Carbon Risks and Opportunities in the Mining Industry

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Agenda

- Just a Few Basics
- Climate change – Broad Context
- What are the Drivers behind Climate Change and GHG’s?
- North American Regulatory Review – Patchwork at Best
- Measurement and Quantification of GHG’s in the Mining Industry
- Offset Project Example
- Risks and Opportunities
- Summary of Issues
Basics - What is Climate Change Generally?

- Generally there is scientific acceptance that global temperatures are rising and causing subtle climate change effects around the world.
- There is a data to evidence that this rise in temperature is linked to industrialization.
- Industrialization is linked to the generation of Greenhouse Gases (“GHG’s”), which are generally the products of combustion of fossil fuels (there are others).
- Greenhouse gases such as Carbon Dioxide (CO\textsubscript{2}), Methane (CH\textsubscript{4}), and Oxides of Nitrogen (N\textsubscript{2}O) act to reflect back to earth heat that would have otherwise escaped to space.
- The six primary GHG’s of concern.
**Basics - The Six Primary GHG’s of Concern**

<table>
<thead>
<tr>
<th>GHG</th>
<th>Symbol</th>
<th>GWP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>CO₂</td>
<td>1</td>
</tr>
<tr>
<td>Methane</td>
<td>CH₄</td>
<td>21</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>N₂O</td>
<td>310</td>
</tr>
<tr>
<td>Sulphur Hexafluoride</td>
<td>SF₆</td>
<td>23,900</td>
</tr>
<tr>
<td>Perfluorocarbons</td>
<td>PFC’s</td>
<td>150-14,800</td>
</tr>
<tr>
<td>Hydrofluorocarbons</td>
<td>HFC’s</td>
<td>6,500-12,200</td>
</tr>
</tbody>
</table>

- Each has its own “Global Warming Potential” (“GWP”) which is an expression of how potent a GHG each gas is compared to CO₂.
Basics – Carbon Dioxide Equivalent (CO₂e)

- GHG’s are usually expressed in CO₂e by converting all tonnes of emitted GHG’s to “equivalent CO₂ tonnes” or “CO₂ equivalent” (expressed as (CO₂e)) by using the global warming potentials as follows:

\[ CO₂e = CO₂ + 21 (CH₄) + 310 (N₂O) + 23,600 (SF₆) + \ldots \]
**Basics - The Ubiquitous “Hockey Stick”**

**Climate change timeline**

- **1992**: United Nations Framework Convention on Climate change enters into force
- **1997**: Kyoto protocol signed
- **1998**: Australian GHG Abatement Scheme
- **1999**: California Climate Action Registry
- **2000**: Chicago Climate Exchange
- **2001**: Canada ratifies Kyoto protocol
- **2002**:
- **2003**:
- **2004**:

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Climate change timeline

- Kyoto Protocol in force
- European Emission Trading Scheme Introduced
- AI Gore’s Inconvenient Truth Released
- First RGGI Auction
- Waxman Markey Bill
- US EPA Reporting
- Durban UNFCC
- Quebec Proposes Cap and Trade Reg
- US EPA Reporting expands
- Quebec Cap and Trade
- California AB 32
- Copenhagen UNFCC
- California Prop 23
- Ontario and Quebec GHG Reporting
- BC Historical Emission Reporting
- Canada Turning the Corner
- Canadian Federal Offset Draft Regulations
- BC GHG Reporting >10,000
- WCI Reporting
- WCI Cap and Trade Delayed
- Cancun UNFCC
- WCI/EPA Calculation Methods Alignment Progress
- Alberta GHG Reduction Program
- BC Carbon Tax
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013

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Drivers - Market and Regulatory

**Political**
- Pressure from international NGL, industry, corporate organizations
- Political power of green debate
- Government regulation and incentives

**Economical / Market**
- Private and public funds on green technologies
- Market growth in carbon trading
- Market for green products expanding
- Supply chain and customer push for green credentials

**Social**
- Increased awareness of sustainability issues: climate change
- Shareholder activism
- Higher media coverage
- Public expectations of accountability

**Technology**
- Clean energy technology
- Further development in water efficiency, waste reduction, clean coal, renewable energy, energy efficiency

Strategic and Operational Risks and Marketing Opportunities
Regulatory Review - United States

- EPA is generally acting in the absence of other federal action.
  - EPA Mandatory Reporting Rule (Dec 2009): 25,000 tonnes CO$_2$e in specific sectors.
- November 2010 Elections – Republican control of House – Agenda changes.
- Uncertainty as to national cap and trade.
- California forges ahead post Proposition 23 – WCI and AB32.
- RGGI active in North East for Power Plants for a number of years.
**Regulatory Review - Canada**

- Ratified Kyoto, but failed to participate.
- Mandatory reporting over 100,000 tonnes CO\textsubscript{2}e since 2004, 50,000 tonnes in 2010 for 2009 and beyond.
- Stated alignment with US GHG policies.
- Initially selected an intensity bases system.
- Draft Federal GHG Offset Rules released.
- Uncertain Federal climate change policy.
- Coordination between provincial and federal level for reporting.
- Several provinces moving in the absence of Federal action, but to varying degrees (BC, Alberta, Ontario, Quebec).
Regulatory Review - North American Regional Programs

• Question of equivalency, alignment, and even existence under any future federal programs.

• Potential that regional / provincial / state programs become more or less prominent with or without Federal actions.

• Political sensitivity to any program.
Regulatory Review - Western Climate Initiative

• Scheduled to commence in January 2012 – not achieved.
• Arizona, California, Montana, New Mexico, Oregon, Utah, Washington, British Columbia, Manitoba, Ontario and Quebec.
• Observers: 6 US states, 1 Province, 6 Mexican states.
• 10,000 tonne CO$_2$e reporting threshold, 25,000 regulated.
• Structure of cap, allowances, and early action credits still under development (but progressing most in Quebec and California).
• Target implementation now January 1, 2013 for California and Quebec only.
• Offset program included.
Regulatory Review - US EPA

• EPA Rule 40 CFR Part 98 is referred to as the Greenhouse Gas Reporting Program (“GHGRP”) implemented 2010.
• Reporting is 25,000 tonnes CO$_2$e per year.
• An estimated 85-90 percent of the total US GHG emissions from approximately 13,000 facilities are covered.
• EPA is not requiring reporting of mobile source emissions or activity data from fleet operators or state and local governments. Diesel engines handled under Title II of the Clean Air Act.
**Regulatory Review - California**

- Originally adopted 2007 for cement plants, refineries, hydrogen plants, electricity generation, cogeneration, general stationary combustion, and electricity retailers and marketers.


- Stationary combustion at a mine for example would be captured through “facility” reporting.

- Generally 10,000 tonne CO$_2$e reporting threshold. Verification required after 25,000 tonnes.

- Cap an Trade due to come into effect January 1, 2013 for facilities above 25,000 tonne threshold. Offset system included.

- 2% per year reduction for first few years, free allowances at the start, moving to auctions later in program.
Carbon Tax – currently at $30 tonne CO$_2$e.

BC GHG Reporting Regulation – 10,000 tonne CO$_2$e reporting threshold. First year, 2010. Verify over 25,000 tonnes.

Harmonization with WCI/EPA ongoing.

Emission Offsets Regulation.

Carbon Neutral Government Regulation.

BC seen as having “comprehensive” agenda on GHG’s, but cap and trade has stalled.

Offset program facing public pressure.

Reporting Regulation captures several mines due to fuel for mobile equipment fleets and stationary combustion mainly.
Regulatory Review - Ontario

- Regulation 452/09 under the Environmental Protection Act.
- Facilities emitting over 25,000 tonnes of CO$_2$e report.
- GHG emissions beginning with the 2010 reporting year in 2011.
- Verification starting 2012 year on 2011 data.
- Guidelines include calculation methodologies for Stationary Combustion and Mobile Equipment which affects the mining industry.
- Follows WCI methodologies. EPA harmonization.
- Cap and trade to come and expected to be WCI.
- Reporting Regulation captures several mines due to fuel for mobile equipment fleets and stationary combustion mainly.
Regulatory Review - Quebec

- Similar reporting requirements as for other WCI. First year to report is in 2011 on 2010 data.
- 10,000 mt CO\textsubscript{2}e reporting threshold.
- Verification above 25,000 tonnes CO\textsubscript{2}e starting 2012 on 2011 data.
- Following WCI methodologies, EPA harmonization.
- Cap and trade Regulation announced for January 1, 2013 in alignment with California under WCI structure.
- Reporting Regulation captures several mines due to fuel for mobile equipment fleets and stationary combustion mainly.
Regulatory Review - Alberta

- Specified Gas Reporting Regulation (SGRR), 2004. Threshold 50,000 tonnes CO$_2$e.
- Facilities > 100,000 tonnes CO$_2$e per year must reduce emissions intensity by 12% per annum.
- Can improve operations, purchase Alberta-based offsets, contribute to the Climate Change and Emissions Management Fund ($15 per tonne), or purchase or use emission performance credits (EPC’s).
- Future of Alberta’s program? Non aligned with any regional or Federal program – an island in North America.
- Mining industry is affected through Stationary Combustion and Mobile Equipment.
- Oil sands mining is significant emitter in Alberta, but also coal mines.
Measurement and Quantification - General

Quantifying Greenhouse Gas Emissions

Set goals and targets for GHG inventory
Set organizational & operational Boundaries
Identify & calculate GHG emissions
Manage inventory quality
Report inventory and seek assurance

Identify Sources
Select Calculation Approach
Collect Data and Choose Methods
Calculate Emissions
Aggregate Data

Adequate data management systems?
Adequate process management systems?
Reporting and Quantification Standards

- There is no single mandatory standard or calculation methodology for greenhouse gas emissions reporting/offsets, although the WCI is bringing methods together.
- Examples of greenhouse gas standards and calculation methodologies used in Canada and the US include:
  - WRI/WBCSD Greenhouse Gas Protocol
  - ISO 14064 standards for greenhouse gas accounting and verification
  - BC Emissions Reporting Calculation Methodology Manual
  - Alberta Specified Gas Emitters and Reporting Regulations
  - EPA Calculation Tool
  - California AB 32
Measurement and Quantification - Sources of GHG’s in the Mining Industry

• Emissions profiles tend to revolve around four areas:
  – Stationary Combustion – Depending on operation
  – Mobile Equipment fleet (but not everywhere)
  – Methane (mainly for coal mines)
  – Electrical Equipment (SF6) - sometimes
Measurement and Quantification – Stationary Combustion

• Example – A molybdenum mine with an onsite roasting facility burning large amounts of natural gas.

• Typical Emissions Factor for Natural Gas: 1.927 kg of $\text{CO}_2\text{e}$ per cubic metre of natural gas.

• Suppose the facility burns 50,000,000 cubic metres of natural gas per year.

• GHG emissions are therefore 50,000,000 times 1.927 divided by 1000 = \textbf{96,350 tonnes of CO}_2\text{e per year.}
Measurement and Quantification – Mobile Equipment

- An open pit copper mine uses a fleet of trucks running on diesel to transport ore from the shovel to the primary crusher.
- Typical Emissions Factor for diesel: 26.91 kg CO$_2$e per litre of diesel burned.
- Suppose the fleet burns 1,000,000 litres of diesel per year.
- GHG emissions are therefore 1,000,000 times 26.91 divided by 1000 = 26,910 tonnes of CO$_2$e per year.
Measurement and Quantification - Methane

- An underground coal mine operates ventilation systems that exhaust gases from the mine.
- Volumes and concentrations of the exhaust gases are measured according to regulations at a certain frequency.
- Since these are “fugitive” emissions not from combustion, calculations are more complex.

\[
CH_4V = n \times \left( V \times MCF \times \frac{C}{100\%} \times 0.6775 \times \frac{288.71K}{T} \times \frac{P}{1\ atm} \times 1.440 \right)
\]

- Further calculations for flaring if methane is collected and destroyed via the use of flares or otherwise combusted.
Measurement and Quantification – SF6

- A copper/gold mine has a significant amount of installed horsepower associated with the SAG mill and ball mills.
- The electrical substations contain panels that use SF6 to prevent arcing.
- Maintenance records are kept over the years with respect to the inventory of SF6 on site and any charging that was done to any system.
- Record keeping showed that .56 kg of SF6 were unaccounted for after a year where maintenance was done.
- GHG emissions are therefore .56 times 23,900 = 13,384 tonnes of CO$_2$e per year.
**Offset Project Example**

- Mine not subject to a cap and trade regulation (below threshold).
- Large fleet of trucks operating on diesel.
- Implementation of technology for better routing, less idle time.
- Equivalent productivity under new technology.
- Reduction in fuel consumption per tonne.
- Records available to substantiate volumes of diesel used, etc.
- Emission offset based on volume of diesel saved times diesel emissions factor.
- Potential validation and verification transaction costs.
- Potential Registration costs.
- Regulatory or voluntary market sale.
Offset Project Example

• Let’s say that the project reduced diesel consumption by 500,000 litres per year, and that the project was in British Columbia.

• The emissions factor for diesel accepted in BC is 26.91 kg/L of CO₂e emitted per litre of diesel burned in heavy industrial conditions with vehicles of moderate control.

• Therefore, the savings in GHG emissions would be 500,000 x 26.91 divided by 1000 kg per tonne or 13,455 tonnes of CO₂e saved.

• In the BC Regulatory market, offset tonnes sell for $8-$15 per tonne depending on their quality.

• This is $107,640 - $201,824 in revenue – each year for the project

• Projects last 8 years (Technology “catches up”).

• Frictional costs can be substantial (Project Development, Verification).
Risks and Opportunities - What’s Your Profile?

Exposure to physical affects of Climate Change (e.g. weather events)

High Exposure

Operational Exposure

Highly Exposed

Low Exposure

Strategic Exposure

Exposure to changes in the marketplace due to Climate Change (e.g. regulation, customer attitudes)
Potential Risks

• Subject to any reporting regulation? Subject to any cap and trade regulation?
• Does our mine have the necessary measurement and data management systems to properly capture and report data?
• Are the mine’s data-management systems robust enough to withstand third-party verification, if required?
• What do you expect the mine’s baseline and emission-reduction targets to look like under a regulated situation? How do you plan to achieve those targets?
Potential Risks

• How would you plan to manage allowances and potential emission liabilities under a regulated regime?

• Could any future cap and trade impact your key costs, such as electricity, transportation? Do you need to renegotiate existing contracts?

• Do you have the required expertise to adequately manage this new regulatory landscape?
Potential Opportunities

• Are there any energy-reduction opportunities in the mine that we have not yet explored?

• What kinds of projects should be undertaken to reduce the mine’s reliance on fossil fuels?

• What kinds of projects could be undertaken that would attract incentives or producer credits that can offset the cost of those projects?
**Potential Opportunities**

- Are there any opportunities for the mine or other company facilities to generate offset projects?
- What strategy does the mine have to manage allowances and/or acquire offsets as part of its requirement for emissions reductions under a regulated environment?
Summary of Issues

• New financial market is emerging that revolves around carbon.
• Uncertainty/change in regulations and standards.
• Complex issues for reporting and verification.
• Control environment fundamental to greenhouse gas accounting (systems and procedures).
• Regular reporting and monitoring can drive value and opportunity.
• Realising value: Cost savings, reliability, decision-making capability and brand enhancement.