Presentation Outline

- Introduction
- Global CMM project development
  - Status, opportunities, challenges
  - Selected country profiles
- Carbon financing for CMM projects
- Summary
• Coalbed Methane Outreach Program
  - Voluntary program since 1994
  - EPA’s Climate Change Division
  - Our mission:
    - To promote the profitable recovery and use of coal mine methane by working cooperatively with coal companies and related industries
  - Our focus:
    - Greenhouse gas emission reduction opportunities
Methane to Markets Partnership

- Encourages development of *cost-effective* methane recovery and use opportunities in 4 key sectors with potential for near-term emissions reductions.

**Coal Mines**  
**Oil and Gas Systems**

**Landfills**

**Agricultural Waste**
Coal Mine Methane

• CMM projects have multiple benefits
  ➢ Greenhouse gas emissions reductions
  ➢ Promotes mine safety
  ➢ Provides additional revenues
Types of coal mine methane (CMM)

Coal mine methane (CMM): methane released as a result of mining activities

Recovery of CMM from diverse sources

Ventilation Air (Underground mines)
Ventilation shafts emit large volumes of dilute CH$_4$ (~ 1% or less)

Degasification from Underground Mines

In-Mine boreholes and/or Gob (“Goaf”) gas
Drainage during or after mining yields low to medium quality CMM

Pre-Mine Drainage
Drainage before mining yields high-quality CMM

Abandoned (closed) Mines

Surface Mines
End-uses for CMM depend on gas quality

High-Quality Gas (> 90% CH₄)
- Natural gas pipelines
- Vehicle fuel (LNG)
End-uses for CMM depend on gas quality

Medium-Quality Gas (50 to 80% CH₄)

- Power generation
- Combined heat & power
- Coal drying
- Boiler fuel
- Industrial applications
- Heating or cooling applications
- Fuel cells
End-uses for CMM depend on gas quality

Low-Quality Gas (<40% CH₄) and Ventilation Air Methane (~ 1% CH₄)

- Oxidation (mitigation)
- Combustion air
- Lean burn turbines
Global CMM Emissions & Emissions Avoided

“Emissions Avoided”
= CMM recovered and used
Global Recovery & Utilization of CMM

- Degasification systems
  - CMM drainage at active underground coal mines: 14 countries

- CMM recovery and utilization projects
  - At active and/or abandoned (closed) coal mines: 12 countries

- More than 220 CMM projects worldwide
  - Avoided methane emissions: > 3.8 billion cubic meters annually (> 54 MMTCO2E / yr)
Global Opportunities for CMM Projects

• Drained gas from active underground coal mines represents great opportunity
  ➢ Source of medium- or high-quality gas

• Recovery and utilization of drained gas can be increased:
  ➢ Increase gas drainage efficiency and recovery
  ➢ Improve gas quality: upgrading or refining technologies
  ➢ Tailor end-use technologies to use medium-quality gas
  ➢ Improve infrastructure (e.g., pipelines)
Global Opportunities for CMM Projects (2)

- Ventilation Air Methane from underground coal mines
  - Ventilation systems: most significant source of CMM
    - Account for 50% of global CMM emissions
    - 230 MMTCO2e (16 Bcm) emitted in 2000
  - Typically contains low methane concentrations (~ 1%)
    - Presents technical, economic challenges to recover
  - Technologies are available, under development
    - Thermal oxidation has been demonstrated, commercially available
    - Catalytic oxidation and other technologies under development
    - Demonstration projects underway in Australia, China, USA
Global Opportunities for CMM Projects (3)

• Abandoned (Closed) Underground Coal Mines
  ➢ In many countries, a relatively untapped resource
  ➢ Advantages
    – Project is independent of mine operations
    – Great potential for emissions reductions
  ➢ Challenges
    – Predicting gas flow and designing appropriately sized project
    – Risk of flooding
    – Ownership claims can be complex
  ➢ United Kingdom, Germany are world leaders
Global Opportunities for CMM Projects (4)

- **Surface Coal Mines**
  - In many countries, an untapped resource, but growing interest
  - Projects involve pre-mine degasification in advance of highwall
  - Few documented projects of this type
Global Challenges to CMM Project Development

- Lack of clarity about legal and regulatory issues, especially gas ownership

- Lack of technology and technical knowledge
  - Resource assessments
  - Technology selection
  - Conducting feasibility studies

- Lack of pilot projects to demonstrate site-specific economic recovery and utilization

- Lack of financing or capacity to obtain financing
Selected country profiles
China: CMM Sector

- **CMM emissions: 1st globally**
  - ~200 MMTCO2e in 2004 (~14 billion cubic meters)

- **Coal production: 1st globally**
  - ~90% of coal production from underground mines
  - ~50% of large, state-owned mines are “gassy”

- **Challenges to CMM development:**
  - Most mines inaccessible to gas pipeline network
  - Limited drainage technologies:
    - >200 mines have drainage systems
    - Low quality drained gas
  - Project ownership limited for foreign project developers
China: CMM Projects

• ~60 CMM projects currently operating at active mines: total 240 million cubic meters/yr
  ➢ Power generation: > 100 MW total installed capacity
  ➢ Town gas (heating / fuel): > 500,000 households
  ➢ Boiler fuel
  ➢ Industrial applications
  ➢ Vehicle fuel

• Many more CMM projects planned, under development (~240 million cubic meters/yr)
  ➢ Power generation: > 220 MW additional capacity
  ➢ Town gas: 46,000 more households
China: CMM Project Profile

- Sihe Mine, Jincheng Mining Group, Shanxi Province
- 120 MW power generation project to use IC engines
  - World’s largest CMM power generation plant
- $237 million project funding from ADB, World Bank, local entities, JBIC, US TDA
• CMM emissions: 2nd globally
  ➢ 58.5 MMTCO2e in 2006 (~ 4 Bcm)
• Coal production: 2nd globally
  ➢ ~ One-third from underground mines
  ➢ ~ 50 operating mines are considered “gassy”
  ➢ 23 underground mines conduct drainage
  ➢ Over 400 gassy abandoned mines identified as potential project sites
• Relatively few challenges to CMM development
United States: CMM projects

- **CMM recovered and utilized (2006)**
  - 50 Bcf, equal to 1.4 Bcm or 20 MMTCO2e

- **Active Underground Mines: projects at 14 mines**
  - Total recovered and used: 46.2 Bcf (1.3 Bcm)
  - Almost all projects are pipeline injection
  - One 88 MW peaking power generation plant
  - Other uses: Coal drying, mine heating

- **Abandoned Mines: about 30 mines**
  - Total recovered and used: 3.4 bcf (0.1 Bcm)
  - Primary uses: Pipeline injection, gas sales
United States: VAM mitigation

• Demonstration: VAM oxidation project at closed mine
  - CONSOL Energy closed mine in West Virginia simulating active mine flows, methane concentrations
  - MEGTEC VOCSIDIZER technology
  - Mitigation only; no power generation
  - Has been running successfully since spring 2007

• Demonstration project to be installed at active mine
  - Jim Walter Resources mine in Alabama
  - Biothermica VAMOX technology
  - Mitigation only; carbon credits to be generated
  - Planned to be operational by end of 2008
Ukraine

- **CMM Emissions: 3rd globally**
  - 26.3 MMTCO2e
- **Coal production: 13th globally**
  - 60 million tonnes
- **10 CMM recovery and use projects underway**
  - Most in Donetsk region
  - Boiler fuel, combined heat and power, power generation, industrial use
  - 2 under development
Russia

- **CMM Emissions: 4th globally**
  - ~ 21 MMTCO2e of CMM emissions in 2003 (~1.4 Bcm)
- **Coal production: 5th globally**
  - 44% of mines are underground; 85% are “gassy”
- **Challenges to CMM development**
  - Large competing natural gas resources with low, state-regulated gas sales price
  - Lack of appropriate technology
  - Complex rules on foreign investments
- **CMM utilization projects in Kuzbass, Pechora Basins**
  - ~ 43 million cubic meters emissions avoided
  - Boiler fuel, power generation, mine heating projects
  - UNDP and GEF project (ongoing):
    - remove barriers to financing and implementing CMM recovery and utilization projects (Kuzbass)
    - Boiler fuel / power generation project under development
Poland

- **CMM emissions:** 7th globally
  - 11.3 MMTCO2e
- **Coal production:** 8th globally
  - 159 million tonnes
- **21 CMM recovery and use projects**
  - Located in Upper Silesian Basin
  - Boiler fuel, coal drying, combined heat and power, industrial use, power generation
Germany

- **CMM emissions: 8\textsuperscript{th} globally**
  - 8.4 MMTCO2e
- **Coal production: 7\textsuperscript{th} globally**
  - 206 million tonnes, mostly lignite
- **47 CMM recovery & use projects**
  - Almost all at abandoned mines
  - Power generation, combined heat and power
United Kingdom

- **CMM emissions: 10\textsuperscript{th} globally**
  - 6.7 MMTCO2e
- **Coal production: 19\textsuperscript{th} globally**
  - 20.0 million tonnes
- **33 CMM use & recovery projects**
  - Mostly at abandoned coal mines
  - Power generation, boiler fuel, flaring
CMM Project Financing Through Carbon Offsets

- Carbon credits are increasingly an important source of project revenue for CMM projects
- Carbon financing milieu
  - Regulatory (compliance) arena
    - Kyoto Protocol emissions trading schemes
      - Clean Development Mechanism
      - Joint Implementation
    - European Union Emission Trading Scheme
    - Australia New South Wales
    - California, Regional Greenhouse Gas Initiative (US)
  - Voluntary markets
    - Chicago Climate Exchange
    - Over the counter (OTC) trades
CMM Carbon Financing

- **Update on CDM CMM projects**
  - 55 CMM projects “in the pipeline”
    - 8 have been registered, 5 requested registration, 42 at validation stage
    - 53 projects in China, 1 in Mexico, 1 in South Africa
    - Total CER value:
      - 121 MMTCO2e (through 2012)
      - 301 MMTCO2e (through 2020)

- **Certified Emissions Reductions (CERs)**
  - Only 2 CMM projects have been issued CERs (both in China)
  - Total: 628,000 tonnes CO2e

- **2007 prices for CERs (all types):**
  - 8 – 10 euro / metric ton CO2e
CMM Carbon Financing

- **Update on Joint Implementation (JI) CMM projects**
  - 17 CMM projects “in the pipeline”
    - 3 registered so far:
      - Total 6.7 MMTCO2e through 2012
    - Total GHG reductions of all JI CMM projects in pipeline:
      - **Total 293 MMTCO2e through 2012**
    - Where are they?
      - 9 projects in Ukraine, 3 in Germany, 2 in Poland, 1 in Russia, 1 in Slovakia

- **Emission Reduction Units (ERUs)**
  - No ERU’s issued to date for CMM projects
CMM Carbon Financing

- **Voluntary markets:** Chicago Climate Exchange
  - Voluntary, legally-binding GHG emission reduction, trading system
  - Members commit to reduce GHG emissions
    - 6% below baseline (1998-2001) by 2010
    - Offset credits limited to 50% of emission reduction commitment
  - Coal company participation
    - Member: Jim Walter Resources
    - Member: PinnOak Resources (now Cleveland Cliffs)
    - Offset provider: CNX Gas

- CMM projects (2007)
  - 5 offset projects, 30% of transaction volume
  - Provided between 4.5 – 6 MMTCO2e offsets (estimated)

- Relatively low carbon prices
  - $3.40 - $4.00 per ton CO2e (August 2008)
  - $3.15 per ton CO2e (2007 average)
CMM Carbon Financing

- **Voluntary markets: over-the-counter (OTC) trades**
  - Bilateral deals operated outside an exchange
  - Verified (or Voluntary) Emissions Reductions (VERs)
    - 42.1 MMTCO2e transacted (2007)
    - Global OTC market value: $258 million (2007)
    - Average price: $6.10 per ton CO2e
  - 3rd party standards frequently used
  - CMM projects in the OTC market
    - 7% of offset credits, or ~3 MMTCO2e
    - Average price: $4.90 per ton CO2e
CMM Carbon Financing

- **Methodologies most relevant to CMM projects**
  - CDM (ACM 0008)
  - CCX
  - GE AES

- **Other methodologies that may be relevant**
  - Voluntary Carbon Standard (VCS)
  - VER+
  - Voluntary Offset Standard (VOS)
  - ISO 14064
Summary

- **CMM projects have multiple benefits:**
  - Environmental, energy security, economic

- **Global CMM project opportunities abound especially at underground mines**
  - Drained gas
  - Ventilation air methane
  - Abandoned (closed) mines

- **Carbon financing is an important revenue stream for many CMM projects**
  - In compliance markets (through CDM, JI)
  - Growing demand for CMM projects in voluntary markets
Thank you! Merci beaucoup!

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