umr.edu/~tien/symp.html>.

International Coalbed Methane Symposium

The 1999 International Coalbed Methane Symposium will be held May 3-7, 1999 at the Bryant Conference Center at the University of Alabama in Tuscaloosa, Alabama, USA. The symposium will focus on both innovative and basic technologies for gas extraction and utilization, and will encompass coalbed methane, tight gas sands, and Devonian shales. Contact Gwen Hood at (205) 348-7192 for more information.

International Investment Promotion Seminar for Coalbed Methane Development in China

The Energy Planning & Management Branch of United Nations Department of Economic and Social Affairs (UNDESA), the Chinese Bureau of Coal, and the U.S. Environmental Protection Agency are jointly sponsoring a Coalbed Methane (CBM) Investment Promotion Seminar to be held in Beijing in the fall of 1998. The principal objective of the seminar is to increase the understanding between Chinese authorities and potential investors of the legal, regulatory, institutional, and policy issues that relate to the development of CBM projects in China. For additional information, contact Karl Schultz U.S. EPA /CMOP, at (202) 564 9468, or Mr. (Peter) Kui-Nang Mak, UNDESA, at (212) 963-8798.

International Workshop on Coalbed Methane Recovery and Utilization

In October, 1998, coalbed methane experts from around

the world will convene at a coalbed methane workshop in Beijing, China. Topics will include methane recovery and utilization practice, advanced recovery technology and equipment, economic valuation of coalbed methane projects, and opportunities for international cooperation in the coalbed methane field. The deadline for paper submission and registration is July 31, 1998. Contact Karl Schultz, U.S. EPA /CMOP, at (202) 564 9468 for further information.

International Conference on Coalbed Methane – Technologies of Recovery and Utilization

On May 27–29, 1998, the Central Mining Institute in Katowica, Poland will conduct an international conference in Szczyrk. The conference will focus on resource assessment, new technologies, power system applications, case studies, and environmental protection. Contact Jozef Dubinski at (+48 32) 583-022 or by fax at (+48 32) 596-533 for more information.



Past Events

1998 CMOP Conference

On April 9, 1998, the U.S. EPA Coalbed Methane Outreach Program held its 3rd annual conference, which focused on "Marketing Your Coal Mine Methane Resource", in Pittsburgh, Pennsylvania. The goal of the conference was to present innovative concepts, techniques, and technologies used in marketing coal mine methane. It was presented in three sessions: Strategies for Creating New CMM Markets, Strategies for Creating New CMM Power Production Markets, and How to Benefit from New Government Policies. A limited supply of conference proceedings is available to interested parties.

Contact Roger Fernandez, U.S. EPA /CMOP, at (202) 564-9481.

North American Coalbed Methane Forum – Spring Meeting

On April 8, 1998 the North American Coalbed Methane Forum held its biannual meeting in Pittsburgh, Pennsylvania. Project updates were provided, and technical presentations were made on topics including the use of CBM as an energy source for coal mine vehicles and the practical application of new logging techniques. Please direct any questions regarding this conference to Dr. Kashi Aminian at (304) 293-7682.

Easy Access to CBM Information

Information on CBM production and processing is available from the Gas Research Institute's Technology Transfer Centers. Information needs can be conveyed by calling GRI in Denver (303-575-9130) or Houston (713-650-0788). Typically search results can be provided electronically within hours, with hard copy provided by mail or messenger.

Send in Your Web Address

We are increasing our World Wide Web interconnectivity by adding appropriate site links to our CMOP Web site. If you would like your site to be considered, please let us know by faxing (202-565-2077) or e-mailing (fernandez.roger@epa.gov) your name, affiliation, and Web site URL to Roger Fernandez, U.S. EPA /CMOP.

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tages. CMM producers can put excess produced gas into storage until market prices climb, thereby reaping the benefit of selling to a high spot market. Users benefit by having a more regular flow of gas available, thus avoiding a host of potential difficulties associated with fluctuating flows. Although certain technical issues must be resolved to fully ascertain the viability of such storage at any specific underground mine, abandoned/closed

mines offer a potentially profitable option for CMM developers.

Note: A peer review document entitled "Technical and Economic Assessment of Coalbed Methane Storage in Abandoned Mine Workings" is available from CMOP. Contact Roger Fernandez at (202) 564-9481 to request a copy.

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Please keep us updated on any changes in your contact information. Send us your new address, e-mail, or phone/fax number as soon as you can so you don't miss an issue of *Coalbed Methane Extra*.

CMOP Contact Information

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