Surface Mining Worldwide: Emission Reduction Project Opportunities – Barriers & Possible Solutions

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The Future of Surface Mining
Surface Mining in the 21st Century

- During the 20th century, underground mining was the dominant technique.
- Today, coal production is undergoing a significant shift to open pit mining.
- Technological developments have made it possible to mine reserves of declining grades and more complex geology without increasing costs.
  - Reduce energy consumption and cultivate their renewable energy sources.
  - Investing in renewable energy installations, deploying innovative energy technologies and driving towards more automated mine processes to optimize energy consumption.
- Surface mining costs are less expensive than underground mining costs on a per ton basis.
Surface Mine Methane Emissions
2016 U.S. CMM Emissions

Billion Cubic Feet, Million Tonnes CO$_2$e

NOTES: Ventilation and Drained and Vented emissions were calculated using 2015 ratio applied to reported 2016 underground emissions.

Projected 2020 Global CMM Emissions
(Million Tonnes CO$_2$e)

NOTES: Blue text represents Non-Annex I countries.
### UN Annex 1 countries’ 2015 SMM emissions listed by magnitude of emissions

<table>
<thead>
<tr>
<th>Country</th>
<th>SMM Emissions* (Million m³)</th>
<th>SMM Emissions* (Thousand t CO₂e)</th>
<th>Percent of Total CMM Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia**</td>
<td>1,524</td>
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NOTES: * Emissions include both mining and post-mining activities; ** GMI partner countries

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**SOURCE:** UNFCCC Greenhouse Gas Inventory Data, March 21, 2018.
## Major Non-Annex 1 coal producing countries with opencast mines

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<td>China</td>
<td>Since 1985, is the largest coal producing country with 3,242.5 Mt in 2016</td>
</tr>
<tr>
<td>India</td>
<td>1 of 3 top 10 coal producers that saw an increase in production in 2016, coal consumption increased 2.1% in 2016, following an 18 year trend</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; largest coal producing country, 2&lt;sup&gt;nd&lt;/sup&gt; largest coal exporter, in-country coal consumption increased 3.8% in 2016, continuing from 10.2% increase in 2015</td>
</tr>
<tr>
<td>Colombia</td>
<td>4&lt;sup&gt;th&lt;/sup&gt; largest coal exporter, exports increased 7.1% in 2016</td>
</tr>
<tr>
<td>South Africa</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; largest coal exporter, exports increased 1.3% in 2016</td>
</tr>
<tr>
<td>Mongolia</td>
<td>9&lt;sup&gt;th&lt;/sup&gt; largest coal exporter, exports increased 78.3% in 2016, all coal mined from surface mines</td>
</tr>
</tbody>
</table>

Challenges to Surface Mine Drainage
Coal Mining Methods

Coal Mining Methods

- **Strip Mine**
  - Develops along strike of coal seam

- **Open Pit Mine**
  - Numerous levels or benches (stepped from surface to bottom of pit)

- **Mountain Top Mine**
  - Removal of mountain using huge draglines
Initiatives for Surface Mine Methane Drainage
Initiatives for Surface Mine Methane (SMM) Drainage

2003: U.S. Bureau of Land Management (U.S.BLM)
   - Conflict Administration Zones (CAZs)

2005: EPA Surface Mine Methane Assessment (internal report)

2009: U.S. Verified Carbon Standard (VCS) methodology

2010: Clean Development Mechanism (CDM) methodology
   - ACM0008 version 7 now includes opencast/surface mines
Recent Initiatives Impacting SMM Drainage

- **2012: Climate Action Reserve**
  - Coal Mine Methane Project Protocol
  - Excludes surface mines

- **2013: Mexico’s Voluntary Carbon Credit Exchange**
  - Has projects registered through CDM, VCS, and CAR

- **2013: Québec Cap-and-Trade System for Greenhouse Gas Emissions Allowances**
  - 5 protocols, 2 focus on coal mining
  - Active coal mines, destruction of methane from a drainage system
  - Linked to California Registry in 2015
Recent Initiatives Impacting SMM Drainage

- 2014: California Air Resources Board
  - Mine Methane Capture Protocol
  - Active underground mine VAM
  - Active underground mine methane drainage
  - Abandoned underground AMM
  - Active surface mine methane drainage

- 2018: Ontario’s Cap-and-Trade System links with Quebec and California
Opportunities for Emissions Reductions
SMM Facts

• Performance based protocols make validating SMM projects much easier
  — No need to prove additionality for each project

• Worldwide SMM market is untapped
  — The number of active surface mines is growing, and they are becoming bigger and bigger – emitting more and more methane.
  — Very large number of abandoned surface mines – opportunities where developer would not be in the way of the miner.

• SMM development considerations vary greatly
  — Mining method
  — Location
  — End use market
    • Pipeline quality gas allows access to all markets
### Surface Mine Projects

<table>
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<tr>
<th>Project</th>
<th>Last Year of Activity</th>
<th>Average Annual Emission Reductions (tCO₂e)</th>
<th>Emission Reductions for Crediting Period (tCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Antelope Rochelle, Wyoming, USA</td>
<td>2011</td>
<td>90,463</td>
<td>904,628</td>
</tr>
<tr>
<td>Wahana Baratama, South Kalimantan, Indonesia</td>
<td>2011</td>
<td>207,111</td>
<td>1,449,778</td>
</tr>
<tr>
<td>Semirara Mine, Semirara Island, The Philippines</td>
<td>2011</td>
<td>385,478</td>
<td>2,698,346</td>
</tr>
</tbody>
</table>

Wahana Baratama Coalbed Methane Generation Project PDD: [http://cdm.unfccc.int/Projects/Validation/DB/9Y4C1SLSOQIMHIZGRXF053RFNRQERO/view.html](http://cdm.unfccc.int/Projects/Validation/DB/9Y4C1SLSOQIMHIZGRXF053RFNRQERO/view.html); Semirara Coalbed Methane Generation Project PDD: [http://cdm.unfccc.int/Projects/Validation/DB/YCCWHT4J05P2A4OSN6LGDGK9RYEBXQ/view.html](http://cdm.unfccc.int/Projects/Validation/DB/YCCWHT4J05P2A4OSN6LGDGK9RYEBXQ/view.html); NARM PDD: [https://vcsprojectdatabase1.apx.com/mymodule/ProjectDoc/Project_ViewFile.asp?FileID=70&IDKEY=niquwesdfmnk0iei23nnm435oiojnec909dsflk9809adlkmlkf496530](https://vcsprojectdatabase1.apx.com/mymodule/ProjectDoc/Project_ViewFile.asp?FileID=70&IDKEY=niquwesdfmnk0iei23nnm435oiojnec909dsflk9809adlkmlkf496530)
Why has nothing happened since then?

- Coal seams are not recognized as potential gas producing reservoirs at surface mines
  - Perceived to be too shallow
  - Mine safety is not a driver
  - Perceived to be too logistically complicated
- Opportunities are not recognized
  - Lack of dissemination of information
  - Aggregate magnitude of emissions are estimated, and not measured
- Bigger “fish” elsewhere – the projects are perceived to be too small and not worthy of investment
- Lack of, or little known economic incentives
NOTES: Emissions include both mining and post-mining activities
CMM & SMM Emissions from Annex I Countries

Prospective Opportunities
Global wind resources

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Global solar resources

Global Horizontal Irradiance W/m²

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What can we do?

- Educate policy makers to magnitude of surface mine emissions and what can be done to reduce these emissions
- Increase importance of SMM in working groups that focus on reducing CMM emissions
- Develop best practice guidance for SMM Recovery
- Combine with other renewable energy supplies such as wind and/or solar to develop “Energy Parks”.
  - 3 MW solar farm being installed at South 32’s Cannington Lead Mine in Western Australia to supply power to the nearby village, airport and for use at the mine
Thank You

For more information...

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