ENERGY EDGE

The Impact of the Kyoto Protocol on the Global Coal Mine Methane Market

ABSTRACT

The Kyoto Protocol, which sets binding limits on industrialized nations' greenhouse gas emissions, has been ratified (as of February 2004) by 120 nations. As a result, governments are now developing the policies and measures to reduce or offset their emissions to meet their emission caps. The Kyoto Protocol limits emissions on six different greenhouse gases, including methane, and it also includes provisions for international "emissions trading." Coal mine methane projects may play a significant role in compliance, and project developers may stand to benefit significantly from Kyoto.

This paper gives an overview of Kyoto and then analyzes its impact on the coal mine methane industry. It examines demand for emissions credits, reporting that the EU may need to identify approximately 156 million metric tons of CO_2 equivalent, and Japan 156 million tons, and Canada 198 million tons. The current EU trading system price for emission reductions is €13/ton, and comparing these prices with the global marginal abatement costs for coal mine methane emissions shows that at least 111 million tons of CO_2 equivalent reductions are available for less than €9/ton. The paper then explores the markets for coal mine methane emission reductions, and projects the impact Kyoto will have on coal mine methane projects in different countries. It is theoretically possible for the industry to triple in size if all profitable emissions reductions are undertaken. It also discusses how the coal mine methane markets in Australia and the United States, two countries that have not yet ratified Kyoto, may develop based on state government and private emissions markets. It concludes with a section on the steps coal mine methane developers may take to benefit from the Kyoto markets.

INTRODUCTION

Methane emissions from coal mines are significant. 2000 global emissions of coal mine methane are estimated to be nearly 32 Billion Cubic Meters (1,100 Bcf) of CH_4, or 456 million metric tons of CO_2 equivalent emissions [1]. While this constitutes approximately 1% of total human-induced greenhouse gas emissions, it can be a highly significant part of the global emission reduction effort over the next 10-20 years. This is because technologies exist to recover and use a significant portion of these emissions. Analyses performed by the U.S. Environmental Protection Agency (US EPA) have projected emissions to 2010 and estimated the marginal costs to reduce these emissions [1]. Some of these emissions may be abated at a profit, and progress in countries as diverse as the U.S., China, Germany, and Australia demonstrate this. However, the majority of emissions cannot be profitably used if just the energy value of the methane is counted in project economics. For further reductions, additional subsidies or price signals are necessary. The greatest promise for further developing the industry, and reducing global methane emissions, comes from incentives created under an international agreement called the Kyoto Protocol.

THE KYOTO PROTOCOL AND ITS "FLEXIBLE MECHANISMS"

It is important to examine the basis of the Kyoto Protocol and project-level compliance mechanisms it has instituted in order to understand the scale and nature of Kyoto in stimulating the coal mine methane market. Beginning in the late 1980s, policymakers began to pay attention to global increases in temperature and studies indicating that human induced emissions of greenhouse gases were a major contributor to the warming. By 1992 the United Nations Framework Convention on Climate Change set out to stabilize human-induced greenhouse gas concentrations at a level that would prevent dangerous interference with the climate system. In 1994 the Convention came into force with 185 states ratifying the treaty. Ratifying nations began taking actions, generally voluntary in nature, to reduce emissions but the level of emissions continued to rise throughout the 1990s in most parts of the world. As a part of the Framework Convention process, however, a Protocol was negotiated in Kyoto, Japan in 1997 that set binding limits on 38 industrialized nations. Each of these countries is allocated a certain emission reduction target to be met between 2008 and 2012. Countries may meet their targets by reducing domestic emissions, or they may trade the rights to emission reductions with other developed or developing nations. This provision is called the "flexible mechanisms", under which a coal mine methane project may contribute.

Definition of Emissions Credits

In any discussion of "emissions credits" or "emissions allowances" it is important to understand what such credits are, and what they are not. Emissions credits are not tax credits. They are also not funds to capitalize projects, although public and private funds have been created to facilitate emissions reductions. Emissions credits are essentially the transfer of pollution rights. For entities facing caps on their emissions, they have a choice of either reducing their on-site emissions, or of obtaining rights to pollute that are based on emissions reductions from other entities. Some emissions trading systems are closed, such as the U.S. Acid Rain Trading Program. In closed systems, credits need to be obtained from other entities facing caps. The Kyoto system is open, meaning that emissions credits may be obtained from other entities facing caps (as in the EU Emissions Trading Scheme) or credits may be procured by developing vetted and certified emissions reductions from entities and projects not necessarily facing caps.

Joint Implementation and Clean Development Mechanism Credits

The credits assigned to emissions reductions are what make coal mine methane projects interesting for governments and companies with caps on their emissions. Between nations with binding limits, the project-level transferable credits are called "Emission Reduction Units" (ERUs) undertaken through what is called "Joint Implementation." One ERU is the equivalent of one metric ton of carbon dioxide emission reduction. Joint implementation is the Kyoto Mechanism to implement projects between developed countries. Joint implementation projects require approval of both the buyer's and the seller's governments and must clearly lead to additional reductions beyond "business as usual."

The Clean Development Mechanism (CDM) allows for crediting of projects in countries that have ratified Kyoto but do not have binding limits on emissions (developing countries) to host projects that bring additional emissions reductions and also meet sustainable development criteria. Projects must have clearly defined baseline, monitoring and verification methodologies approved by an international CDM Executive Board. CDM credits are called "certified emissions reductions" (CERs) and unlike ERUs, that are creditable starting in 2008, are creditable and bankable from when Kyoto enters into force.

Kyoto Emissions Trading Systems

Many nations have or are creating national greenhouse gas emissions trading systems and are setting caps on emissions to force industry to begin reducing emissions in preparation for the Kyoto period of 2008-2012. The first fully developed national trading system was created in the United Kingdom. The European Union will limit CO_2 emissions from key industry sectors beginning in 2005. Up to at least 6% of all emissions reductions in this system (at least beginning in 2008) may be obtained by using Kyoto's Flexible Mechanisms, including methane emission reductions. Discussions currently underway within the European Union may result in allowing the use of Kyoto's "flexible mechanisms" beginning in 2005 and possibly without requiring that the Kyoto Protocol enter into force.

While 120 nations have ratified Kyoto, it is important to note that three major industrialized countries have not. The Bush Administration announced in 2001 that the United States would not ratify, and Australia has followed this approach. In addition, Russia has not yet ratified and different government representatives give conflicting messages on if and when Russia will ratify. Because the Protocol only comes into force if nations with a total of 55% of all emissions in industrialized countries ratify, and because the current total is only 44%, Kyoto is not yet in force. The European Union has stated, however, that regardless of the status of Kyoto it will continue to maintain its limits on emissions.

There are a host of intricacies regarding the use and acceptance of ERUs, CERs and other emissions credits that are not the focus of this paper, but the basic idea is that a company or government in a country needing to meet its emission reduction targets might receive credit for an approved project that reduces greenhouse gas emissions in another country.

KYOTO'S IMPACT ON GLOBAL CMM INDUSTRIES

A comparison of the demand for emissions credits, the expected market prices to obtain these credits, and the supply and costs of developing profitable coal mine methane projects can provide a good understanding of the potential for coal mine methane projects to serve as a supply of credits. It is important to note that other issues, such as the capital investment required, the difficulty of developing projects, and the ability to accredit coal mine methane emissions reductions will also impact the overall prospects for the industry to benefit from emissions credit demand and supply emissions credits to prospective buyers. Below is an overview analysis of these issues.

Emissions Reduction Demand

Demand for credits comes primarily from the European Union (EU), Japan, and Canada. The average international target for all countries ratifying Kyoto and with binding limits is 5.2% below 1990 emissions in the period from 2008-2012. Each country has a unique target. Canada for instance has a Kyoto target of reducing emissions to 6% below 1990 levels and expects to need a total of 198.57 million metric tons of additional CO_2 equivalent reductions beyond "business as usual" by 2010. The European Union as a whole needs an estimated 321.33 million tons, and Japan at least 156.15 million tons [2]. Some countries, in particular the "economies in transition" of Central and Eastern Europe are expected to have caps exceeding their projected 2010 emissions so are likely to be net sellers of credits.

Current trading in greenhouse gas credits gives a rough indicator of the potential revenue that emission reductions may provide if sold. An expert poll taken in early 2003 indicated that 2008 vintage CO_2e credits were trading at between €2.0 and €15.0/tCO_2e, with an average price of €8.0 ($10 U.S.) [3]. The EU Emissions Trading Scheme, which starts in 2005, has

already developed a futures market and this may be indicative of prices a project developer might expect in a few years. Current 2005-2007 credits trading are averaging a price of approximately €13/tonne CO_2e (approximately $16/tonne) [4]. Comparing the anticipated demand with prices gives us an indicator to the value of emissions credits. European demand, if at €13/tonne and 320 $MtCO_2e$, would result in a total annual demand of €4.125 billion ($5.156 billion U.S.).

It is unclear how these prices will trend, although it might be reasonable to expect prices to rise for credits beginning in 2008, when more stringent caps will be placed on emitters. However, the majority of credits will likely be traded within EU countries and there are additional transaction costs in developing credits from countries outside of this region. Also, coal mine methane projects within the EU will not count (at least directly within the scheme) against emissions caps. Methane will, however, likely be counted after 2008.

For JI and CDM projects, a number of transaction barriers will drive down the net price of credits. As will be discussed below, there are a number of steps that need to be taken to accredit projects that will slow development and add to costs [5].

CMM Marginal Costs

The impact of this demand for emissions credits on the coal mine methane industry is reflected in the marginal costs of coal mine methane projects. U.S. EPA "marginal abatement cost" (MAC) analyses give us a good idea of how much additional project activity would be profitable if the Kyoto emissions credit market is included in project revenue streams. U.S. EPA's analyses used country-specific energy prices and basic assumptions regarding the technical project options that would be chosen. Based on these and some basic information regarding the emissions in a given country, the MACs give a general idea of how much additional marginal revenue would be needed (at a discount rate of 15% and tax rate of 40%) for projects to be profitable. Figure 1 presents the global MAC "cost curve" that indicates what the global market would be at different prices [1].

The Global MAC shows that at a price of €8.73/tCO_2 equivalent, approximately 111 million metric tons of CO_2 equivalent ($MtCO_2e$) (7.7 Bm^3 or 275 Bcf) of additional projects would be economically feasible. As table two shows, the majority of the low cost projects are found in only a handful of countries: China, the U.S., Russia, Australia and Ukraine. But there are likely to be a number of promising projects in at least a dozen countries. What will be key in understanding where the prospects lie will be considering where the Kyoto (or other) markets have demand for emissions reductions.

Currently, approximately 3 billion cubic meters of CMM is employed annually in energy projects globally, with the majority of these emissions reductions in the U.S (1.2 Bm^3) and China (<.8 Bm^3). Hence, the theoretical potential for the CMM market is to nearly quadruple in size if an emission credit price of €9 or €10/ton were globally attainable. However, not all of these emissions reductions are likely to qualify anytime soon for Kyoto credits. The profitable reductions at €8.71/ton from the U.S. and Australia are 23 $MtCO_2e$, and with neither country ratifying Kyoto they are not likely to be saleable at anywhere near this price. Assuming Russia ratifies, however, we might expect that an additional 88 $MtCO_2e$ (6.1 Bm^3 or 218 Bcf) could be profitably used, which would be about three times the size of the current CMM market.

Impact of Kyoto Markets on Project Viability

Because methane is approximately 23 times more potent than carbon dioxide as a greenhouse gas, and because a gassy coal mine emits very large quantities of methane, a single coal mine methane project may produce a large number of credits. For instance, a modest-sized project in Russia's Kuzbass Basin that would introduce advanced in-mine methane drainage, transport that methane to a coal-fired boiler and convert the boiler to co-fire this methane may cost approximately €1,500,000 and produce over 560,000 ERUs over ten years [6]. Considered in terms of project economics, if each of those 560 thousand ERUs were valued at €8/tonne, they would bring in project life revenues of nearly over €4.5 million, in addition to the additional revenues that sales of displaced coal would bring the project.

Looking at the impact from a market price comparison, one million tons of CO_2e from a methane project equals 2.47 Bcf of methane gas or .06 Bm^3. Conversely, one Bm^3 equals 14.3 million tones of CO_2e or one Bcf equals 404,100 t CO_2e. So, to use another example, a medium-sized CMM project that used or sold 15 million m^3 of methane/year (.47 Bcf) and with a market price for CO_2e of €8/tCO_2e ($10/t$CO_2e$) would reduce emissions by 190,000 tCO_2e and realize carbon credit revenues of €1,520,000 ($1,900,000) each year. This is an additional revenue stream of €0.10/cubic meter or $4/mcf of methane emissions avoided.

How the Kyoto Markets May Develop

As the case study above demonstrates, project developers are likely to find many more projects attractive with Kyoto Mechanism credits. Clearly, however, many projects that may be theoretically profitable with credits will not in practice be viable because of technical, market, and policy/regulatory risks. Nonetheless, the Kyoto Mechanisms are likely to increase significantly the market for coal mine methane.

At this time, the Kyoto Markets are immature and systems for limiting emissions are only beginning to come in place. It is also important to recognize that without either Russia or the United States ratifying Kyoto it will not come into force. If both countries were to ratify the Protocol, the demand for Kyoto credits would rise significantly. This, however, is unlikely because of the difficulties that the U.S. would face in complying because of the significant growth in U.S. emissions since the treaty was negotiated. Assuming only Russia ratifies, the market prices will be significantly lower than with the U.S. also in Kyoto. Nonetheless, the price of EU Emissions Trading Scheme Allowances does give some idea that prices will be somewhere in the range of €10/Tonne, and even at a lower price the marginal abatement analyses indicate many additional projects will be profitable.

The likely growth of the coal mine methane industry will not happen overnight. Until 2005 relatively few companies face any cap on their emissions. Starting in 2005, thousands of European companies will face caps but it is not yet clear if methane project offsets may count against these caps until 2008 within the EU emissions scheme. CMM projects undertaken through the CDM mechanism will likely be the primary mechanism available to transfer credits into Europe.

Beginning in 2008 CMM project offsets are likely to become more attractive throughout much of the world as both JI and CDM projects will count against emissions caps. But even then it will take time before the theoretically profitable projects under Kyoto are developed. As the paper discusses below, there are a number of steps that need to be undertaken in order for projects to qualify for emissions credits, and the complexities and costs of undertaking these steps will slow market growth. Nonetheless, over time, assuming Kyoto comes into force or

that alternative caps in countries that have ratified Kyoto remain, the industry is likely to grow significantly.

CMM AND EMISSIONS MARKETS IN "NON-KYOTO" MARKETS

Three of the countries with the highest per capita greenhouse gas emissions have not ratified the Kyoto Protocol. While it is interesting that the costs to reduce emissions in these countries are likely to be lower than in most countries that have accepted binding international limits, two of these countries, Australia and the United States, have increased their emissions more rapidly than most other industrialized nations since Kyoto was negotiated in 1997. As a result, it has become challenging for them to meet their negotiated targets. Russia's emissions have declined and most projections show that it will not be difficult for it to meet its target; nonetheless it remains unclear if it will ratify in the near future.

Because they are not parties to Kyoto, CMM projects in Australia, Russia, and the U.S. will not be able to sell Kyoto emissions credits. However, there may be potential for projects in these countries to benefit from emissions markets that are not associated with Kyoto's Flexible Mechanisms. Some activities are organized by industry groups interested in reducing or offsetting their corporate emissions. Other activities are mandated by state and regional emissions trading systems. Still other companies are seeking to reduce their emissions in anticipation of future regulatory regimes. Most of these actions are not likely to result in a clear price signal to reduce CMM emissions, but there are a few exceptions. Below is an overview of some of the activities in Australia and the U.S. and how they may play a role in encouraging emissions reductions in these countries.

Australia

In Australia, the Federal government's Greenhouse Gas Abatement Program provides funds for low-cost projects to reduce greenhouse gas emissions, including CMM projects. So while there is no formalized emissions credit market at the national level, developers have been able to undertake projects beyond "business as usual." A number of state governments have already developed systems that may provide incentives for CMM project activities. In New South Wales, for instance, the state government has developed benchmarks for reducing greenhouse gas emissions from the electricity sector that includes "abatement certificates" which may be obtained under certain circumstances by reducing on-site emissions, including emissions not directly related to electricity consumption. In New South Wales, the government has also created a Sustainable Energy Research and Development Fund that has supported innovative CMM project technologies [7]. Also, in spite of Australia's rejection of Kyoto, there have been a few international carbon credit transactions based on emissions reductions undertaken in Australia [8].

United States of America

While the current U.S. administration refuses to ratify Kyoto, a number of state governments have begun to impose their own regulations limiting greenhouse gas emissions. Many of these policies are still being formulated but some are already in place. In Massachusetts, for instance, the government issued a rule that requires major coal and oil-fired power plants to cut average CO_2 emissions by 10%. While the state as a whole is imposing a much less stringent standard than under Kyoto, regulated companies may invest in "off-system" reductions. In addition, states are discussing means of developing inter-state emissions trading systems that may create additional incentives. Another, private sector initiative called the Chicago Climate Exchange (CCX) sets voluntary caps on emissions from member

companies, and allows for trading of emissions allowances between companies, and, in certain instances, allows its members to obtain offsets from projects outside of the emissions scheme. To date, coal mine methane projects are not eligible as offsets, but companies joining the scheme may develop CMM projects and trade the reductions to other companies within the scheme (www.chicagoclimatex.com). Credit prices under the CCX are significantly lower than under Kyoto-based schemes because the emissions caps are on average less severe, and currently average approximately $.90/t$CO_2$e.

In addition to the state-based emissions limits, the U.S. Federal Government continues to play an important role in providing unbiased information to industry on "no-regrets" opportunities. The U.S. EPA's Coalbed Methane Outreach Program (www.epa.gov/coalbed) has helped coal companies understand what potentially profitable CMM projects are available, and since 1990 the quantity of U.S. CMM emissions reductions has tripled. In addition, there continues to be action in Congress on developing a tax credit for projects that use CMM [9]. As for now, however, there is no nation-wide price signal beyond prevailing energy prices to encourage additional CMM projects.

STEPS FOR PROJECT DEVELOPERS TO HARNESS KYOTO/OTHER MARKETS

While the potential for Kyoto or other emissions credit mechanism to make coal mine methane projects viable is significant, there are a number of steps required to realize the credit revenues. First, developers must determine if their projects qualify for credits, secondly, the projects emissions reductions must be carefully quantified, and approaches to monitor and verify the emissions reductions developed. Approval of the credits needs to be obtained from the relevant authorities and certification bodies, and an appropriate purchaser of the credits needs to be identified and sold on the project credits. It is important to note that there are likely to be significant costs in turning a project's emissions reductions into certified credits, and additional costs in transacting credits. In addition, it is often advisable to obtain the services of experts in each of the steps towards turning a project's emission reductions into money. Below is a discussion of each of these steps.

Credit Qualification

Project developers first need to determine if their projects will likely qualify for emissions reduction credits. This requires a review of the project's emissions and a basic analysis of whether the emissions reductions are truly "additional." Additionality means that the emissions reductions would not occur in a "business as usual" scenario. Different emissions credit regimes have different definitions for what makes a project truly additional. The most stringent of criteria would include environmental, investment, technological and policy/regulatory additionality. Environmental additionality requires that a project consider if there would be more emissions than with the project. This may include determining if the project would result indirectly in emissions occurring elsewhere in the country or world. Investment additionality may mean would the project be financed and developed without the emissions credits: in other words, would the project be sufficiently profitable to take place without credits? Technological additionality means would the project bring about emissions reductions above and beyond those coming from technologies that are already practiced in a given market. And policy/regulatory additionality would ask if there exist laws or regulations that might compel the project to take place, which would, therefore, disqualify a project as being additional.

In some instances, the developer will also have to demonstrate that the project contributes to other social objectives. This is especially important for projects in developing countries where

the Clean Development Mechanism requires that projects meet the sustainable development objectives identified by the host government.

Additionality

A coal mine methane project developer may need to consider at least the following issues in order to determine environmental additionality. Projects that produce methane from virgin coal seams that will not be mined in the future would not be able to claim methane emissions reductions as additional, as the methane would remain in the ground. The project might qualify from emissions reduction credits, however, if it would result in lower CO_2 emissions than the "business-as-usual" means of using energy, such as replacing coal combustion (which produces more CO_2 than coal mine methane). If a project were to drain methane in advance of mining, it would be critical for the developer to demonstrate from mine plans that the fields drained would in the future be mined, and account for the emissions reductions resulting from the project when coal is mined, not when the gas is produced.

Abandoned mine methane (AMM) projects may face additional technical and policy considerations in order to demonstrate creditable emissions reductions. Because of the geo-technical and data-gathering complexities of estimating AMM emissions, the Framework Convention on Climate Change's scientific body, the Intergovernmental Panel on Climate Change, has not yet established methodologies for national AMM emissions inventories. As a consequence, there may be certain risks in obtaining approval, especially for projects in countries with binding limits where AMM emissions are not included in the national emissions inventory. Nonetheless, methodologies are being developed and there is no doubt that many AMM projects result in real emissions reductions. Project developers will have to show, however, that the methodology accurately accounts for emissions and avoided emissions. It will be particularly important for a developer to accurately calculate the correct quantity of avoided emissions if the drainage of methane results in gas production exceeding the emissions that would otherwise occur.

If a coal mine methane project's financial analysis shows good rates of return, then it is incumbent on the developer to demonstrate that without the emissions credits that the project would be too financially risky for project investment. This might require demonstrating that historically coal mine methane projects in the energy market did not go ahead in spite of positive financials, or that projects that were developed failed.

In some instances it will be important for the developer to also consider if their technologies go beyond the prevailing technologies to drain and use the methane. For instance, does the project introduce drainage techniques that result in significantly higher recovery potentials than are currently employed, or does the end-use technology use the methane more effectively than existing practices?

In cases where the project needs to meet host-country sustainable development objectives, it will be important to understand what these are. They are likely to include local economic development and job creation, local environmental benefits, and other benefits (such as mine safety) that a coal mine methane project could bring. However, there may be instances where a coal mine methane project would be perceived as not contributing, and possibly conflicting with sustainable development objectives. For instance, the project could be viewed as reducing local industrial capacity if equipment chosen was imported and if equipment produced domestically existed and would work adequately for the project. Overall, though, the many positive benefits of most CMM projects are likely to be viewed as meeting sustainability objectives.

Quantifying Baseline and Emissions Reductions

Once the developer is convinced that the project will bring real and additional emissions reductions, it is important to develop a good baseline and quantify the potential emissions reductions. For most coal mine methane projects, it should be a fairly straightforward exercise to develop viable boundaries for the baseline. One important consideration is to avoid developing a boundary which is too broad for accurately defining a correct and quantifiable baseline. In this respect, Climate Mitigation Works believes that the baseline should not be defined around the mine's emissions, which may fluctuate based on mining conditions and the gas content of the coals mined, but rather, that the baseline should in most cases employ an "absence of project" scenario. For instance, if the baseline is set around the mine's overall emissions, and if the mine increases production or mines through gassier coal, then the project might then be considered to result in increased emissions, even though this is obviously not the case. An "absence of project" baseline also avoids the converse: if the mine's gas liberation decreases significantly, then the project would overstate the emissions reductions. The result of a project-based baseline is that, assuming the project can quantify when the avoided emissions would occur, then the amount of methane used by the project becomes the emissions reductions accruing from the project. This is easy to accurately quantify and accounts for the real reductions that the project may claim. AMM projects and projects that drain and use gas before the coal is mined offer additional technical and accounting challenges, but with good records, geo-technical data, and effective measuring approaches these projects' baselines can, and should, effectively employ the "absence of project" baseline methodology.

Development of Monitoring and Verification Procedures

The developer needs to also come up with approaches to accurately monitor and verify the emissions reductions. In most cases this should be a straightforward exercise: presenting a methodology that uses frequent or continuous methane monitoring equipment and regular reports on the methane used or sold by the project. It will be important to also make provisions for third-party verification of the emissions reductions. There are a number of companies that offer these services.

Obtaining Project Approval

There may be a number of parties that need to approve the project. In all cases where the Kyoto Flexible Mechanisms are employed, the host country government or its designate will outline procedures and review the project for approval. In the case of Clean Development Mechanism projects, it will also be necessary for the developer or its representatives to present the project for approval by the Clean Development Mechanism's Executive Board for approval. Detailed procedures are outlined by the CDM board at www.cdm.unfccc.int.

Identifying Credit Purchasers

There are a number of different approaches that may be taken to identify credit purchasers. Some private companies directly purchase emissions credits. Others employ the services of private emissions brokerage companies to help identify buyers and characterize and transact credits. A number of funds, private and public, offer tenders for emissions reductions. Purchasers often have special interest in particular project types, geographical regions, or particular types of credits, and have a particular quantity of emissions credits that they wish to secure. Different emissions credit-types have different market prices, and some purchasers are willing to secure credits that may not yet be certified, at a discount. In order to develop an appropriate strategy, it is important to understand the needs of the purchasers and what expert assistance will be necessary to turn emissions reductions into certified credits.

CONCLUSION

Depending on credit prices, the Kyoto emissions credit mechanisms have the potential to triple the amount of profitable CMM methane production, and project developers stand to gain from growth in the Kyoto emissions markets. However, uncertainties remain that impact the value of emissions credits, the largest being when and if Kyoto will come into force. Until these uncertainties abate, there are real risks in depending on credits to make projects economically viable. Because of the significance of the potential additional revenues from credits, however, developers in countries signing on to Kyoto should certainly explore the potential with qualified emissions credit experts. Over the next few years it is likely that these uncertainties will abate while more nations and companies seeking credits create and develop the Kyoto emissions markets.

NOMENCLATURE

AMM	Abandoned mine methane
Bm^3	Billion cubic meters
CBM	Coalbed methane
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CH_4	Methane
CMM	Coal mine methane
CO_2e	Carbon dioxide equivalent
ERU	Emission Reduction Unit
EU	European Union
EU ETS	European Union Emissions Trading Scheme
GHG	Greenhouse Gas
JI	Joint Implementation
mcf	Thousand cubic feet
MAC	Marginal abatement cost
$MtCO_2e$	Million metric tons of carbon dioxide equivalent
tCO_2e	Metric ton of carbon dioxide equivalent
US EPA	U.S. Environmental Protection Agency

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TABLES

Table 1. Select GHG Emissions and Emission Target Gaps

	GHG Emissions Target 2010 ($MMTCO_2e$)	GHG Emissions Gap in 2010 $MMTCO_2e$
Australia*	464.89	75.81
Bulgaria	132.89	0.92
Canada	571.13	198.57
Czech Republic	176.81	-48.52
Germany	962.35	-150.27
Hungary	95.53	-29.62
Japan	1161.25	156.15
Poland	630.55	-136.55
Romania	210.72	-62.52
Russia	3040.33	-942.29
Ukraine	919.22	na
United Kingdom	653.79	-23.12
United States*	5714.62	2400.38
European Union	3867.67	321.33

* The governments of Australia and the United States have refused to ratify Kyoto.

** The government of Russia has not yet ratified Kyoto, but may.

Table 2. CMM Emissions and Profitable Reductions: Select Countries and Global Total

	2010 $MMTCO_2e$	Reduction "@<€8.73/tonne CO_2e
Industrialized Countries		
Australia	28.6	5.75
Bulgaria	1.2	
Canada	0	0
Czech Republic	3.8	
Germany	10.9	
Hungary	2.2	
Japan	2.1	0.27
Poland	13.4	
Romania	6.5	
Russia	30.5	7.01
Ukraine	24.1	5.62
United Kingdom	4.9	
United States	82	17.69
Developing Countries		
China		51.74
Kazakhstan		4.32
India		0.17
Turkey		0.58
Mexico		
Vietnam		
Global Total	**528**	**111.05**

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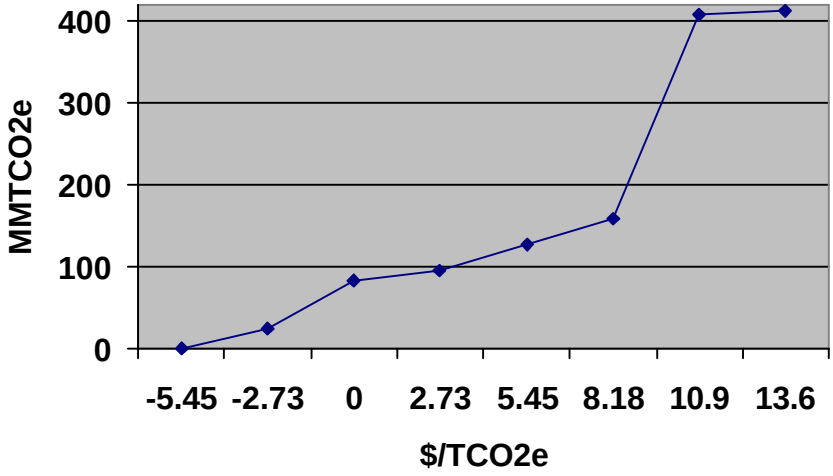
FIGURES

Figure 1. Global CMM Marginal Cost Curve



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