FUNDAMENTALS OF CARBON REGULATIONS AND THEIR IMPACTS ON THE MINING INDUSTRY

Abstract

In an ever increasing "carbon" society; management and growth will be measured by one's carbon footprint (or output). Industries, especially mining, are under an ever increasing scrutiny of carbon, water and environmental mandates. These mandates are measured by the emissions caused by the combustion of fossil fuels. The fundamental building-block for any business, strategic or management decision must be based on an understanding of one's "footprint". The scrutiny is most stringent for the commodities producers, power producers & fuel suppliers in the energy market. An overview of currently acceptable standards, application of those standards and nuances experienced in collecting the data necessary to analyze and complete a company's carbon footprint will be presented. A lack of regulation, the fear and expectation of new and ever constraining rules, regulation and a change in the federal administration is a recipe for uncertainty in the marketplace.

Introduction

Regardless of where one stands politically on the subject of carbon regulation, a carbon constrained world is here, and most likely here to stay. The US Congress has been debating over 100 actions addressing aspects of global warming, climate change, carbon capture (sequestration) and storage, and carbon credit cap & trade. These actions are strengthened by more than 80% of State legislatures preparing new regulations to define, regulate, tax, and control carbon. Additionally, the Kyoto Reduction Protocol under the United Nations Framework Convention on Climate Change is set to expire in 2013. Changes are occurring rapidly in industry while industry wants stability. Companies have a need to understand the regulatory market. All these factors influence the new carbon market every day.

Uncertainty In The Framework: Voluntary vs. Regulated

Confusion within the U.S. framework falls in the Voluntary vs. Regulated debate. Presently, there are no mandatory requirements for carbon cap and trade or carbon dioxide sequestration. However, carbon cap and trade requirements, via the Waxman-Markey bill, Kerry-Boxer bill, or some resemblance thereof are on the horizon. Additionally, there are now emerging requirements with respect to the reporting of Greenhouse Gas (GHG) emissions. With that being said however, there still exists much confusion and uncertainty due to a lack of clear regulation in several industries. For example, most electric regulating bodies in the U.S. are requiring all new applications to "address" the carbon question of what to do with carbon emissions, while not specifying how they must be dealt with – i.e. lack of regulation.

Uncertainty in Carbon Programs

The fear or reluctance in the marketplace for industrial investment stems from the lack of clear direction. There is uncertainty in industrial circles about under which program a carbon project falls. For example, projects could fall under any number of programs, such as:

- Climate Action Reserve GHG quantification protocols
- Clean Development Mechanism rules under the UNFCCC
- REC's – RGGI vs. States (29 presently have some form of Renewable Energy Credit program)
- Voluntary Carbon Credits: CCX vs. Over The Counter

- Different GHG verification requirements, such as ANSI accredited firms vs. CSA certified individuals.

This myriad of choices in combination with the more important issue of a lack of "enforcement" by virtue of the present voluntary status makes it very difficult to encourage private commercial investment from the affected industrial sectors.

Energy Policy Act

The volatility created by the impending carbon constraints has caused many potentially-affected companies to evaluate their carbon footprints. Knowing a companies' "status," or rather completing an inventory to determine how much "carbon" (e.g. GHG emissions) a company emits, is the first step in addressing any carbon management plan. For years, the Department of Energy has had in place a voluntary carbon reporting system. Under the Energy Policy Act of 1992, Section 1605, National Inventory and Voluntary Reporting of Greenhouse Gases calls for companies to voluntarily submit the amount of carbon produced by the company, conceptually very similar to an IRS 1040 form. The "plan" is to identify how much carbon a company produces, then to create and implement a plan to reduce that carbon emission by some criteria (a certain percentage). In the event the company exceeds its reduction goals, the reduction above the plan is able to be brought to the market to be "sold or traded" under one of the existing cap & trade systems (Chicago Climate Exchange (CCX) of the European Union Emissions Trading Scheme (EUE TS)). Historically, this legislation has been completely voluntary, however this is now changing.

Mandatory Reporting of GHG

As of October 30, 2009, the reporting of carbon emissions has become mandatory, as designated by the EPA's Mandatory GHG Reporting of Greenhouse Gases Rule (MRR). This rule requires the monitoring and reporting of annual emissions of greenhouse gases and applies to many industrial applications including power generation, multiple types of manufacturing facilities and underground coal mines. The rule only requires reporting from facilities that emit more than 25,000 tons per year. This rule does not require any action to control GHGs.

Timeline:

- April 10, 2009: Proposed Rule published.
- June 6, 2009: Comment period closes for MRR.
- October 30, 2009: EPA issued final rule in the Federal Register.
- December 29, 2009: The final rule is "effective" (binding under the law) 60 days after publication in the Federal Register.
- January 1, 2010: Affected facilities must begin collecting data.
- January 29, 2010: Final date for application for deferment of Best Available Monitoring Methods (BAMM)
- April 1, 2010: end of any deferment period for BAMM
- April 1, 2010: QA/QC Monitoring Plan due for inspection by EPA.
- May 2010: Expected revisions to MRR to include coal mines
- March 31, 2011: The first annual GHG report is due for GHGs emitted during calendar 2010.
- March 31, 2012 and beyond: annual reporting of previous calendar year emissions numbers.

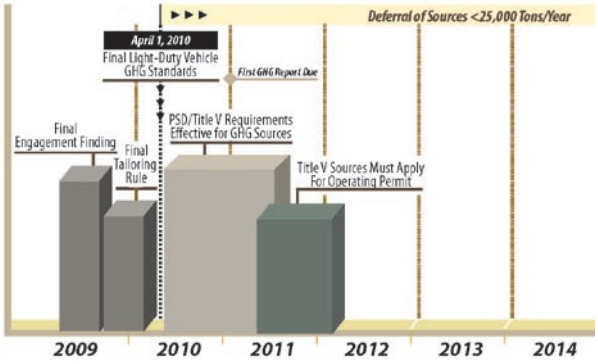

Figure 1: MRR Timeline (2009 – 2015)

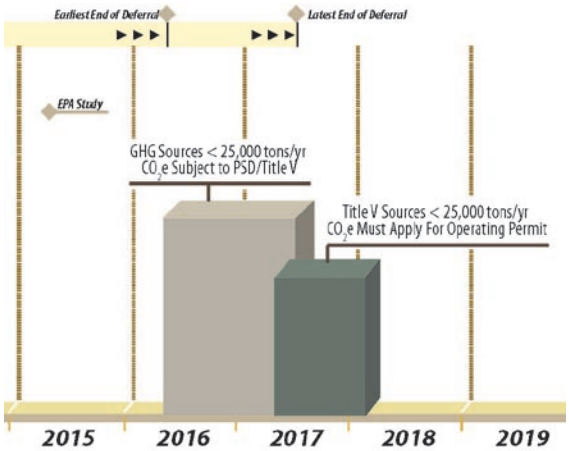

Figure 2: MRR Timeline (2015 – 2019)

It is pertinent to note that the coal mining industry has an additional year before monitoring and reporting must begin, due to debate involving the substantial/excessive number of GHG monitoring systems that would have to be installed for every mine portal, mine shaft and well hole. Therefore, underground coal mining operations are expected to begin collecting data on January 1, 2011.

Waxman-Markey

The American Clean Energy and Security Act of 2009, also known as the Waxman-Markey Bill, has been under debate for much of 2009 and still continues to be debated. This bill has been approved by the House of Representatives in June 2009 but awaits approval in the Senate. This Act aims to establish a cap and trade program for GHGs to address climate change. This entails setting a cap on the amount of greenhouse gases a manufacturing facility, electricity-generation plant, coal mine, etc. can emit into the atmosphere. It will be necessary for all facilities to calculate their carbon footprints to create a baseline. If a GHG emitting facility emits GHGs into the atmosphere at an amount over or under its specified limit (as compared to the baseline), it has the option to buy or sell its deficient or excess amount of carbon credits, respectively. The bill requires the reduction of GHGs (from 2005 levels) of 3% by 2012, 20% by 2020, 42% by 2030 and 83% by 2050.

International

Similar to the U.S., the carbon issues involving the international community are also complex; relying in some cases on the Kyoto Protocol or European Union Rules and in some cases on the International Organization for Standardization (ISO) for requirements and guidance. However, as most countries are signatory to the Kyoto Protocol, a singular approach is at least an option for private sector entities in those countries.

The Need For Standardization

Standardization is critical for success of carbon dioxide reduction efforts. It allows all parties to operate on a level playing field. It encourages interaction and is required for Key Nations (US, EU, AUS, China & India) to become or remain engaged. This is specifically true relative to the Kyoto Protocol, where planning a project in the U.S. is not presently an option for participation under emission trading provisions of Kyoto, and therefore U.S. companies are generally absent from most international trading schemes.

Regardless of Market (GHG, CCS, Clean Energy) standardization must address four key factors: Cost, Validation, Standards & Regulations, and Risk & Liability.

Whether voluntarily adopted or required by law, standards touch us all every day. For example, standards exist for indoor air quality, for sustainable tree harvests and now we are seeing the development of standards that define the elemental efforts needed to protect the climate – carbon reductions (also known as carbon offsets).

Standards work to everyone's benefit:

- by defining many safety requirements, they help reduce the risk of personal injury;
- by setting out performance and design criteria, they bring order and know-how to the problems, like making plugs fit sockets;
- by setting recognized benchmarks, they help open doors to new markets and facilitate trade around the world;
- by providing a framework for best management practices, they help advance business excellence;

Some assessments have confirmed that standards provide economic benefits by influencing institutional change and the structure of the economy; creating a competitive advantage in sectors or technologies with high uncertainty; expanding markets and supply chains.

Standards influence institutional change and the structure of economies by changing the knowledge content of companies so that they can become more decentralized (i.e. globalized) in their operations, supply chains and market opportunities. Standards allow companies to access suppliers who can manufacture components, vendors who can sell their products and labor and knowledge anywhere in the world.

Firms that initially develop and implement standards that become industry accepted have a competitive advantage in the marketplace. This advantage can be leveraged to fund the evolution of that industry standard or to finance development of new industry standards, thereby using standardization and new product development to generate profits.

Finally, standards can speed product development and reduce risk during the first critical phases of entering a new marketplace. This is primarily the benefit that is driving the development of voluntary carbon standards. New markets, like those associated with carbon trading are characterized by high development and deployment risk and significant financial leveraging. These risks can be reduced by using standards that reduce the potential uncertainty for both buyers and sellers and provide for smoother and less costly transactions.

All of these benefits facilitate trade between buyers and sellers both domestically and internationally, which is why it is necessary for standards to enter the arena of

climate change, both to help improve environmental management but also to support emerging emissions trading markets.

Challenges For PRB Coal Companies

Many companies in industry have been busy working to inventory their carbon footprint. Knowing the company's carbon emissions is the first step in creating any Inventory Reduction Plan (IRP). With the uncertainty and volatility in the market, this process is not without its share of challenges.

Coal Mineral Rights vs. Methane Gas Rights

One such challenge that has presented itself for companies is that of carbon emissions for coal mine methane that a company does not control, but for which is liable. In the process of completing a carbon inventory (footprint) of some of a company's assets in a western U.S. surface mine, one is required to quantify the volume of natural gas (CH4 – methane) released when the coal asset is mined. The issue is created by the fact that the mining company does not control the gas asset within their mine. However, the company is still required to report (quantify) the amount of gas (carbon) released by the mining process.

A substantial problem exists due to the fact that the US Supreme Court ruled that when the mineral rights to the coal are sold, the rights to the coalbed methane are not included. Therefore, a company other than the coal operator is recovering and selling the coalbed methane. If the coal operator is required to report the total volume of methane emissions (within its coal reserves) based on the traditional mass-balance equation, it should be able to take credit for the methane recovered and sold. In order for the coal operator to take credit for the emission reduction of the mass of methane that is recovered, they have to have access to the data from every company that has operated recovery wells in the particular coal bed that is being mined. While the data probably exists, because the wells were operated in some cases by multiple operators, the collection of a complete data set is difficult at best. Further, there exists no requirement for the gas asset owner to "share" company information with coal asset owner, setting up the issue of being liable for a mass-balance when data is unavailable.

Variety of Gas Content Calculation Methodologies

The issue of methane emissions from surface coal mines is further complicated as there are several different methods for computing in-situ methane gas content: USEPA methodology, USDOE methodology and empirical core sample data.

The US Department of Energy Technical Guidelines Voluntary Reporting of Greenhouse Gasses *Section 1.E.4.2.1.2 Emission Estimation Methods, Subsection 1.E.4.2.1.2.2.2 Surface Mines and Post-Mining Operations* states: Because emissions from U.S. surface mines and from post-mining operations, whether underground or surface, are not systematically measured, estimates must be used instead. To estimate methane emissions from surface mines, and post mining operations, reporters can multiply the amount of coal produced at a given mine in one reporting year times a region-specific emissions factor as shown in the following equation:

- To convert from volume to mass, the density of methane at 20 degrees Celsius and 1 atmosphere of pressure should be used: 0.418 pounds per cubic foot.
- Volume of Methane Produced = Mass of coal Produced * CH4 Volumetric Emissions Factor

The surface mining emission factor is estimated as twice the in-situ methane content in the basin, and the post-mining emissions factor is estimated to be 32.5 percent of the insitu methane content in the basin. Region-specific emission factors adjust for in-basin deviations and states "For surface mines, the total methane emissions that should be reported are: 1. Surface mining (using default emissions factor based on mass of coal produced). 2. Post-mining operation (using default emissions factor based on mass of coal produced)."

Using these estimation methods, a surface coal mine in the specific basin that produces 5 MM ton/year of coal would have to report methane emissions of:
5,000,000tons*11.2ft^3/ton + 5,000,000tons*1.8ft^3/ton =
56,000,000 + 9,000,000 =
65,000,000ft^3 * 0.418 lb/ft^3 = 27,170,000lb =
13,585 tons of reportable carbon emissions.
The capture and sale of methane is reported as an emission reduction. The US DOE source for this methodology originates in the US Energy Policy Act of 1992, Section 1605 (b).

The US EPA endorses the use of a method of calculation of methane emissions which is identical to the above-mentioned US DOE method, but with a substantially different emission factor. This difference in emissions factors provides for a 47% difference in calculated emissions between the EPA and DOE methods, with the EPA method being the conservative of the two. The USEPA source for this methodology originates from

the EPA Publication 430R08001, U.S. Surface Coal Mine Methane Recovery Project Opportunities, July 10, 2008 and EPA 430-R-09-004, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990 – 2007, APRIL 15, 2009. This creates uncertainty as to which method must be used and how it will be enforced. Therefore, a company must value and decide between the following three choices:

1. estimate emissions based on the US DOE methodology
2. estimate emissions based on the US EPA methodology
3. fund a capital-intensive study to collect core samples, providing empirical data

Surface coal mining companies will have to conduct the necessary analysis to evaluate the most economical method for calculating carbon emissions on a case by case basis. Regardless of which method is chosen, the efforts involved with this analysis will come at a cost to mining companies.

Carbon Sequestration: A Potential Solution

As power producers fight the battle between electrical demand vs. carbon reduction, one of the essential tools will be capture and storage (e.g. sequestration) of carbon dioxide. The US DOE and International Energy Agency (IEA) estimate that the U.S. has over 3,000 gigatons of CO2 sequestration potential; which is equal to the emissions of approximately 1,000 coal-fired power plants for 1,000 years. Therefore, this technology is a significant potential solution to the reduction of carbon emissions. Figure 1 illustrates a generalized carbon capture and storage project.

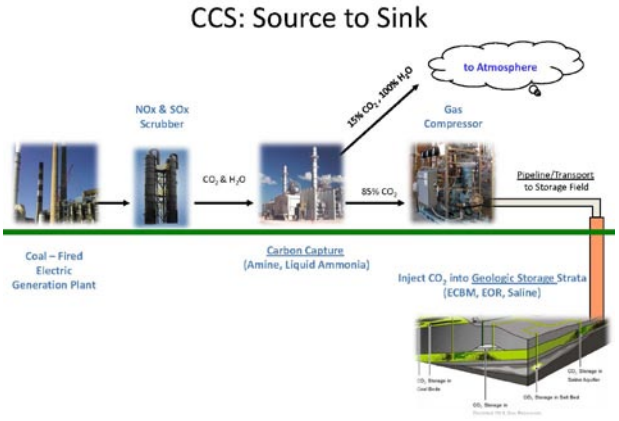

Figure 3: Typical Carbon Capture and Storage

SECARB – Virginia Coal Project

The Southeast Regional Carbon Sequestration Partnership's (SECARB) Central Appalachian Coal Seam Project is one of seven DOE's Partnerships researching carbon capture and storage (CCS). Design and implementation of the tests are underway. The selection of the carbon dioxide injection well was based on geologic considerations for the site, preliminary reservoir modeling, surface access and landowner and mineral owner negotiations.

The regional study area is located within the Central Appalachian Basin. The principal area of investigation for most of the detailed geologic mapping consists of portions of five counties located within southwestern Virginia including Buchanan, Dickenson, Russell, Tazewell and Wise Counties and four counties in West Virginia, including Fayette, McDowell, Raleigh and Wyoming.

The Phase I Initial Characterization and Preliminary Feasibility Study for the project was completed in 2005. Phase II began with an expanded Study Area, Coal Reserve Modeling and Pilot Scale CO2 Injection. Presently, Phase II is completing the characterization of the region to identify several sites for a potential large-volume CO2 injection test to validate the carbon sequestration potential and enhanced coalbed methane recovery potential in the Central Appalachian Basin with additional characterization of secondary storage reservoirs. A large-volume (>100,000 ton CO2) test is necessary to create the high level of confidence in this technology that is necessary prior to planning for commercial deployment.

The objectives of the project include:

- Characterizing potential large-volume test sites in Central Appalachia for coal seam sequestration and enhanced coalbed methane recovery.
- Delineating and characterizing saline aquifers in the region that could provide secondary carbon sequestration options.
- Reviewing and identifying depleted or partially-depleted oil and gas fields that could support large-volume CO2 injection tests.
- Identifying options for stacked storage reservoirs in Central Appalachia.
- Designing test site operations, measurement, monitoring and verification programs and site closure procedures.
- Selecting several test sites in Central Appalachia for a large-volume carbon sequestration coal

seam project which could lead to commercial deployment.

- Implementing public outreach and education.

The Phase II work is designed to serve as the initial geologic and engineering characterization phase for a future large-volume sequestration project. The aim of the future project is to store a large volume of CO2 which can stress formations sufficiently to evaluate the structural integrity and long-term storage capacity of coal-bearing strata in Appalachia. Rigorous measurement, monitoring, and verification tools will be used to ensure the storage and integrity of the CO2 plume in a future large-volume test. The research goals of this project are to verify the ability of coal seams to store large volumes of CO2 and to quantify the Enhanced Coal-Bed Methane (ECBM) recovery potential.

Recent accomplished field testing and completion of coal reserve modeling indicate that the basin has great potential for CO2 storage and ECBM recovery. Based on limited field data, it is estimated that the study area could accommodate 100% storage of CO2 from two proximal coal fired electric power plants for 100 s years. Figure 2 details the isometric storage intervals based on the present data.

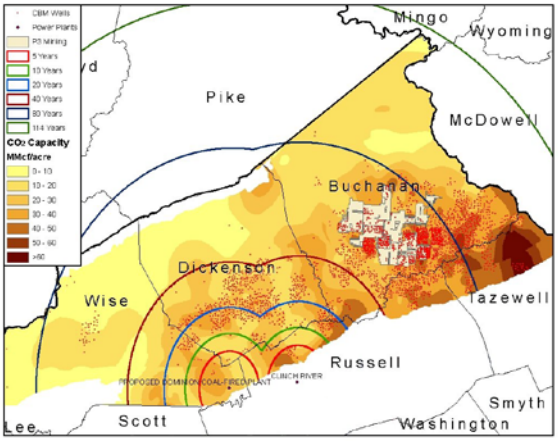

Figure 4: CCS Storage Capacity

Conclusion

Carbon regulation is here; it is continually changing and developing as more and more legislation is enacted and voluntary becomes mandatory. It is essential for companies to make efforts to understand the carbon market and how they are affected by regulation, regardless of the inherent uncertainty associated with carbon regulation. In doing so, companies can help to make regulation reasonable and achievable and avoid the creation of nuances in the regulation (e.g. the PRB case study) that cause uncertainty and unreasonable expectations for carbon emitters. Additionally, companies should help support technology, such as carbon sequestration, which is a potential solution to help companies reduce carbon emissions in an economically and technically coherent manner.

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