

# Coal Mine Methane – Turning a Liability into an Asset

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(As seen in *World Coal*, June 2008)

The gradual integration of the United States into the global carbon market represents an attractive opportunity for US coal mining companies. As of March 2008, seven coal mine companies located in China had registered over \$625 million of carbon credits generated from coal mine methane (CMM) abatement projects. Once registered with the appropriate United Nations body, these credits are eligible to be sold into the European Union's cap and trade system. Based on the current pipeline of projects from 51 additional coal mine companies, including mines located in the Ukraine, Slovakia, South Africa, and Mexico, the total value of eligible carbon credits will increase to nearly \$4.0 billion. The Kyoto Protocol has proved to be surprisingly lucrative to gassy coal mines in developing countries, and now a similar opportunity is available in the US. With careful preparation, gassy underground coal mines in the US are well-positioned to reap the same rewards as their international competitors under the carbon trading markets emerging in the US.

## *The role of coal mines in the global carbon market*

The evolution of the international market for emissions trading provides important and transferable lessons for coal mines in the US. In advance of the establishment of an international carbon market under the Kyoto Protocol, countries like the United Kingdom allowed their coal mines to develop emission reduction projects that produced credits for sale into a domestic emission trading scheme. For example, under the UK's Emission Trading Scheme, UK Coal implemented methane capture projects that produced over 2 million carbon credits, generating revenues of over \$40 million in addition to the energy savings achieved through the use of onsite thermal and electric energy generated from boilers, flares and gas engine plants. According to Tom Breheny the former head of UK Coal's Harworth Power, who now runs an engineering consulting company called Harworth Energy Ltd., "The returns that we generated from selling carbon credits in the UK Emission Trading Scheme enabled UK Coal to install 32 MW of power generating capacity and seven methane destruction flares that would not have been financially feasible if we relied on the energy savings alone."

As a next stage in the evolution of the international carbon markets, European Union countries participating in the Kyoto Protocol approved a mechanism linking developing countries and transition Central and Eastern European countries to the European Union's cap and trade system (the European Union Emissions Trading Scheme or EU

ETS). Under this mechanism, called the Clean Development Mechanism or CDM, coal mines in China and other countries could develop an emission reduction project to abate the release of methane to the atmosphere via onsite combustion or utilization for onsite electrical and thermal energy purposes, and sell the resulting emission reductions as carbon credits into the EU ETS for use by regulated entities to meet their emission targets under the cap. While the global carbon market has flourished, because the US is not a signatory to Kyoto, its domestic coal companies have not had the opportunity to participate.

## *US regulations – a hidden opportunity*

There is a now a growing consensus that the US Government will adopt some sort of carbon regulation in the next few years. Already, state-level regulations have emerged from numerous regional initiatives, the most advanced of which is the Regional Greenhouse Gas Initiative (RGGI) which covers ten northeastern and Mid-Atlantic States and becomes effective in January 2009. And in Washington, the leading US Presidential candidates support the implementation of a federal

cap and trade system if elected. There are currently a number of competing cap and trade bills being considered by Congress, with the Lieberman-Warner Bill (formerly known as the McCain-Lieberman Bill) viewed by most as the leading contender. Whether it is a Republican or a Democrat in the White House in 2009, we anticipate that a cap and trade system will be adopted in the US before the expiration of the Kyoto Protocol in 2012.

The critical question then, for US mining companies, is whether the implementation of a federal cap and trade system for greenhouse gas emissions represents an opportunity or a threat. The certain answer to that question depends on the final details of the regulation, most importantly whether coal mining facilities are included as regulated emission sources; however, it is our view that well-prepared companies can both reduce their downside risk and realize top-line value through the implementation of specific project types in the intervening years.

For example, US underground coal mines implementing Kyoto-compliant emission reduction projects can generate a stream of carbon credits fetching prices as high as \$7 to \$10 per credit in today's voluntary carbon market. At the same time,



BHP Billiton's Illawarra Coal, West Cliff Colliery, MEGTEC Vocsidizer Project

by reducing emissions in a credible, certifiable way, mining companies can reduce the cost of purchasing expensive emission allowances in the event the mining sector is included in a federal cap and allowances are auctioned (what most companies view as the “worst-case” scenario).

All this adds up to a compelling opportunity. Between now and the start of a regulated market in the US, a coal mine could generate significant returns selling voluntary carbon credits while reducing exposure to potential future compliance costs if the sector is included in legislation. To be sure, the amount of benefit realized by a particular mining company requires analysis of that company’s current situation. But by and large, we believe that early mover coal mines are in a win-win position in the US.

### State of the US carbon market

Though the US voluntary carbon market is still in its infancy and liquidity is light, demand for US VERs is growing rapidly. It is estimated by Point Carbon that in 2007 corporate and pre-compliance buyers purchased approximately 45 million carbon credits in the US, or as they are labeled in the voluntary market, Voluntary Emission Reductions (VERs). This represents a twofold increase from 2006. Conservative estimates value the US market for VERs at approximately \$225 million. In 2008, the transaction volume is projected to double to approximately 84 million VERs, conservatively valued at US \$420 million. By 2012 the value of the US market for VERs is expected to treble to a range of \$1.0 to \$2.0 billion. With carbon credits in international regulated markets like the EU ETS currently trading around \$25 while US VERs are trading in the \$5 range all indications point to rising prices as the implementation of a cap and trade system nears.

Given the early stages of the market in the US, and the lack of one central regulator to define what makes a high-quality carbon credit, pricing and acceptance of carbon credits varies widely. Prices can range from \$1.00 to \$15.00, depending on the type of project and documentation process employed. A proliferation of project standards has led to confusion about what makes a “valid” carbon credit, and buyers typically require extensive documentation and third-party verification before payment. In order for mining companies to extract maximum benefit from their emission reduction initiatives, therefore, it is important to take time upfront for project planning and design. The specific process by which an emission reduction activity is undertaken will largely determine its value in terms of both the pricing of any carbon credits produced and the probability of reducing potential future compliance costs.

### What kinds of projects qualify for carbon credits?

In the underground mining industry, there are four approved project types with an established track record of producing carbon credits under the Clean Development Mechanism of the Kyoto Protocol:

- (i) *Abatement Only.* Combustion of CMM through flaring



Riccall Mine, flare safety and monitoring equipment mounting in pipeline

- (ii) *Abatement and Energy.* Generating thermal and electric energy from CMM
- (iii) *Abatement and Energy.* Conditioning CMM for downstream fuel combustion purposes (i.e., converting CMM into pipeline quality gas)
- (iv) *Abatement and/or Energy.* Oxidizing the CMM contained in ventilation air methane either for simple abatement purposes or to generate thermal or electric energy using super-heated steam.

While flaring and oxidization are proven technology applications for underground mines internationally, they still face regulatory hurdles in the US.

UK Coal’s Harworth Power, for example, installed seven enclosed flares on five deep coal mines operating over a four-year period to destroy methane that would otherwise have been vented. The US EPA had carried out a good study into flaring at operating deep mines, and this was the starting point for a two-year investigation by Harworth Power, culminating in the successful commissioning of the first enclosed flare at Riccall Mine near Selby in England. The investigation was a thorough process safety risk assessment, and involved experienced offshore petrochemical flare manufacturers, landfill flare manufacturers, the UK Health and Safety Executive (HSE), Her Majesty’s Inspectorate of Mining, the national Health and Safety Laboratory (Buxton), and various combustion safety academics.

According to Tom Breheny, UK Coal’s Harworth Power had a very positive experience abating methane using enclosed stack flares. “After successful installation and operation of the generators, we then turned our attention to the proportion of gas which was left over, and which continued to be vented. This small proportion of additional gas, was only available for some of the time, and was not reliable or continuous enough to substantiate investment in engines. Flares are a

lower cost alternative to generators, but under the UK’s Emission Trading Scheme still generated a significant return on investment from emissions abatement in the form of carbon credits. For this reason we started with a 2,000 Nm<sup>3</sup> per hour capacity flare at the Riccall Mine and eventually scaled up to seven of these flares that we used on a “peaking” basis across UK Coal’s portfolio of mines.”

An example of an operating underground mine oxidizing low concentration methane (<1.2%) in ventilation air methane is BHP Billiton’s Illawarra Coal, West Cliff Colliery in Australia which is converting 0.9% purity methane at air flow rates of 150,000 CFM into 38 GWH of electricity generated from super-heated steam. According to Colin Bloomfield, President of BHP Billiton’s Illawarra Coal the operational results of MEGTEC’s Vocsidizer, a leading manufacturer of oxidizer equipment, has been very pleasing. “The plant has been successfully running for over eight months, and to date we have abated over 225,000 tonnes of greenhouse gases by a combination of both direct methane emissions (191,000 tonnes of CO<sub>2</sub>e) and displaced electricity emissions (34,000 tonnes of CO<sub>2</sub>e).”

Bloomfield emphasized the important role that a regional greenhouse gas emission reduction program in Australia had on the overall project economics. “The NSW Government’s Greenhouse Gas Reduction Scheme is central to the commercial operation of the facility which generates revenue from NSW Greenhouse Abatement Certificates. With the plant generating about 38 GWH of electricity annually, we are achieving significant emission reductions.” Not only is Illawarra Coal reducing its greenhouse gas emissions, and thereby realizing valuable carbon credit (i.e., “abatement certificates”) revenues, but it is also accruing the economic benefits of increased energy output from

onsite power generation.

Both of the flaring and oxidizer projects generated, or are generating, financially meaningful volumes of carbon credits. In the US there is already a pilot oxidizer project operating on an abandoned coal mine in West Virginia. The EPA's Coal Bed Methane Outreach Program (CMOP) has done a number of studies to promote the use of enclosed stack flares on operating mines, including the "Benefits of an Enclosed Gob Well Flare Design for Underground Mines." Changes in US regulation are likely, as it will not be a tenable position to regulate a coal mine under a cap and trade system, or prevent them from participating in this market as a seller of off-sets, while at the same time prohibiting the use of the full suite of options for utilizing the degassed and vented methane to reduce their emissions.

In the US, where feasible, the optimal choice for underground gassy coal mines is to condition the CMM to >95% purity and sell it as pipeline quality gas. At prices of \$7 MCF or higher it is not surprising that creating pipeline quality gas is the ideal solution in the US. Historically, it has not been economically feasible to condition the lower quality CMM (i.e., 30-70% CH<sub>4</sub> purity) and pipe the gas to the nearest pipeline. Certainly Jim Walter Resources and Consol Energy have been pioneers in capturing their CMM and converting it into pipeline quality gas. For those underground mines with more marginal quality gas reserves in the 30-70% CH<sub>4</sub> range, carbon credits are now a viable financial tool to enhance project returns and achieve the necessary payback and hurdle rates to justify the investment in conditioning and purifying gas to a pipeline quality level.

Though there are some examples of successful power generation projects utilizing high-quality CMM in the US, notably Consol Energy's 88 MW peaker power plant, these projects can struggle to achieve sufficient returns on investment given that

gas-fired electricity is not on average competitive with coal-fired electricity. The combination of carbon credit revenues and new regulations encouraging utilities to increase the amount of energy generated from cleaner-burning fuels can improve project economics and justify utilizing CMM to generate grid-supplied power. In the international markets, from China to the Ukraine, the predominant project type to-date has been to generate electrical or thermal energy for onsite use.

### ***What should coal mines be doing now?***

Despite lingering uncertainty about the ultimate shape of US greenhouse gas legislation, there are a number of actions that coal mine companies can take now to identify opportunities and threats and better position themselves for carbon regulation. In assessing the potential value and risks associated with their carbon assets, the first step is to carry-out a comprehensive audit of actual coal mine methane reserves in the context of current mining plans in order to estimate the amount of methane that is to be liberated and vented over the next ten years. This includes not only the CMM that is liberated from pre-mining vertical boreholes and gob wells, but also the ventilation air methane. The next step is to measure actual emissions from all CMM outflow points across the mine.

While most mines track these numbers for regulatory reporting purposes, it should suffice to use a simple hand held methanometer and air flow measurement device to take readings over an extended period to establish an average emission estimate. The purpose of these activities is to enable the mine owner to develop a better sense for the current emissions baseline. Any emissions reduction project requires a baseline to be used as the bar of measurement against which actual emission reductions are calculated, thus determining the amount of carbon credits that can be generated,

certified, and monetized. With this information in hand, the coal mine owner will be well-positioned to identify and develop high-quality emission reduction projects according to whichever standard is determined to be most suitable for that coal mine.

The process for measuring and establishing a project level baseline is a requirement of every credible standard. The most rigorous standard for CMM emission reduction projects at this time is the Clean Development Mechanism (CDM) under the Kyoto Protocol. The risk to the coal mine of following a less thorough standard is the creation of a carbon credit that has little or no monetary value in the voluntary market and is also unlikely to qualify as an allowed offset in the coming regulatory market. The increased marginal cost of creating the highest value carbon credit is quite low if designed-in from the start, and is more than compensated for by the increase in value.

A simple abatement project, such as an enclosed flare stack attached to a gob well or vertical bore hole venting 800 CFM at a purity of 70% CH<sub>4</sub> could generate approximately 100,000 tCO<sub>2</sub> per annum of emission reductions. At a price of \$7 per VER, for example, these CDM-quality credits could generate \$700,000 per annum in additional revenues, a simple payback of less than one year, to a coal mine during the next few years and will likely generate significantly more value if the credits meet eligibility criteria for trade under a future compliance market. With the potential to both reduce future risk and produce rich revenue streams today, carbon credits generated by utilizing CMM that would otherwise be vented in a business as usual scenario are an asset worth developing now in the US market.

### ***Case Study – Methane Buster***

The Methane Buster was designed with the intent to fix a problem – remove methane from gassy underground mines in off-grid locations. This innovative design, a methane pump powered by the highly variable methane gas that it was employed to pump out of the ground, positioned the machine to recover gas in any remotely positioned well – no extension cord required. To many of the Methane Buster clients, be they coal, soda ash, or any other hard rock or aggregates mine with high in situ gas content in their target mineral, the methane that was liberated was viewed to be a liability, a cost of doing business. The self-sustaining pump simply removed the gas from the underground mine, vented it into the atmosphere; the miners below are provided with a safe working environment and the mining managers can hit their production targets unimpeded by underground explosion risk. The problem was solved, though the opportunity was not fully addressed.

The combination of record high natural gas prices and the emergence of the carbon industry has suddenly increased the demand for the Methane Buster on a global scale. According to Gary Disbennet, "Based on the initial orders that we have taken in the first quarter, we expect to double our sales in 2008". Gary attributes this increased demand for the Methane Buster to be a direct result of the international carbon markets, and the realization of their clients that not only the high quality gas has realizable economic value, but that



Riccall Mine, enclosed stack flare and flame arrestor

carbon credits can enhance the project economics for utilizing the stranded/low-quality gas that otherwise would be vented. “We are increasing our penetration in our existing foreign markets, such as Mexico, and expanding into China, Russia, and Ukraine.”

All of these countries are participating in the Kyoto market for carbon credits and are actively selling credits generated from CMM projects into the European Union Emission Trading Scheme. According to Gary, “the indications that we get from our customers is that carbon credits justify

increasing the volume of methane liberated from degasification vertical bore holes and gob wells, as opposed to pulling the gas out through the ventilation shafts.” There has been a diametric shift in the outlook of many of the Methane Buster customers towards CMM; the methane that was once viewed to be a liability is gradually shifting to be seen as an asset.

Disbennet is quite bullish on the US market for the Methane Buster, “we are ramping-up our production capacity in the US as the indications that we are getting from our customers is that a cap and trade

system is likely, and capturing and using stranded CMM translates into real profits, from both the caloric value for energy generation purposes and the off-set potential.” While he recognizes that many of his clients will continue to struggle trying to resolving the ownership rights to the gas, he doesn’t believe this issue can remain unresolved for much longer. “If a cap and trade system is implemented in the US, then coal mines must be given the means to reduce their emissions, such as utilizing the gas, otherwise they will be held liable for a source of an emission that they don’t actually own.”

## Carbon Glossary of Acronyms and Terms

1. **CDM and CER** – The United Nation’s Kyoto Protocol has two trading mechanisms for trading carbon credits between countries. The emerging market trading mechanism is called Clean Development Mechanism (CDM). A credit in this trading regime is called a Certified Emission Reductions (CER).
2. **CH<sub>4</sub>** – Methane
3. **GHG** – Greenhouse Gas
4. **GWP** – Global Warming Potential, e.g., CH<sub>4</sub> is approximately 21 times more potent of a GHG than CO<sub>2</sub>.
5. **JI and ERU** – The United Nation’s Kyoto Protocol has two trading mechanisms for trading carbon credits between countries. The Central and Eastern European countries, such as Russia participate in the Joint Implementation (JI) regime. The credits in this trading regime are called Emission Reduction Units (ERUs).
6. **PDD** – Project Design Document, a term for the business plan for emission reduction projects under the CDM
7. **tCO<sub>2</sub>e** – Metric Tonne of Carbon Dioxide Equivalent
8. **VAM** – Ventilation Air Methane
9. **VER** – In the absence of a formal trading regime, which is the case in the United States, credits are often referred to as Voluntary Emission Reductions.
10. **VCS** – Voluntary Carbon System is the leading emerging standard in the US for trading VERs.