

Coal Mine Methane Project Development: Global Update



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Presentation Outline

- **Introduction**
- **Global CMM project development**
 - **Status, opportunities, challenges**
 - **Selected country profiles**
- **Carbon financing for CMM projects**
- **Summary**



US Environmental Protection Agency

- **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



Methane to Markets

- 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



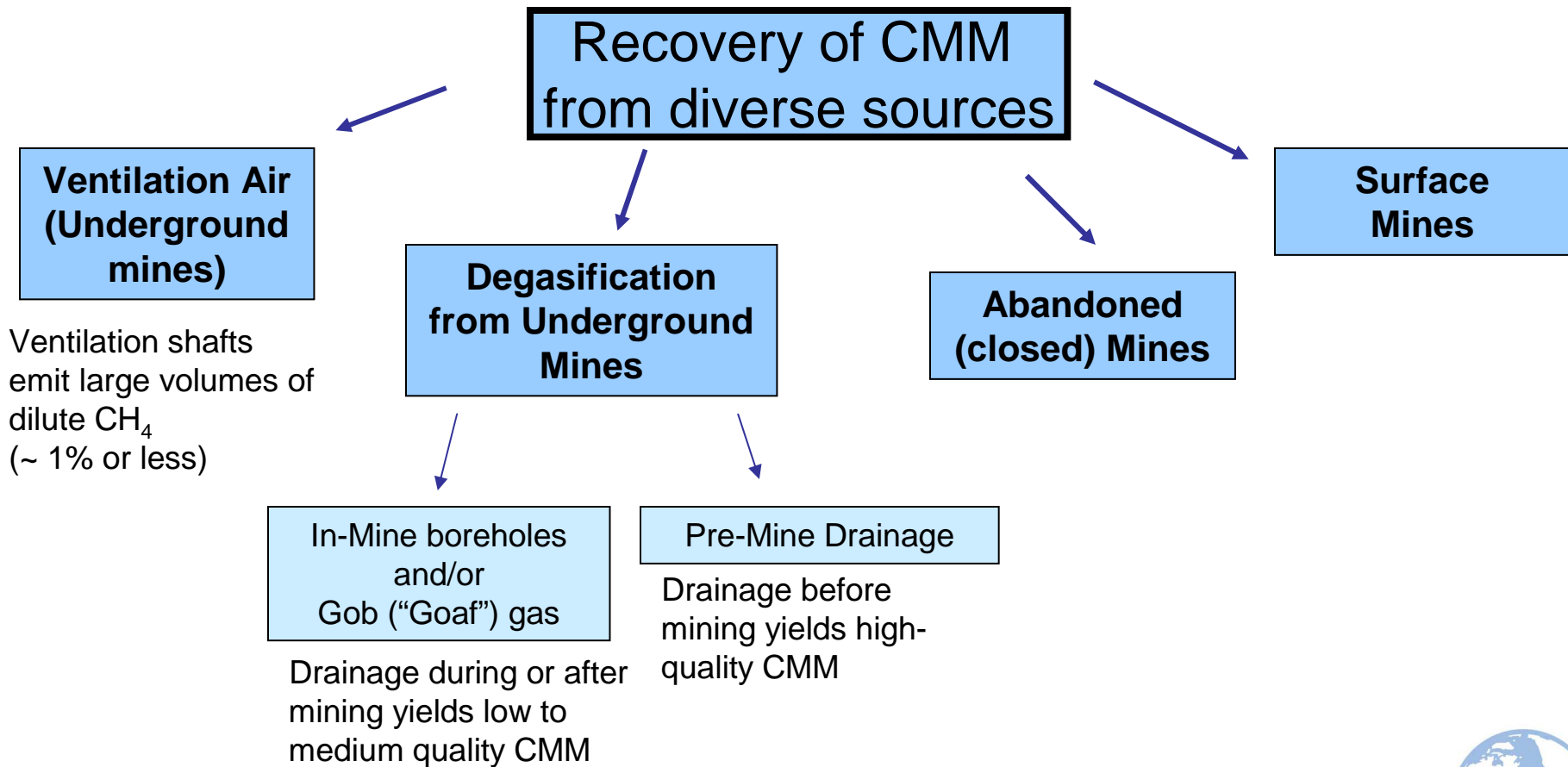
Coal Mine Methane

- **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



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



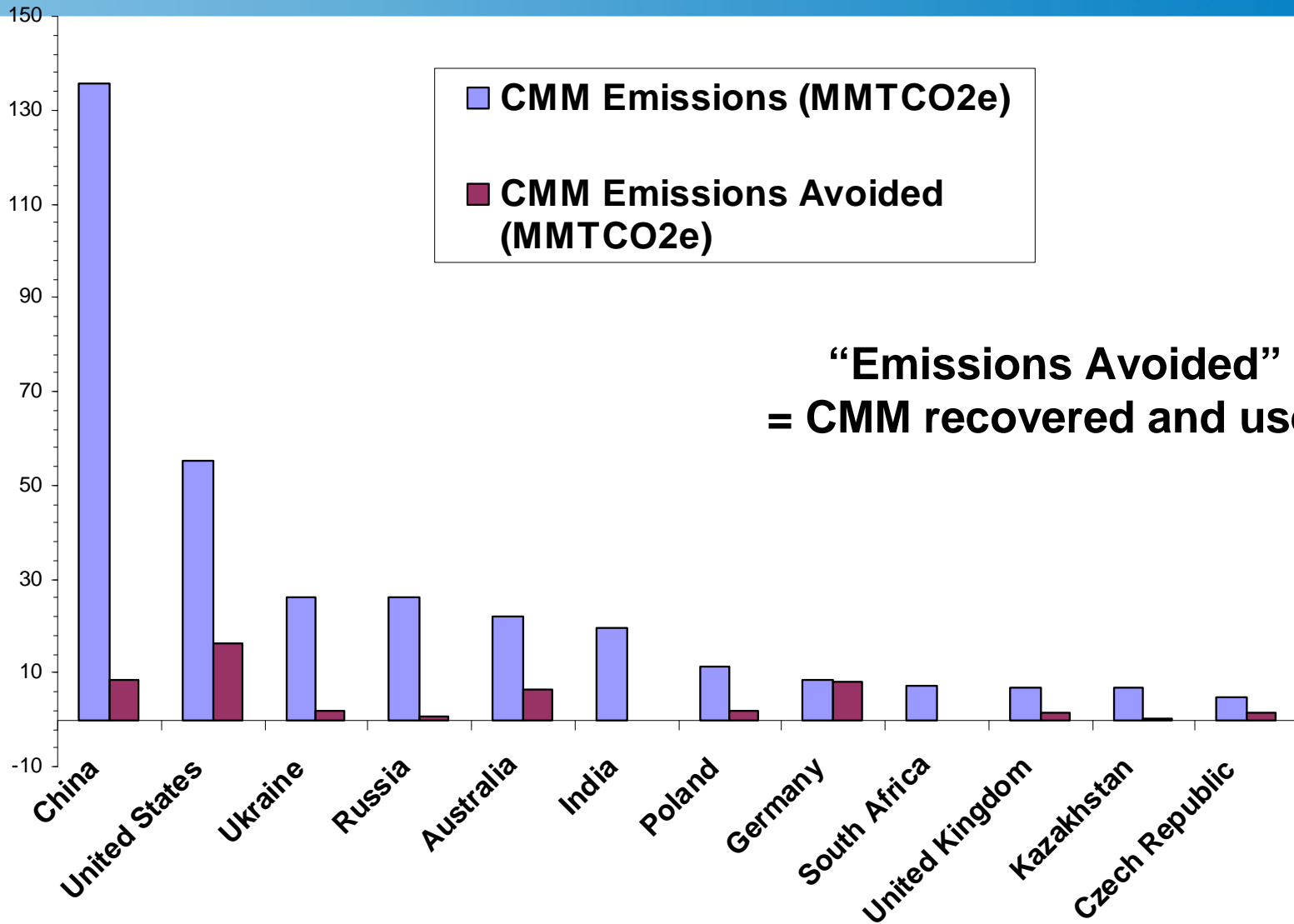
End-uses for CMM depend on gas quality

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

- Oxidation (mitigation)
- Combustion air
- Lean burn turbines



Global CMM Emissions & Emissions Avoided



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

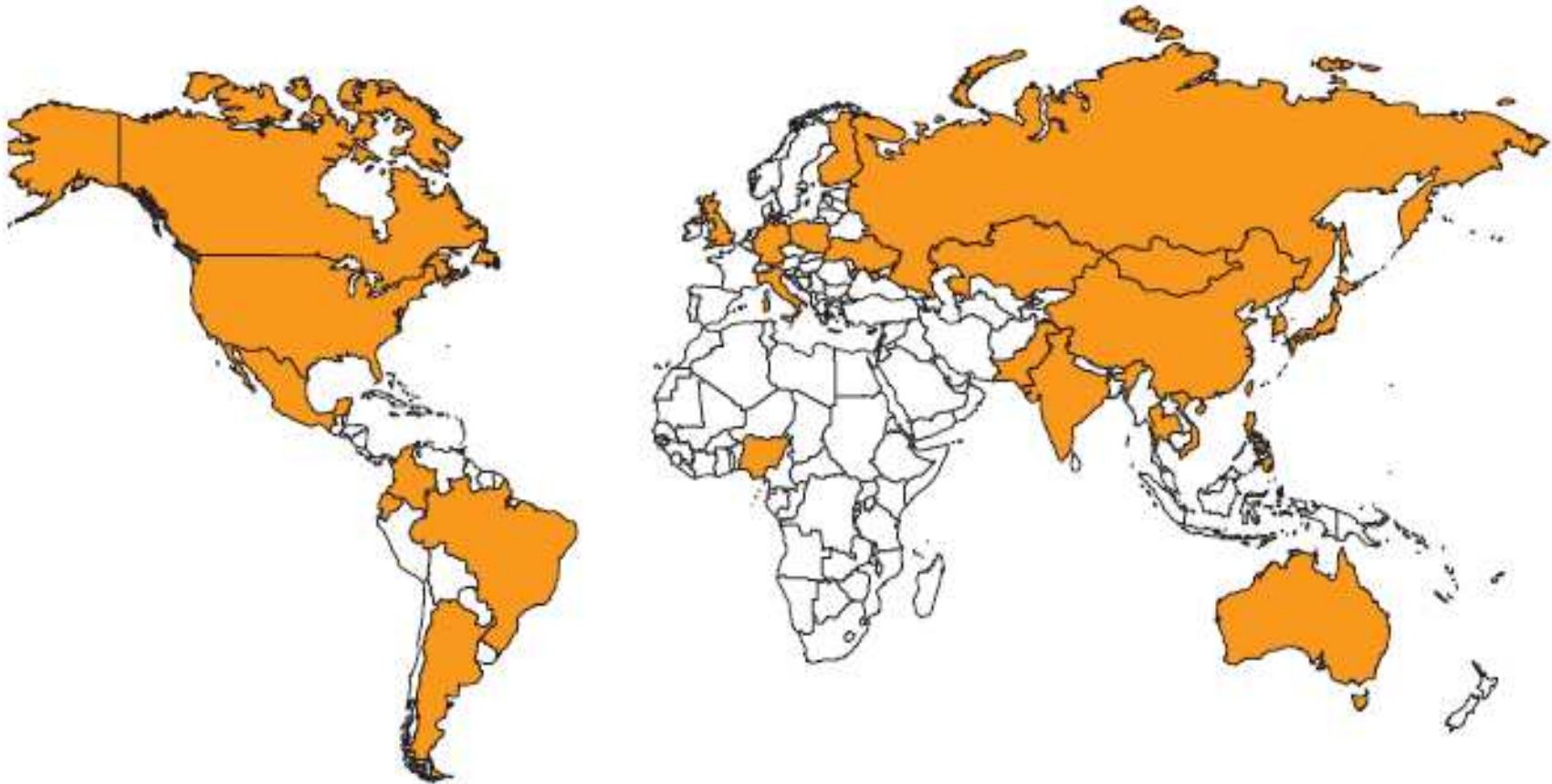


Global Challenges to CMM Project Development

- **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



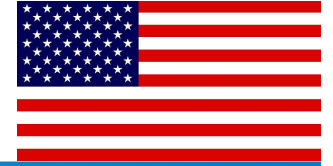
China: CMM Project Profile



- 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



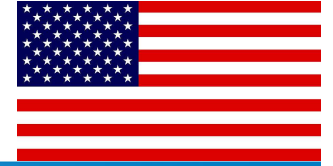
United States: CMM Sector



- **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**



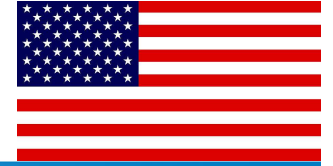
United States: CMM projects



- **CMM recovered and utilized (2006)**
 - 50 Bcf, equal to 1.4 Bcm or 20 MMTCO_{2e}
- **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: 8th globally**
 - 8.4 MMTCO₂e
- **Coal production: 7th 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: 10th globally**
 - 6.7 MMTCO₂e
- **Coal production: 19th 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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