



Coal Mine Methane (CMM) Finance Guide

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TABLE OF CONTENTS

INTRODUCTION	1
OVERVIEW OF METHANE CAPTURE AND USE PROJECTS	2
Why Target Methane?	2
Sources of CMM	2
Recovery and Use of CMM	2
CMM Project Market.	2
CMM Project Development.	3
CMM Project Feasibility	3
CMM PROJECT ECONOMICS	5
CMM Project Revenue Streams	5
CMM Project Costs	5
Assessing Financial Feasibility	6
CMM Project Risks	6
Mine Operation Risks	6
CMM PROJECT FINANCING	8
Equity Investment.	8
Carbon Financing	8
RISK MITIGATION SUPPORT	13
Loan Guarantees.	13
Political Risk and Credit Insurance	13
CONCLUSION	14
APPENDIX A: CMM PROJECT PARTICIPANTS	15
APPENDIX B: KEY ELEMENTS OF FEASIBILITY STUDIES AND U.S. GOVERNMENT SUPPORT	16
APPENDIX C: CMM PROJECT FUNDING SOURCES	18
APPENDIX D: RESOURCES	23
APPENDIX E: CMM PROJECT LENDING EVALUATION CHECKLIST	25
APPENDIX F: GLOSSARY	26



Global methane emissions from the coal-mining sector can be reduced through recovery and utilization projects that collect methane gas from coal mines and use it productively to generate electricity or to provide fuel to households and industry. Often, the critical barrier to developing such coal mine methane (CMM) projects is securing financing.

The U.S. Environmental Protection Agency's (U.S. EPA's) Coalbed Methane Outreach Program (CMOP) is a voluntary program with a goal of reducing methane emissions from coal mining activities. Our mission is to promote the profitable recovery and utilization of CMM, a potent greenhouse gas (GHG) that contributes to climate change if emitted to the atmosphere. When collected and used for energy, CMM is a valuable fuel source.

CMOP estimates that more than 220 CMM projects are already in operation around the world. Many more project opportunities exist, especially in emerging market countries. Several factors have prompted the resurgent interest in CMM projects around the world. First, the steep growth in global energy demand has catalyzed the search for new, unconventional sources of natural gas and power. Second, programs such as the Kyoto Protocol's Clean Development Mechanism (CDM) and Joint

Implementation (JI) have created financial incentives to develop projects that reduce GHG emissions. Third, multinational collaborative initiatives such as the Methane to Markets Partnership (www.methanetomarkets.org) have focused on overcoming the policy, regulatory, legal, and technical barriers that inhibit project development.

Many funding and investment sources emphasize sustainable development, environmental protection, and climate change mitigation as important components of projects that they finance. CMM projects support all of these objectives. CMOP has developed this guide for project developers and investors who are interested in pursuing CMM project opportunities, particularly in emerging market countries. While most of the project and cost information described in the following pages is U.S.-based, there are numerous global opportunities for CMM project development.

This guide summarizes the market potential for CMM projects (e.g., sources/uses of CMM), project economics, types of financing, and risk mitigation. Particular attention has been paid to the emerging markets of carbon credits as potential funding for CMM projects.



OVERVIEW OF METHANE CAPTURE AND USE PROJECTS

Why Target Methane?

Methane, one of the principal GHGs, is second only to carbon dioxide (CO₂) in its contribution to climate change. Globally, it accounts for approximately 15 percent of global total GHGs.¹ Methane is a potent GHG that is more than 20 times more effective in trapping heat than a ton of CO₂ on a pound-for-pound basis over 100 years. Global average atmospheric methane concentrations have more than doubled—from approximately 700 to 1,774 parts per billion by volume—over the time period of 1750 to 2005.² After nearly a decade of stabilized levels, global methane emissions rose by 27 million tons in 2007.³

Sources of CMM

Coal mines are a primary source of methane, responsible for approximately 6 percent of estimated global anthropogenic methane emissions in 2005.⁴ Methane and coal are formed together during the conversion of vegetation into coal. CMM refers to methane released from the coal and surrounding rock strata due to mining activities. In underground mines, it can create an explosive hazard to coal miners, so it is removed through ventilation systems. In some instances, it is necessary to supplement the ventilation with a degasification system to remove methane from the mine. The schematic (next page) illustrates how methane may be removed from longwall mines through the ventilation system and a combination of gob wells, pre-mine drainage wells, and in-mine boreholes.

Recovery and Use of CMM

Specific CMM end uses depend on the gas quality, especially the concentration of methane and the presence of other contaminants. Worldwide, CMM is most often used for power generation, district heating, boiler fuel, and town gas, or it is sold to natural gas pipeline systems. Other uses of CMM include the following:

- Coal drying
- Heat source for mine ventilation air
- Supplemental fuel for mine boilers
- Vehicle fuel as compressed or liquefied natural gas (LNG)
- Manufacturing feedstock
- Fuel source for fuel cells
- Direct gas sales to industrial or other end users

CMM Project Market

There are more than 220 CMM projects worldwide in 13 countries that, in total, recover and use more than 3.8 billion cubic meters of gas annually from active and abandoned coal mines, thereby avoiding 54 million metric tons of carbon dioxide equivalent (MtCO₂e) of GHG emissions each year. A comprehensive list of global CMM projects can be found in the Methane to Markets International Coal Mine Methane Projects Database at: www2.ergweb.com/cmm/index.aspx.

Globally, the greatest volume of CMM recovered and used is from drainage (degasification) systems at underground coal mines. Degasification systems are currently employed at some of the most gassy coal mines in 14 countries. Technologies to recover and harness dilute methane from mine ventilation systems are also beginning to be employed in some parts of the world. Several countries with declining coal production are effectively capturing and using the methane from their abandoned (closed) underground coal mines.

Project Opportunities

Drained gas is the methane captured or recovered from degasification systems at underground coal mines. Pre-mine drainage produces very high-quality gas with methane concentrations that can exceed 90 percent. Gob wells generally produce lower quality gas due to entrained air and other impurities. Methane concentration in gob gas varies widely, from less than 25 percent in some Chinese mines to 80 percent in some U.S. mines, depending on how carefully air intrusion is controlled. Currently, in the United States, 24 underground coal mines employ degasification systems, liberating more than 36 billion cubic feet (Bcf) annually (more than 1 billion cubic meters) in 2007. Of this amount, about 32 Bcf are recovered and utilized for energy.

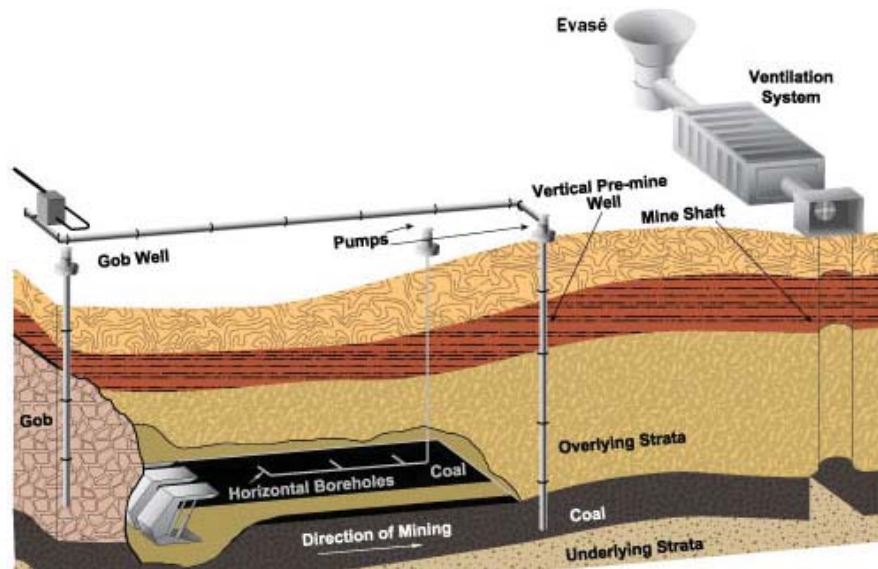
¹ U.S. EPA. Global Anthropogenic Non-CO₂ Greenhouse Gas Emissions: 1990-2020. June 2006. www.epa.gov/climatechange/economics/downloads/GlobalMitigationFullReport.pdf

² Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report: Climate Change 2007, Working Group I Report "The Physical Science Basis," November 17, 2007. www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter2.pdf

³ National Oceanic and Atmospheric Administration. "Greenhouse Gases, Carbon Dioxide And Methane, Rise Sharply In 2007." ScienceDaily. April 24, 2008. www.sciencedaily.com/releases/2008/04/080423181652.htm

⁴ U.S. EPA, idem

Removal of CMM From Longwall Mines



Globally, most drained gas is used in internal combustion engines or turbines to generate power. China and Australia, for example, have projects of this type. Other uses for drained gas include town gas, industrial uses, coal drying, and vehicle fuel.

Ventilation air methane (VAM) is the very dilute methane—typically 1 percent or less—released from underground mine ventilation shafts. VAM represents more than half of all coal mining emissions in the United States and worldwide. With a few exceptions (see case studies on page 12), it is simply released to the atmosphere; however, it is technically possible to convert the dilute methane in ventilation air to useful energy. The economic feasibility of these projects on a commercial scale is currently being demonstrated in Australia, and projects are in operation or under development in China and the United States.

Even though active mining no longer occurs, abandoned or closed underground coal mines can still produce significant methane emissions (known as abandoned mine methane [AMM]) from diffuse vents, fissures, or boreholes. This methane can be deliberately extracted and used to generate power or for other end uses. There are several thousand abandoned coal mines in the United States. Of these, U.S. EPA has identified some 400 abandoned mines that are considered “gassy” and has developed profiles for abandoned mines that might be good candidates for project development (see www.epa.gov/cmop/docs/profiles_2008_final.pdf). Abandoned coal mines are important sources of methane for power generation projects in several countries, including Germany, Poland, and the United Kingdom.

CMM Project Development

Project development involves multiple steps, ranging from evaluating project economics to determining how to mitigate multiple project risks (see flow chart next page). Typical project participants include the mine operator, the project developer, regulatory agencies, and the end user or energy buyer. Some CMM projects might be pursued as “turnkey” operations, where a supplier/vendor constructs and installs the necessary equipment and maintains responsibility for its operating performance. Detailed descriptions of potential project participants can be found in Appendix A.

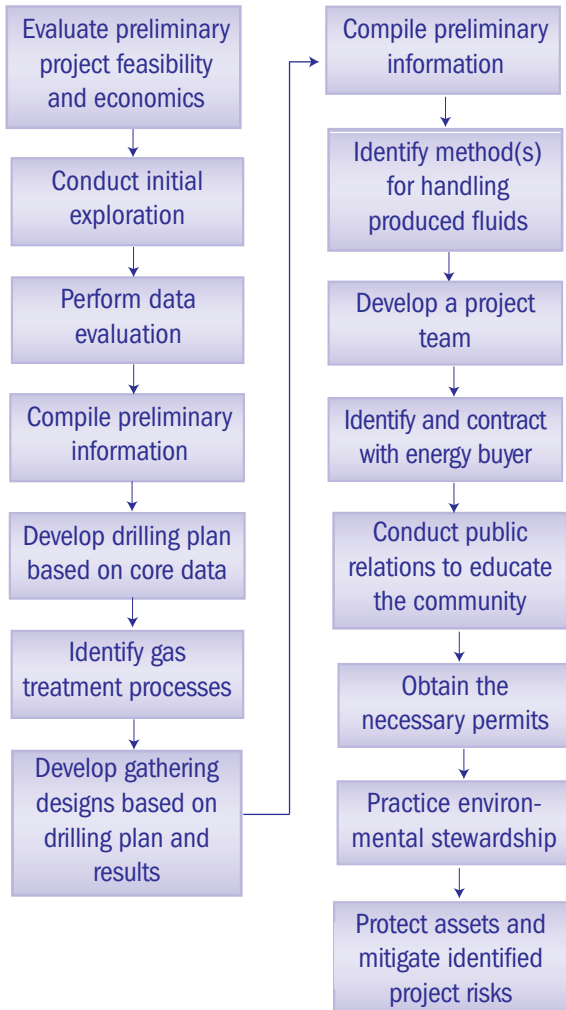
For the purpose of this guide, we focus on assessing the initial project economics (e.g., costs) and securing financing for CMM projects.

CMM Project Feasibility

The demonstration of a CMM project’s technical viability plays an important role in securing financing. The project’s viability can be demonstrated through: pre-feasibility studies (PFS); full-scale, comprehensive feasibility studies (FS); and technology demonstrations. These analyses are typically funded by the project developer or investors, although some government agencies fund these studies, including U.S. Trade and Development Agency (USTDA), U.S. Agency for International Development (USAID), U.S. EPA, Australia’s Commonwealth Scientific and Industrial Research Organisation (CSIRO), and Australia’s national government.⁵

⁵ Formerly Australia Greenhouse Office, now Department of Climate Change.

CMM Project Development Activities



Pre-Feasibility Studies and Feasibility Studies

One of the first steps in project development involves performing a PFS to evaluate potential project options. The PFS is a first-order analysis of possible project configurations including location, size, technology to be employed, market(s) to be served, costs, and revenues. It identifies one or more options that appear to be technically feasible and economically attractive. Typically, the PFS will be conducted at a level of detail adequate to broadly identify financing requirements and considers the potential capital structure, taking into account expected project cash flows under various scenarios. If the PFS indicates a potentially viable project, a more in-depth analysis, such as a comprehensive FS, would be conducted.

A comprehensive FS is a rigorous, detailed assessment of the technical and economic viability of a CMM project at a specific site or group of sites. The objective is to perform due diligence to determine if financial investment in the project is warranted, given the project risks. A comprehensive FS considers the financial as well as technical, legal, regulatory, and environmental elements of the potential project. Key elements of a comprehensive FS can be found in Appendix B.

Logistical, time, and financial costs are quite high for an FS at a coal mine, and several site visits and detailed information collection from mine site personnel are required. Such a study can typically take several months or a year to complete.

U.S. government funding to support the PFS/FS efforts for CMM projects (see examples in Appendix B) may be available to project developers depending on the location and nature of the project.



CMM PROJECT ECONOMICS

This section identifies the primary revenue streams and costs for typical CMM projects, as well as some of the risks associated with these projects.

CMM Project Revenue Streams

- **Revenues:** CMM projects might generate revenues through the sale of gas or electricity and/or realize cost savings from avoided energy costs.
- **Carbon Credits (e.g., GHG offsets, emission reductions):** CMM projects capture methane that would otherwise have been vented into the atmosphere, and put it to use, thus reducing GHG emissions. These emission reductions, if properly verified, might be considered GHG offsets and sold as “carbon credits.” The financing opportunities associated with carbon credits are discussed further on page 8.
- **Tax Credits:** In certain jurisdictions, tax credits might be available for the development or recovery of CMM projects.⁶

CMM Project Costs

There are three general categories of costs associated with CMM projects.

Capital Costs

Capital costs include costs associated with the development, construction, and financing of the project. Typical capital cost components are listed in the table below.

The total capital costs of a simple CMM project to produce and sell pipeline-quality gas are likely to be several million dollars. Projects involving enrichment, power production (electricity generation), or equipment conversion will be more expensive,

sometimes involving initial costs of more than \$10 million even with an existing gas recovery system.

Operating Expenses

A project’s operating costs depend on the project’s complexity and the end product that is being sold. Operating costs for gas sales projects using high-quality gas from pre-mine drainage are generally lower than gas sales projects involving gas upgrade or enrichment, which are, in turn, lower than operating costs for electricity generation projects. Operating costs components include:

- Personnel, maintenance, and operation of gas recovery systems.
- Annual operating costs for compressors, water/gas separator, and equipment maintenance and insurance.

For more project-specific information on capital and operating costs, please see U.S. EPA’s Coal Mine Methane Project Cash Flow Model at: www.epa.gov/cmop/resources/cashflow_model.html. This online model will be updated periodically to reflect the most current cost data. For more detailed information on gas upgrade costs, see U.S. EPA’s document *Upgrading Coal Mine Methane to Pipeline Quality (2008)* at: www.epa.gov/cmop/docs/red24.pdf.

Royalties, Fees, and Other Expenses

Royalties are assessed for the gas used by project developers who are not the owner of the gas rights. On U.S. federal lands, the prevailing royalty rate is 12.5 percent, subject to individual contract negotiations. On private lands/leases, the royalty rate is negotiated and is typically within this range.

Capital Cost Component	Description of Activities and Equipment
Degasification system	Drill, install, and complete wells and boreholes, including water disposal
Gas collection and gathering system	Blowers, compressors, lines
Gas processing system	Separators, dehydrators
Electricity generation	Gas turbines or IC engines, generator sets, utility interconnections
Offsite gas sales	Enrichment equipment, compressors, sales meter/gas analyzer, transmission pipeline
Onsite gas use	Conversion of mine boilers

⁶ Please check with your legal and accounting advisors to determine if tax credits apply.

In absolute terms, the project development and up-front financing costs are roughly the same irrespective of the size of the project; in percentage terms, however, they are a much bigger burden on smaller projects. There are a number of organizational and transactional costs associated with project development, which might represent upwards of 25 to 30 percent of the total capital costs. These costs include:

- Conducting “due diligence” or examining and verifying the assertions and records of other project parties.
- Performing system design, engineering, and economic assessment.
- Negotiating and drafting legal documents and agreements.
- Obtaining the necessary permits, licenses, and rights-of-way for pipelines or power lines.

Other significant non-operational expenses that are regularly incurred include the following:

- Taxes (federal, state).
- Financing-related costs (including interest).

Assessing Financial Feasibility

There are two standard and interrelated methods used to measure an investor’s return on equity for assessing CMM project financial feasibility:

- **Discounted Cash Flow Method:** The sum of a project’s net cash flows over the project’s life is discounted to the present (i.e., the net present value [NPV] of the project). The discount rate used to make this calculation represents the investors’ cost of capital. If a project’s NPV is positive, then the project is deemed capable of yielding the investor’s minimum required return.
- **Internal Rate of Return:** The internal rate of return (IRR) on a project is the discount rate at which the NPV of the project’s net cash flow is zero. In other words, it is the rate that equates the present value of future cash flows with the initial capital investment. A project’s expected IRR can be compared with return rates on alternative investment opportunities.

Sensitivity analysis should also be carried out to examine the impact of risks on project returns. Risks could include changes in key financial variables, such as gas production or electricity prices.

As previously mentioned, CMOP has developed the Coal Mine Methane Project Cash Flow Model, a Web-based cost-benefit analysis tool to assist developers with estimating financial scenarios associated with CMM projects. The online tool allows users to enter mine-specific information including percent methane of the drained gas, distance from drainage area to onsite use, compressor/blower efficiencies, drainage well and blower development costs, gas availability, project lifetime, loan terms and interest rate, and certified emission reduction (CER) unit sale price. The model provides estimated outputs including equity amount, IRR, and a cash flow analysis. The tool is available on the CMOP Web site at: www.epa.gov/cmop/resources/cashflow_model.html.

CMM Project Risks

Project risks change depending on the stage of the project: development, construction, or operation. The equity investor generally bears the development risks of a project—those risks associated with the developer’s ability to complete the project and receive project cash flows. In this case, the developer/investor would be unable to recover “sunk” costs, such as legal or consulting fees incurred. Construction and operations risks might also be associated with substantial losses. Associated CMM project risks are described in the exhibit on page 7.

Mine Operation Risks

Mine operators might encounter a separate set of potential risks than project developers and/or investors. Maintaining the productivity and profitability of their mining operations are the primary concerns of mine managers. Mine operators are also concerned about potential risks that the CMM project could pose to their coal operations in terms of safety and flexibility, as well as the risks of the project itself. Possible risks for mine operations include:

- **Interference with mining operations.** Coordinating gas production and use with coal operations requires both detailed planning and great attention in implementation, which could potentially distract from or interfere with coal production, or both.
- **Reduction in mine planning flexibility.** Mine operators might be concerned that gas operations will limit their ability to change plans at a given mine or to close or sell a mine (e.g., contracts requiring delivery of specified amounts of gas over a given time frame could infringe on the ability to alter coal mining operations).

Risks Associated With CMM Projects

Project Development Risks	Construction and Operations Risks
<ul style="list-style-type: none">• Inability to obtain agreements with mining company and adjacent land owners.• Indications of marginal gas resource (such as gas quality, rate of flow, and longevity).• Inability to negotiate energy sale agreements.• Inability to obtain permits.• Insufficient development capital.• Inability to secure financing.	<ul style="list-style-type: none">• Construction cost overruns or delays in construction completion.• Poor gas productivity (such as flow rate, reliability, and quality).• Technological risk (poor system performance).• Market risk (drop in revenues due to price changes).• Contractual/legal problems with customers, mine owner/operator, system suppliers, or regulatory agencies.• Mine closing or change in mining plan, causing stranded investment.



Appropriate sources of financing vary depending on the project. Project developers often manage their risk exposure by using project financing, a financing technique used to raise debt financing on the basis of a project's projected cash flows. Project revenues might also include carbon financing, which could provide a revenue stream based on mitigated carbon emissions.

Equity Investment

Lenders typically require that developers invest equity to demonstrate their confidence in the project's success and willingness to risk their own financial resources. While acceptable debt-to-equity ratios vary, project financing using project debt can be highly leveraged. The actual ratio preferred by lenders usually reflects the project's perceived risk as well as the borrower's financial stability. In practice, many CMM projects developed in the United States have been financed through corporate resources rather than project-specific debt and equity.

A wide variety of financial institutions or financiers provide debt or equity capital, or both (see examples at right). These entities vary in terms of their risk tolerance; some will accept project risk and others will not. Multilateral and bilateral funding institutions, such as the Asian Development Bank, the World Bank, and the Japan Bank for International Cooperation, have played a significant role in financing CMM projects. Appendix C provides a more complete overview of these and other project funding sources, the risk/return profiles of these institutions, the particular investment areas in which they specialize, and the current status of the marketplace.

An equity investment can be made in a project itself (i.e., as in a project finance transaction) or in the company developing the project. In the former case, the investor's return is solely a function of the project's financial performance. In the latter, the return is a function of the financial performance of all the company's operations, rather than the project alone. Consequently, the investor must evaluate the company's strategy, its competitive advantages relative to other firms in its industry, and the quality of its management, in addition to the economics of the particular project.

Equity investors can become involved in a project at any stage in the project development process depending on their level of activity and risk tolerance. In the early stages of project

Examples of Project Funding Sources

- Commercial banks profit by lending money at higher interest rates than they pay on deposits. Banks might provide short-, medium-, and long-term corporate and project finance loans at a margin or spread over a benchmark rate such as LIBOR.⁷
- Finance companies normally provide debt financing for projects and transactions, often financing projects in earlier stages than banks and investing in a wider range of industries. Most finance companies will not put up initial risk capital to fund project development, but they will provide subordinated debt financing in exchange for increased lending rates.
- Investment bankers provide a wide variety of services that support raising financing. They provide advice on corporate and project financing alternatives, arrange debt and equity public offerings and private placements, and assist in transactions such as mergers, acquisitions, and divestitures.

development, there is a relatively high probability that the project will never be implemented, so investors who fund the early costs bear the most risk. Most equity investors will consider a project only after technical and economic studies (such as FS) show that the project is technically and financially viable, and after important contracts such as energy purchase/sale agreements have been signed.

In addition to the typical financial sources noted above, many bilateral and multilateral organizations have funding available for climate change-related programs or initiatives, and several are currently engaged in projects to mitigate GHG emissions (see selected examples in Appendix C).

Carbon Financing

Many CMM utilization projects can offer financial returns that are sufficient on their own merits to attract traditional investors and lenders. For other projects, the sale of carbon credits from GHG emission reductions may be required to make them an attractive investment. In most cases, carbon credit revenues

⁷ London Interbank Offered Rate, comparable to the U.S. Federal funds rate.

Carbon Credit Terminology

- **Carbon Financial Instruments (CFIs):** The Chicago Climate Exchange (CCX) unit of trade, which can be issued as allowance-based or offset credits. One CFI represents 100 tCO₂e.
- **Certified Emission Reductions (CERs):** A unit of GHG emission reductions issued pursuant to the Clean Development Mechanism of the Kyoto Protocol, and measured in tCO₂e. One CER represents a reduction of GHG emissions of one tCO₂e.
- **Emission Reduction Units (ERUs):** A unit of emission reductions issued pursuant to Joint Implementation. This unit is equal to one tCO₂e.
- **European Union Allowances (EUAs):** The allowances in use under the European Union Emissions Trading Scheme (EU ETS). An EUA unit is equal to one tCO₂e.
- **Renewable Energy Certificates (RECs):** Tradable environmental commodities in the United States which represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource.
- **Verified Emissions Reductions (VERs):** A unit of GHG emission reductions that has been verified by an independent auditor and can be traded on the voluntary market.

Source: World Bank, Ecosystem Marketplace and New Carbon Finance.

alone are inadequate to provide the level of funding necessary for project planning and implementation. Carbon credits are particularly useful for improving the cash flow of projects that are otherwise economically marginal and, therefore, unattractive to investors.

The emerging carbon credits market consists of three main types:

- **Regulatory (Compliance) Carbon Markets:** Cap-and-trade systems under regulatory regimes, such as the Kyoto Protocol (through the Clean Development Mechanism or the Joint Implementation scheme), the European Union Emissions Trading System (EU ETS), or the Australia New South Wales (NSW) trading scheme.
- **Voluntary Carbon Exchanges:** Voluntary yet legally binding, membership-based cap-and-trade systems, for example the Chicago Climate Exchange.
- **Voluntary Over-the-Counter (OTC) Markets:** Project-based carbon offsets purchased exclusive of a cap-and-trade system, usually through negotiated bilateral agreements.

Regulated Carbon Markets

The Kyoto Protocol is a legally binding agreement under which nearly 200 industrialized countries have agreed to reduce collective GHG emissions to an average of 5 percent below 1990 emissions levels by 2012. To date, the regulated overseas GHG markets that have evolved under the Kyoto Protocol are flexible cap-and-trade mechanisms that enable developed countries and countries with economies in transition (EITs) to purchase carbon credits from other developed countries and EITs to fulfill emission reductions commitments including:

- **Joint Implementation (JI):** A project-based transaction system under the Kyoto Protocol to allow emitters in developed countries (i.e., "Annex 1" countries) to purchase carbon credits from GHG reduction projects implemented in another developed country or EITs.
- **Clean Development Mechanism (CDM):** A project-based transaction system under the Kyoto Protocol, through which developed countries can accrue carbon credits by financing GHG reduction projects in developing countries.

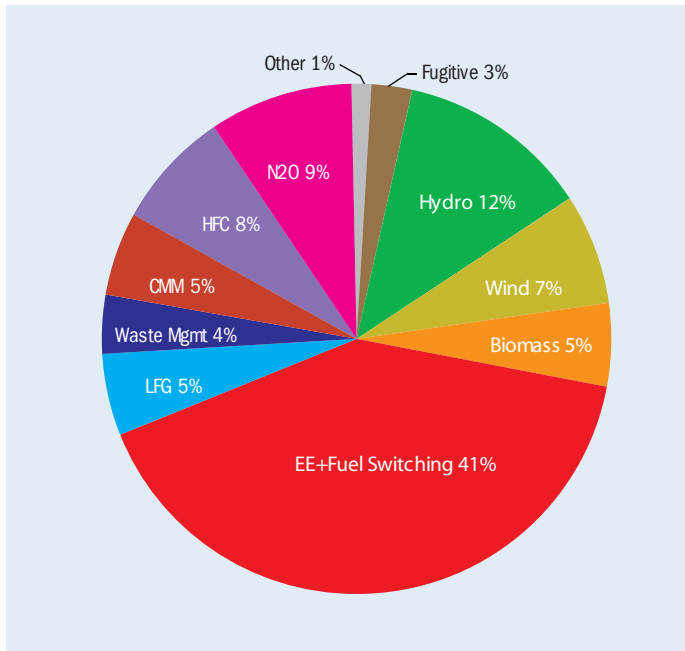
Case Studies: Leveraging Carbon Funds for CMM Projects in China

Two CDM utilization projects are underway in the coal mining concession area of the Yangquan Coal Industry (Group) Company Limited (YCIG) in China.

- **CMM Capture and Use for Power Generation:** This project installed 90 MW of gas engines for power generation from CMM.
- **Using CMM for Fuelling a Furnace System:** This project represents the first CMM-fuelled aluminum hydroxide roasting furnace system in China and perhaps the world. The furnace project is expected to reduce methane emissions by nearly 7 MtCO₂e over seven years (2007-2013).

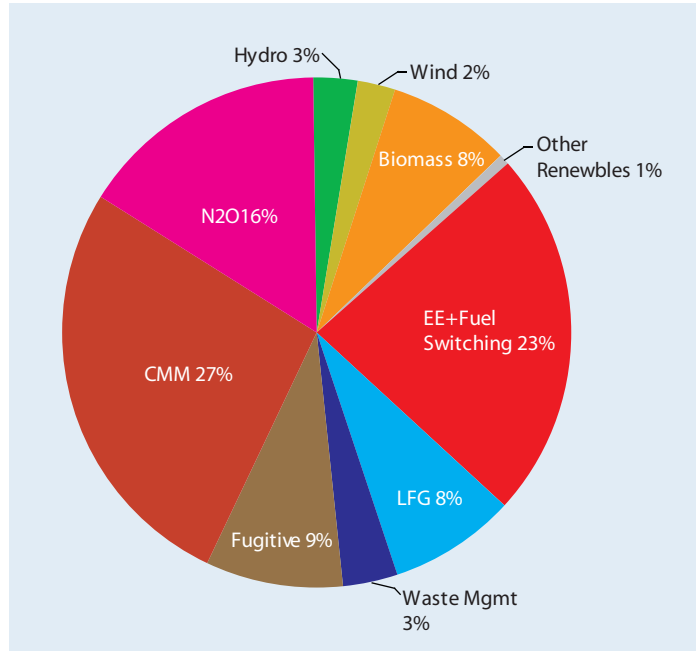
Funding for both projects was secured through the European Carbon Fund (ECF), which contributes to the financing of projects that help fight climate change by reducing GHG emissions around the world.

CDM Projects by Source, 2007



Source: World Bank *State and Trends of the Carbon Market 2008*

JI Projects by Source, 2007



Source: World Bank *State and Trends of the Carbon Market 2008*

There are several distinct emissions trading systems that have been established either within the framework of the Kyoto Protocol or entirely outside of it. These allowance-based transaction systems set a regulatory cap or limit on total carbon emissions and allow trading within that cap to meet the established limits. Some of the caps can be met through the purchase of offsets. These systems establish legally-enforceable limits and are enforceable in their own right. Examples include the EU ETS and Australia's NSW Greenhouse Gas Reduction (previously "Abatement") Scheme (GGAS).

Recent Kyoto Protocol carbon market activity is reflected in the pie charts on the previous page, with CMM representing 5 and 27 percent in CDM and JI projects, respectively.

In the United States, 10 East Coast states have developed the Regional Greenhouse Gas Initiative (RGGI, www.rggi.org), a regulated carbon market, to reduce CO₂ emissions from power plants.⁸ Currently, neither the RGGI program nor other regional and state-level programs underway in the United States, such as the Oregon Standard and the Western Climate Initiative, explicitly address CMM emissions reductions, but they may in the future.⁹

⁸ Connecticut, Delaware, Maryland, Massachusetts, Maine, New Hampshire, New Jersey, New York, Rhode Island, and Vermont participate in RGGI.

⁹ For a complete summary, see "Forging a Frontier: State of the Voluntary Carbon Markets 2008" at: www.ecosystemmarketplace.com/documents/cms_documents/2008_StateofVoluntaryCarbonMarket2.pdf.

Voluntary Carbon Markets

Voluntary carbon markets can be divided into two distinct components: carbon exchanges (e.g., CCX) and OTC markets.

- The Chicago Climate Exchange (CCX) was launched in 2003 and describes itself as "the world's first and North America's only active voluntary, legally binding integrated trading system to reduce emissions of all six major GHGs with offset projects worldwide." CCX Members (full, associate, and participant) represent all sectors of the global economy. They make a voluntary but legally binding commitment to meet annual GHG emission reduction targets. Those who reduce below those targets have surplus allowances to sell or bank; those who emit above the targets comply with their commitment by purchasing CFIs. Two U.S. coal mining companies have joined the CCX as members and at least one CMM project developer has joined as an offset provider.
- Over-the-Counter (OTC) carbon markets are not driven by any sort of emissions cap and do not operate via a formal exchange (e.g., trading). Buyers of carbon credits are typically motivated by environmental philanthropy, public relations (demonstrating sustainability), or pending regulations. OTC sellers include project developers, aggregators/wholesalers, retailers, and brokers.

Overall Value of Global Carbon Markets

Markets	Volume (MtCO ₂ e)		Value (US\$ million)	
	2006	2007	2006	2007
Chicago Climate Exchange (CCX)	14.3	42.1	58.5	258.4
Over-the-Counter (OTC) Carbon Markets	10.3	22.9	38.3	72.4
Total Voluntary Markets	24.6	65.0	96.7	330.8
European Union Emissions Trading Scheme (EU ETS)	1,044	2,061	24,436	50,097
Primary Clean Development Mechanism (CDM) ¹⁰	537	551	5,804	7,426
Secondary Clean Development Mechanism (CDM)	25	240	445	5,451
Joint Implementation (JI)	16	41	141	499
Australia New South Wales (NSW) Trading Scheme	20	25	225	224
Total Regulated Markets	1,642	2,918	31,051	63,697
Total Global Market	1,667	2,983	31,148	64,028

Source: New Carbon Finance, Ecosystem Marketplace, World Bank

While the regulated or compliance markets currently outperform the voluntary markets, 2006 and 2007 trading volumes and values suggest that the OTC market is gaining momentum (see above).

Challenges of Carbon Financing

There are several issues associated with securing carbon credits for CMM projects. Some of these challenges or barriers include:

- Lack of standardized methodologies. Because there is no one universal carbon trading program, GHG reduction projects are subject to different standards. For example:
 - CDM and JI projects are subject to the requirements of Approved Consolidated Methodologies (e.g., ACM0008). These methodologies require that the project demonstrate its “additionality” or emissions reductions in excess of those that would otherwise occur under a baseline scenario. <http://cdm.unfccc.int/methodologies/DB/UJW6WTG49X4VYQZK8U4TC8YWY51U1Y/view.html>
 - Voluntary carbon markets each have their own standards. For example:
 - CCX Offset Project Registration, Verification & Crediting Procedure: www.chicagoclimatex.com/content.jsf?id=104

- International Organization for Standardization (ISO)14064 Standards:

Part 1: www.iso.org/iso/catalogue_detail?csnumber=38381

Part 2: www.iso.org/iso/catalogue_detail?csnumber=38382

Part 3: www.iso.org/iso/catalogue_detail?csnumber=38700

- Voluntary Carbon Standard (VCS): www.v-c-s.org/documents.html

- Ownership of credits. In order to buy or sell credits, proof of ownership must be demonstrated and legally transferred to the other party following the transaction. Under most circumstances, credit ownership will be recorded under the appropriate trading mechanism (e.g., CDM, EU ETS, CCX) but in the absence of clear reporting (i.e., OTC markets), a contract specifying ownership of the resultant carbon credits should be obtained.
- Process for validating/verifying credits. The validation of carbon credits has become increasingly important. This also requires having an acceptable methodology and third-party verifiers. These mechanisms allow the market to impose some discipline by ensuring that credits are valid.

¹⁰ Primary CDM transactions refer to the first sale of CERs from the project owner to the buyer. Secondary CDM transactions refer to subsequent sales of primary CERs.

- Regulated markets: There have been substantial delays in validating and verifying CDM projects, in particular.¹¹ These delays, in turn, slow the issuance of CERs, which might affect project financing and implementation.
- Voluntary markets: Third-party verification has become prominent. More than 87 percent of credits in the OTC voluntary markets in 2007 were verified by a third party.¹²
- Post-2012 uncertainty. In the absence of a global trading regime, it is unclear how the carbon credit markets might fair in the post-Kyoto period (i.e., after 2012). Financial institutions might not be willing to invest in projects for which there is limited or no future liquidity. However, national governments, multilateral funds, and/or other investors with mandates for alternative investments (e.g., venture capital, hedge funds) might continue to pursue carbon credits beyond 2012 if certain guarantees can be secured (e.g., future “market price,” forward contracts).

¹¹ World Bank's *State and Trends of the Carbon Market 2008*

¹² Ecosystem Marketplace and New Carbon Finance, 2008

VAM Mitigation: Cutting Edge Technologies Convert Methane Emissions to Income

In September 2007, the world's first commercial-scale power plant using VAM as the primary fuel went into full operation at the West Cliff Colliery of BHP Billiton in Australia. The plant generates 6 megawatts (MW) of electricity and reduces GHG emissions by 250,000 tonnes of carbon dioxide equivalent (tCO₂e) each year, thereby allowing BHP Billiton to convert the reductions into corresponding carbon credits. Use of this extremely lean fuel is made possible by a patented combination of emission control and steam cycle technologies developed by MEGTEC Systems, a Methane to Markets Project Network member. By using its flameless VOCSIDIZER[®] regenerative thermal oxidizer (RTO) as an energy source, MEGTEC generates high grade, super-heated steam from a fuel with 0.9 percent methane content. This project is the culmination of technology demonstrations conducted in Australia and the United Kingdom. The VOCSIDIZER[®] has also been demonstrated in the United States at a CONSOL Energy mine. The West Cliff facility received financial assistance from the Australian Greenhouse Office Greenhouse Abatement Programme.

Biothermica Technologies Inc., a Methane to Markets Project Network member, announced in April 2009 that its VAMOX[™] CMM abatement system is fully operational at Jim Walter Resources' mine no. 4 in Brookwood, Alabama. For the first time in the United States, VAM is being destroyed at an active coal mine, all the while generating bankable carbon credits. Biothermica will use its VAMOX[™] RTO to mitigate VAM as it is released to the atmosphere, creating income by selling carbon credits from the VAM destruction. Approved by the U.S. Mine Safety & Health Administration (MSHA), this medium-size unit will achieve GHG emission reductions amounting to approximately 40,000 tCO₂e annually, the same as removing 8,000 cars from the road. Biothermica plans to develop additional VAM oxidation projects around the world under various GHG reduction schemes.



RISK MITIGATION SUPPORT

Raising debt and equity to finance projects in developing countries can be challenging. There are a number of risk mitigation instruments that facilitate raising private capital in these markets. These instruments are designed to transfer certain defined risks from lenders and equity investors to creditworthy third parties such as guarantors or insurers. Multilateral institutions (such as the World Bank, Asian Development Bank, Inter-American Bank), export credit agencies (e.g., U.S. Export-Import Bank, Japan Bank for International Cooperation, Export Development Canada), and political risk insurers (e.g., Overseas Private Investment Corporation, Nippon Export and Investment Insurance, United Kingdom's Export Credit Guarantee Department) provide different types of risk mitigation support. The CMM project sponsor that possesses a thorough knowledge of these instruments and practices will be better prepared to negotiate with potential financiers and, ultimately, is more likely to succeed in attracting capital.

Loan Guarantees

In order to reduce political risk exposure associated with cross border lending, banks or other lending institutions might require a loan guarantee to ensure timely repayment. A loan guarantee is a promise of an acceptable, creditworthy party to repay all or part of the loan in the event (or under certain specified circumstances) that the borrower does not or is unable to repay the loan. In limited recourse project finance, project developers rarely provide guarantees of loan repayment, although partial guarantees under specified circumstances (such as construction completion) do occur. Loan guarantees are typically provided by national governments interested in catalyzing economic activity in their areas (see text box). Depending on the credit quality of the guarantor, these guarantees reduce the loan default risk which in turn reduces the interest rate on the loan.

Some financial institutions have standardized loan application forms that potential borrowers complete. Most, if not all, institutions will expect the borrower to present a business plan (i.e., project documents and technical studies). Appendix E provides a checklist of the typical lending terms and conditions that financial institutions might use in evaluating CMM projects. This document should provide the CMM project developer with a good sense of the information required before approaching a financial institution.

Risk Reduction Assistance

Certain institutions offer financial assistance to reduce the risks that domestic companies might face when exporting their products or services abroad.

- The **Export-Import Bank of the United States (Ex-Im Bank)** provides long-term loans and guarantees, working capital guarantees, and political risk insurance tied to the sale of U.S. goods and services. It also offers certain special financial terms to companies that export environmental goods to foreign companies that are unable to obtain traditional financial support. www.exim.gov
- The **Overseas Private Investment Corporation (OPIC)** helps U.S. businesses invest overseas by offering support to mitigate these risks. OPIC provides a range of traditional finance resources, such as loans and guarantees. In addition, it offers political risk insurance products for cross-border lending or investing in emerging markets. www.opic.gov
- As a member of the World Bank Group, the **Multilateral Investment Guarantee Agency (MIGA)** promotes foreign direct investment into developing countries to help support economic growth, reduce poverty, and improve people's lives. MIGA addresses investment concerns and political risk perceptions by providing political risk insurance, technical assistance, and dispute mediation services to help remove obstacles. www.miga.org

Political Risk and Credit Insurance

Risk mitigation, in the form of political risk insurance or credit insurance, is offered by public (multilateral and bilateral development institutions - see text box above) and private insurance companies. It is often used in international project finance transactions and is available to both lenders and equity investors. Political risk insurance typically covers the following risks: inconvertibility and transferability of foreign currency, expropriation and nationalization, political violence and breach of contract. Credit insurance covers losses in the event of a debt service default regardless of the cause (i.e., covering both political and commercial risks) and is often used when a government entity is the off-taker of the product.



CONCLUSION

A host of finance and revenue sources are available to CMM project developers worldwide. By tapping the appropriate sources, funding can be secured for all phases of the project development cycle, from prefeasibility studies, to technical specification development, to pilot/demonstration studies and full implementation. The finance organizations and opportunities outlined in this guide contribute to the project development process in several ways. Some provide risk reduction products to mitigate a technology or service provider's concerns about entering foreign markets. Others provide lending and related financial assistance for projects that offer environmental benefits and contribute to sustainable development and poverty alleviation. Still others purchase carbon credits and thereby could supplement a project's cash flow. The preceding examples demonstrate that by mixing equity investment with financing available from a variety of sources, project developers can support even the largest CMM development projects.



APPENDIX A: CMM PROJECT PARTICIPANTS

	Construction and Operations Risks
Developer	Responsible for conceptualizing, assessing, developing, and implementing a project. Identifies project opportunities and then completes or delegates project development tasks. Leads the project through all phases, which include project development, financing, construction, and operation. May be independent of, a partner with, or the same as, the mine operator.
Mine Operator	A critical participant and at a minimum, supplies the site and fuel to the project. Projects using coal mine methane (CMM) are located at the host coal company’s mine, typically employing the mine’s de-gasification system. Projects might take place prior, during or after mining, depending on the technology employed. Often plays a much more extensive role. At most existing CMM projects in the United States, also functions as project developer.
Regulatory Agencies	Provide permits and approvals in the United States, including: U.S. Mine Safety and Health Administration (the mine operator must file a degasification plan as an amendment to the mine ventilation and dust control plan); state mining authority; state oil and gas agency; and state environmental or natural resources department. On U.S. federal lands, the Bureau of Land Management deals with coal/gas leases, and the U.S. Forest Service deals with surface access rights on restricted lands (e.g., Inventoried Roadless Areas). The developer might also need permits for rights of encroachment on the land owner’s property and for potential environmental impacts related to pipeline rights-of-way, water treatment, and combustion related to gas processing. Most permits require that the developer file detailed project plans, designs for underground and surface equipment, and land surveys.
System Supplier	Provides the systems that convert raw gas to pipeline quality gas or electric and thermal energy that might require more than the off-the-shelf compressors, pipes, and meters that the mine operator or developer can install. The viability of a project depends on the system and its supplier’s guarantees and therefore is considered a major project participant. Vendors will often sell a system on a “turnkey basis,” where the vendor is responsible for the installation and performance of the entire system. Often investors will insist that the system supplier retain system ownership until rigorous performance testing is completed. Suppliers may extend their warranties through the project life by means of a maintenance contract.
Project Contractor	Responsible for the design, procurement, construction, and/or installation of CMM project equipment. Either possesses all necessary capabilities in-house, or will enter into subcontracting arrangement with other firms. Some contractors, in conjunction with a system supplier, will provide a project facility on a guaranteed turnkey basis, assuming responsibility for the project’s completion and operational performance.
Project Operator	Responsible for cost-effective delivery of the energy product throughout the life of the project. Performs management functions, as well as the operation and maintenance (O&M) of the system, typically on a contractual basis with the project. Can be a separate third-party firm under contract to the project owners, or one of the other participants. Major maintenance is usually the function of the system supplier.
Energy Product Buyer	Provides the CMM project’s revenues. Buyers include electric utilities, local gas distribution companies, gas wholesalers/blenders, major gas pipelines, and local fuel users (e.g., boilers, kilns). The mine itself could take delivery of CMM project electricity, thermal energy, or raw gas to power onsite equipment. In order to obtain financing for the project, the project must contract with the energy product buyer for a period not less than the term of the senior debt, plus a 2-3 year “tail.”
Financial Institutions/Carbon Financiers	Fill multiple roles, from arranging to providing the financing for the project.



APPENDIX B: KEY ELEMENTS OF FEASIBILITY STUDIES AND U.S. GOVERNMENT SUPPORT

A comprehensive feasibility study includes the following key elements:

- A summary of mine characteristics based on information from the pre-feasibility study (PFS) and site visit(s).
- A detailed assessment of available gas resources based on historical gas emissions from the mine, data on *in situ* gas content, and plans for future mine activities. This element might include pilot well tests.
- A detailed assessment of degasification technologies and mine drainage techniques, both those currently in place and those that could be added to maximize the quality and quantity of drained gas.
- A detailed assessment of technical possibilities to use the gas based on its quality, the overall project objectives, and the PFS results. End uses to be considered include power generation, gas sales to pipeline (with or without upgrade), coal drying, and mine heating.
- A detailed assessment of market opportunities for gas and/or power, including factors such as the distance to nearby pipelines, the current and projected market price of gas, the demand for and price of power generation in the area, and the possibility of carbon credits.
- A detailed assessment of proposed project costs for the project scenarios of interest, using estimates and financial projections. These are based on best-available estimates from technology vendors and technical experts.
- A detailed assessment of site-specific legal, regulatory, and environmental issues, including the status of gas ownership rights, any issues associated with access to surface lands for degasification systems, and other restrictions on the potential project (e.g., wetlands infringement).
- A detailed cost–benefit analysis for each technically viable scenario based on the market assessment and the overall project objectives.
- A conclusion section that includes an assessment of the project’s overall viability, whether financial investment should be made, and any other appropriate recommendations.

The following U.S. government agencies provide assistance for determining project feasibility, ranging from pre-feasibility studies to comprehensive feasibility studies and technology demonstration projects.

- **U.S. Trade and Development Agency (USTDA)** provides funding to facilitate the export of U.S. technologies, products, and services to developing and transitional countries. Applications for USTDA feasibility study grants and technical assistance grants can be submitted via two mechanisms: 1) sole source by a U.S. company partnering with a project abroad, or 2) competitive bidding by a foreign grantee. USTDA has provided grant funding to assess the feasibility of several coal mine methane (CMM) projects. For instance, USTDA funded a study of potential ventilation air methane (VAM) utilization projects in Poland. It has also supplied the grant funding for project design and related planning at the Jincheng Anthracite Coal Mining Group’s Sihe Mine in Shanxi, China, which involves a 120 megawatts (MW) CMM-based power generation project. Recently, the agency provided about US\$500,000 in grant funding for a feasibility study of CMM development potential in Ukraine. www.ustda.gov
- **U.S. Agency for International Development (USAID)**, as part of its Methane to Markets commitment, offers funding support for methane mitigation projects. USAID missions, such as those in India and Ukraine, have offered Global Development Alliance (GDA) funding support to energy industry representatives, research and academic groups, financial institutions, and nongovernmental organizations to assist in promoting methane capture and productive use. One of their key activities has been a technology demonstration project of in-mine drilling and methane degasification at a Ukraine coal mine). www.usaid.gov
- **U.S. Environmental Protection Agency (U.S. EPA)** has funded a number of CMM project-level technology demonstration projects, pre-feasibility studies (PFS), and comprehensive feasibility studies (FS). Domestically, the U.S. EPA has worked with the U.S. Department of Energy to support a demonstration project of VAM technology.

As part of its support for the Methane to Markets Partnership, U.S. EPA has also funded a number of pre- and comprehensive feasibility studies overseas, including these activities in the following partner countries:

- China: Three comprehensive feasibility studies of CMM projects; a PFS of VAM mitigation; and a technology demonstration of VAM technology.
- India: A PFS of VAM mitigation at two mines.
- Mexico: A demonstration project.
- Mongolia: A PFS at an underground coal mine.
- Nigeria: A PFS at an underground coal mine.
- Poland: A pre-feasibility assessment of 10 mines for VAM mitigation and a technology demonstration.

For more information on U.S. EPA's activities, visit: www.epa.gov/cmop.



APPENDIX C: CMM PROJECT FUNDING SOURCES

Types of Financiers	Risk/Return Portfolios	Specialized Investment Areas	Current Status
Commercial Banks			
<p>Commercial banks profit by lending money at higher interest rates than they pay on deposits. Banks might provide short-, medium-, and long-term corporate and project finance loans at a margin or spread over a benchmark rate such as the London Interbank Offered Rate.</p>	<p>Because banks are generally conservative, they apply risk minimization techniques. A project developer seeking bank financing therefore must be prepared to show the bank’s loan officer all important project contracts; a credible, independent project technical assessment; and pro forma financial statements demonstrating the project’s ability to service debt. The developer also should be prepared to discuss its own project development experience and creditworthiness, as well as project assets that could serve as collateral.</p> <p>Because banks are regulated at the federal and/or state levels and are legally restricted from making risky loans, they are conservative lenders, generally providing senior, secured loans to experienced entities. They typically do not fund projects in their development stages, preferring to wait until projects are well-characterized.</p>	<p>Bank financing has been used to fund large-scale coal mine methane (CMM) projects that require major capital investments in both gas recovery systems and collection/utilization components. Few, if any, smaller CMM projects have been bank-financed, however, because:</p> <ul style="list-style-type: none"> • Most banks are unfamiliar with the CMM project market. • Smaller projects frequently are not profitable for banks, even when expected pricing is high, due to the bank’s costs for examining and processing the transaction. 	<p>CMM projects are not inherently “unbankable,” despite the lack of bank participation thus far. They are generally supported by strong contracts, earn sufficiently high rates of return, and employ a resource that is well-characterized. The latter point is especially true in the case of use projects at mines with degasification systems. If banks find a CMM project of an acceptable size and are willing to lend on a project finance basis, they could play a more significant role once they have greater familiarity with the industry. Banks located near gas resources might be good candidates because they are more likely to have experience with the gas industry and, therefore, be more comfortable with CMM projects.</p>
Gas Purchasers			
<p>Gas pipeline companies and gas distribution companies are potential sources of capital for CMM projects because they are interested in securing low-cost supplies of gas.</p>	<p>These companies often face “make or buy” decisions: will it be more profitable to buy or develop gas resources? By developing CMM and other gas projects, they might be able to ensure themselves long-term, low-cost supplies.</p>	<p>Gas/purchase sale contracts can be negotiated between the CBM project and the gas company such that the project is profitable and the gas company pays a relatively low price for gas.</p>	<p>Gas companies to date have played a significant role in financing CBM projects.</p>

Types of Financiers	Risk/Return Portfolios	Specialized Investment Areas	Current Status
Venture Capitalists			
Venture capitalists usually invest in convertible preferred stock because this instrument greatly increases upside potential.	Because venture capitalists provide risk capital to fledgling ventures that often have nothing more than ideas, many of their investments are unsuccessful. In exchange for bearing this risk, venture capitalists expect to earn unusually high returns—in the range of 40 percent after taxes.	Venture capitalists specialize in funding startup companies, including those that develop energy technologies. They might not be suitable investment partners for small CMM project developers, however, because they invest in companies rather than projects and given the active role they take in running companies. CMM project developers that partner with venture capital firms might have to be willing to cede some control of their companies.	In recent years, venture capital investments have been rushing toward clean or alternative energy technologies. ¹³ According to the United Nations Environment Programme (UNEP), sustainable energy venture capital and private equity investment were up more than 30 percent in the second quarter of 2008 in comparison with the same period in 2007. ¹⁴
Pension Funds, Insurance Companies, and Other Institutional Investors			
Pension funds, mutual funds, and other institutional investors are large, regulated companies that pool money provided by smaller investors and then make investments. They control billions of dollars of U.S. investment funds.	Most institutional investors are strictly bound by U.S. Securities and Exchange Commission (SEC) laws and their own covenants and restrictions, which dictate the types of investments the investors might make.	Almost all money under institutional management must be invested in highly rated, publicly traded stocks, bonds, and other highly liquid securities.	Institutional investors have limited appetite for projects and, therefore, generally do not represent potential capital sources for CMM projects.
Investment Bankers			
Investment bankers provide a wide variety of financial services (e.g., advice on corporate/project financing alternatives; arrange debt/equity public offerings and private placements; assist in transactions such as mergers, acquisitions, and divestitures).	Investment bankers have minimum size requirements and are unlikely to be interested in project financing less than \$25-50 million. They might, however, be able to place equity with private investors.	Investment bankers could be useful to CMM projects because they are able to identify investors interested in investing in oil and gas projects, not bound by investment restrictions, and able to invest in smaller projects. Investment banks also might be able to help project developers identify suitable partners such as oil and gas exploration companies.	To date, a number of CMM projects have been financed through private investments. Numerous investment banks have arranged CMM project financing, while others, although they have not been involved in CMM projects, have worked with energy project developers and are interested in assisting CMM projects.

¹³ Wald, Matthew L. "Venture Capital Rushes into Alternative Energy." The New York Times. April 30, 2007. www.nytimes.com/2007/04/30/business/30energy.html?_r=1&oref=slogin

¹⁴ UNEP. "Clean Energy Investments Charge Forward Despite Financial Market Turmoil." June 2008. www.unep.org/Documents.Multilingual/Default.asp?DocumentID=538&ArticleID=5849&l=en

Types of Financiers	Risk/Return Portfolios	Specialized Investment Areas	Current Status
Multilateral Sources (Examples)			
<ul style="list-style-type: none"> • The Asian Development Bank (ADB), a multilateral development organization, strives to improve the social welfare of people in the Asia and Pacific regions. • The Global Environment Facility (GEF) works through three implementing agencies—the World Bank, the United Nations Development Programme (UNDP), and the UN Environment Programme (UNEP)—to provide cost-sharing grants and concessional funding to help developing countries fund projects and programs that protect the environment, such as climate change mitigation projects. • The World Bank provides funding for projects that are consistent with its mission to fight poverty and improve the living standards of people in the developing world. The International Finance Corporation (IFC), the private sector arm of the World Bank Group, provides financing for a variety of sustainable energy and climate change mitigation ventures. IFC financing can include both debt and equity finance of private ventures. • The European Bank for Reconstruction and Development (EBRD) uses investment tools to help build market economies and democracies in countries from central Europe to central Asia. 		<ul style="list-style-type: none"> • ADB provides projects with technical assistance, grants, and loans. In recent years, ADB has focused on supporting clean energy projects under its Energy 2000 policy, which seeks to reorient the energy sector in member countries to address regional and global environmental effects. www.adb.org • The GEF Operational Strategy requires that any GEF-funded activity relating to climate change be fully compliant with the directives of the UN Framework on Climate Change Convention (UNFCCC). www.gefweb.org • Projects that are smaller than the World Bank's preferred minimum lending threshold of ~US\$50 million may be bundled with other development activities to construct a finance package of adequate size. www.worldbank.org • EBRD and the European Investment Bank (EIB) established the Multilateral Carbon Credit Fund (MCCF) to assist its 27 member countries in securing carbon emission reductions for eligible projects. Although it does not specifically mention methane emission reduction, it does support fuel-switching from carbon-intensive (e.g., coal, heating oil, oil shale) to less carbon-intensive fuels such as natural gas. www.ebrd.com 	<ul style="list-style-type: none"> • ADB has been a significant supporter of the world's largest CMM-based power generation project at the Jincheng Coal Mining Authority's Sihe Mine in Shanxi Province, China. • Jincheng project cash flow also will be supplemented by the sale of carbon credits (4.5 tCO₂e) to the World Bank's Prototype Carbon Fund. • IFC has successfully concluded an agreement to purchase credits via ING Bank from a project that generates power using methane captured from coal mines in Ukraine.

Types of Financiers	Risk/Return Portfolios	Specialized Investment Areas	Current Status
Bilateral Sources (Examples)			
<p>The Japanese Bank for International Cooperation (JBIC), as the international wing of the Japan Finance Corporation (JFC), contributes to the sustainable and sound development of the international and Japanese economies.</p>			<p>JBIC provided \$20 million in loan financing for the Jincheng project above. JBIC also recently signed a memorandum of understanding (MOU) with The Energy and Resources Institute (TERI) of India in the development of GHG reduction projects in India. www.jbic.go.jp/en/index.html</p>
Electric Utilities			
<p>Historically, electric utilities have been required to purchase power from independent power producers (IPPs) with “qualifying facility” status (for which many CMM projects would be eligible). While competition in the electricity industry has reduced IPP business to some extent, it also might create increased electric utility interest in the CMM market.</p>	<p>This strategy serves two strategic purposes (in addition to the retention of a large customer). First, by taking a customer “off-line,” the utility will reduce the burden on its own transmission and distribution system, thereby enabling the utility to defer significant investment. This type of saving could be important in a more competitive environment. Second, taking a large load off-line also will free up the utility’s own generating capacity so that it will be able to compete for more business in new markets.</p>	<p>Increased competition means that utilities will have to find creative new ways of serving the energy needs of customers. This is where CMM projects might be valuable: The utility might find that the best way to retain a client is to provide the client with the equipment and financing they need to self-generate. The utility thus would earn profits by financing and selling equipment, providing O&M services, and selling backup power, rather than through the traditional method of selling kilowatt-hours.</p>	<p>Under a more competitive industry structure, all utilities will be looking to develop low-cost electricity sources wherever they might find them. CMM projects might represent relatively low-cost generating sources, and as such might provide a way for higher cost utilities to compete in low-cost regions.</p>
Equipment Vendors / Turnkey Developers			
<p>Some equipment/technology vendors/providers are also planning to provide full turnkey service, including carbon financing for offsets/emissions avoided.</p>		<p>So far, VAM mitigation or energy recovery technologies are the first in this market niche.</p>	<p>For example, Biothermica is developing a project using their VAM oxidation technology at a JWR mine in Alabama, including a negotiated deal for carbon credits (see page 12).</p>

Types of Financiers	Risk/Return Portfolios	Specialized Investment Areas	Current Status
Carbon Financing			
<p>In countries that are participating in the Kyoto Protocol (notably China), carbon financing is an important source of project revenue and is closely considered part of the overall project financing and economics. In the United States, there is a rapidly emerging voluntary carbon market that is having a growing impact on CMM project development.</p>		<p>Regulatory (compliance) markets:</p> <ul style="list-style-type: none"> • Kyoto Protocol—Clean Development Mechanism (CDM) and Joint Implementation (JI) • Australia New South Wales (NWS) Trading Scheme • European Union Emissions Trading Scheme (EU ETS) <p>Voluntary markets:</p> <ul style="list-style-type: none"> • Chicago Climate Exchange (CCX) (voluntary trade & cap); currently includes two U.S. coal mining companies as participating members and one gas company (in the CBM/CMM field) as an offset provider. • Over-the-counter (OTC) offset/carbon credit scheme involving retailers, wholesalers or aggregators, and brokers. <p>Emerging cap-and-trade systems:</p> <ul style="list-style-type: none"> • Regional Greenhouse Gas Initiative (RGGI), does not include methane at this point. 	<p>There are currently 55 projects at various stages in the CDM pipeline with a total potential for 121 million tonnes of carbon dioxide equivalent (MtCO₂e) through 2012. Two other CMM projects have been issued certified emission reductions (CERs) totaling 638,000 tCO₂e. In the U.S. voluntary market, CMM is a major source of offset credits, accounting for approximately 30 percent of CCX transactions.</p>

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SELECTED ORGANIZATIONS

Chicago Climate Exchange (CCX) is North America’s only cap-and-trade system for all six GHGs, with global affiliates and projects worldwide. CCX Members are leaders in GHG management and represent all sectors of the global economy, as well as public sector innovators. Reductions achieved through CCX are the only reductions made in North America through a legally-binding compliance regime that includes independent, third-party verification. www.chicagoclimatex.com

The **Climate Action Reserve (Reserve)** is a national 501(c)(3) nonprofit organization representing international interests in addressing climate change and bringing together participants

from the government, environment and business sectors. It works to ensure integrity, transparency, and financial value in GHG emissions accounting and reduction and the progressive GHG emissions policy movement nationally and in the western United States. The Reserve is parent to three programs: the California Climate Action Registry, Climate Action Reserve, and Center for Climate Action. www.climateactionreserve.org

Climate Leaders is a U.S. EPA industry–government partnership that works with companies to develop comprehensive climate change strategies. Partner companies commit to reducing their impact on the global environment by completing a corporate-wide inventory of their GHG emissions based on a quality management system, setting aggressive reduction goals, and annually reporting their progress to U.S. EPA. Through program participation, companies create a credible record of their accomplishments and receive U.S. EPA recognition as corporate environmental leaders. www.epa.gov/climateleaders

The **Energy Information Administration (EIA)**, a statistical agency of the U.S. Department of Energy, provides policy-neutral data, forecasts, and analyses to promote sound policymaking, efficient markets, and public understanding regarding energy and its interaction with the U.S. economy and the environment. EIA administers the Voluntary Reporting of Greenhouse Gases Program, established by Section 1605(b) of the Energy Policy Act of 1992, which provides a means for organizations and individuals that have reduced their GHG emissions to record their accomplishments and share their ideas for action.

The **Environmental Markets Association (EMA)** is the premiere trade association for environmental industry professionals who are active or interested in the market-based solutions to combat pollution and create a sustainable environment. EMA members include large utilities, emissions brokers and traders, consultants, financiers, members of the press, government agencies, nonprofit organizations and academics. www.environmentalmarkets.org

The **International Emissions Trading Association (IETA)** is a nonprofit business organization created to establish a functional international framework for trading in GHG emission reductions. IETA’s membership includes leading international companies from across the carbon trading cycle. www.ieta.org

The **Pew Center on Global Climate Change** brings together business leaders, policymakers, scientists, and other experts to bring a new approach to a complex and often controversial issue. Pew's approach is based on sound science, straight talk, and a belief that multiple entities can work together to protect the climate while sustaining economic growth. www.pewclimate.org

Under partnership between the **World Resources Institute (WRI)** and the **World Business Council for Sustainable Development (WBCSD)**, the Greenhouse Gas Protocol (GHG Protocol) is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage GHG emissions. www.ghgprotocol.org



APPENDIX E: CMM PROJECT LENDING EVALUATION CHECKLIST

PROJECT OVERVIEW

- Project description
- Business plan
- Project financial projections including all assumptions
- Description of principal project risks and risk mitigation analysis
- Financing plan with detailed sources and uses of funds (e.g., equipment, financing costs)
 - Project cost breakdown
 - Evaluation of equity or collateral contributed (e.g., cash, prepaid development expenses)
 - Leverage (i.e., financing provided by borrower and financing requested)
- Carbon finance plan (if applicable)

BORROWER INFORMATION

- Corporate documents (e.g., Articles of Incorporation, Partnership Agreement, LLC Articles, operating agreement)
- Relevant experience in CMM project(s) and related technology
- Resume(s) of project development staff
- Audited financial statements (e.g., balance sheet, income statement, cash flow) – year-to-date, plus 2-3 previous years, if available
- Three-year *pro forma* financial statements demonstrating anticipated results or expected impact of proposed transaction.
- Corporate tax returns (most recent 2-3 years) may be required from project developer

PROJECT FEASIBILITY AND CONTRACTUAL DOCUMENTATION

- Project implementation schedule, showing target dates for achieving essential project milestones
- Feasibility studies, technical and market reports (sufficient to demonstrate project's technical feasibility), with detailed information including the following:
 - Anticipated gas flow rate (e.g., billion cubic feet/day)
 - Projected gas quality (i.e., percent methane and range)
 - For projects at active coal mines: projected mine life, description of mining plan (e.g., seams to be mined, planned production levels, seam depth) including mine maps
 - Planned end-use for CMM and documentation about projected capital, operating, maintenance costs, and expected performance
- Contractual flow chart (i.e., project participants and contracts)
- Environmental assessment
- Description of project contracts (i.e., project contracts to be included such as construction contract), especially agreement with mine owner /operator (for projects at active coal mines), and all agreements with surface owners and documentation of rights to the CMM.
- Background information on each of the project participants, including financial information.

Additionality: According to the Kyoto Protocol, greenhouse gas emission reductions generated by Clean Development Mechanism (CDM) and Joint Implementation (JI) project activities must be additional to those that otherwise would occur. Additionality is established when there is a positive difference between the emissions that occur in the baseline scenario and the emissions that occur in the proposed project.

***Broker/Trader:** A party that mediates between a buyer and a seller (e.g., for the sale of carbon offsets).

Carbon Finance: Resources provided to projects generating (or expected to generate) greenhouse gas (GHG) (or carbon) emission reductions in the form of the purchase of such emission reductions.

***Carbon Financial Instruments (CFIs):** The Chicago Climate Exchange (CCX) unit of trade, which can be issued as allowance-based or offset credits. One CFI represents 100 tonnes of carbon dioxide equivalent (tCO₂e).

Certified Emission Reductions (CERs): A unit of GHG emission reductions issued pursuant to the CDM of the Kyoto Protocol, and measured in tonnes of carbon dioxide equivalent (tCO₂e). One CER represents a reduction of GHG emissions of one tCO₂e.

Clean Development Mechanism (CDM): The mechanism provided by Article 12 of the Kyoto Protocol, designed to assist developing countries in achieving sustainable development by permitting industrialized countries to finance projects for reducing GHG emissions in developing countries and receive credit for doing so.

***Discounted Cash Flow Method:** The sum of a project's net cash flows over the project's life is discounted to the present (i.e., the net present value [NPV] of the project). The discount rate used to make this calculation represents the investors' cost of capital. If a project's NPV is positive, then the project is deemed capable of yielding the minimum required return.

Emission Reduction Units (ERUs): A unit of emission reductions issued pursuant to JI. This unit is equal to one tCO₂e.

European Union Allowances (EUAs): The allowances in use under the European Union Emissions Trading Scheme (EU ETS). An EUA unit is equal to one tCO₂e.

***Internal Rate of Return (IRR):** Discount rate at which the NPV of the project's net cash flow is zero. In other words, it is the rate that equates the present value of future cash flows with the initial capital investment. The expected IRR on a project can be compared to return rates on alternative investment opportunities.

Joint Implementation (JI): Mechanism provided by Article 6 of the Kyoto Protocol, whereby a country included in Annex I of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol might acquire Emission Reduction Units when it helps to finance projects that reduce net emissions in another industrialized country (including countries with economies in transition).

***Retailer:** Refers to parties who sell relatively small amounts of carbon offset credits to individuals or organizations and have ownership of a portfolio of credits.

Renewable Energy Certificates (RECs): Tradable environmental commodities in the United States which represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource.

***Turnkey:** A project or contract that provides for the complete design, procurement (of equipment), construction, and start-up of a facility—by a date certain—for a fixed sum and at guaranteed performance levels.

Verified Emission Reductions (VERs): A unit of GHG emission reductions that has been verified by an independent auditor. This designates emission reductions units that are traded on the voluntary market.

