



# Underground Coal Mine Methane Recovery and Use Opportunities

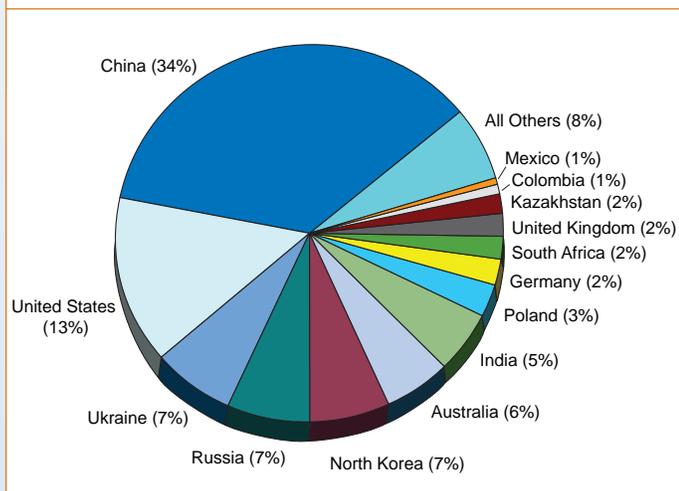
**M**ethane is both the primary constituent of natural gas and a potent greenhouse gas when released to the atmosphere. Reducing emissions can yield substantial economic and environmental benefits. The implementation of available cost-effective methane emission reduction opportunities in the coal industry can lead to improved mine safety, greater mine productivity, and increased revenues. The Methane to Markets Partnership is building international alliances to promote methane recovery and use projects at underground coalmines throughout the world.

## BACKGROUND ON GLOBAL EMISSIONS

Methane is produced from underground and surface mines, and as a result of post-mining activities including coal processing, storage, and transportation. Underground mines are the single largest source of coal mine methane (CMM) emissions in most countries.

Globally, CMM accounts for 6 percent of total methane emissions resulting from human activities. In 2005, estimated worldwide CMM emissions totaled nearly 400 million metric tons of carbon dioxide equivalent (MMT<sub>CO<sub>2</sub>E</sub>), or about 30 billion cubic meters (BCM). By 2020, the world's coal mines are expected to produce annual emissions of 450 MMT<sub>CO<sub>2</sub>E</sub> (40 BCM).

**Figure 1: Estimated Global CMM Emissions, 2005.**  
Total = 388.14 MMT<sub>CO<sub>2</sub>E</sub>



Source: Global Anthropogenic Emissions of Non-CO<sub>2</sub> Greenhouse Gases 1990-2020 (EPA Report 430-R-06-003)

## RECOVERY AND USE OPPORTUNITIES

At active underground mines, methane must be removed from underground operations for safety reasons. This is done with large-scale ventilation systems that move massive quantities of air through the mines. These ventilation systems keep mines safe, but also release large amounts of methane at very low concentrations. At some active and abandoned mines, methane is also produced from degasification systems (also commonly referred to as gas drainage systems) that employ vertical and/or horizontal wells to recover methane.



**Figure 2: A gob well, used to extract CMM from post-mining collapsed coal seams.**

There are a variety of profitable uses for CMM, and the optimal use at a given location is dependent on factors such as the quality of methane, the availability of end-use options, and project economics. The range of CMM projects includes natural gas pipeline injection, electric power production, co-firing in boilers, district heating, mine heating, coal drying, vehicle fuel, flaring, and manufacturing/industrial uses such as feedstock for carbon black, methanol, and dimethyl ether production. For the very-low-concentration methane in mine ventilation air, technological development has progressed to the point that this CMM source can be oxidized and the resulting thermal energy can be used to produce heat, electricity, and refrigeration.

## ISSUES FOR PROJECT DEVELOPMENT

To develop successful projects, one must address a range of issues from project concept through installation and operation. Successful projects require a thorough methane resource assessment and gas liberation analysis, effective integration of mine degasification and utilization with mining operations, and a ready market for the methane. Although there has been substantial progress in implementing CMM projects in recent years, project developers face a range of technical, economic, and institutional issues that impede further progress. Important issues include:

- Recognizing that methane is a commodity with a practical and profitable use rather than a nuisance and a safety hazard
- Ensuring that coal mines and project developers have access to modern methane drainage and use appropriate technologies and training to make use of this valuable resource
- Establishing an appropriate mechanism for the collection and dissemination of credible and unbiased data, including technical and market information
- Clarifying the laws, regulations, and policies that govern CMM capture and use and addressing any deficiencies or limitations
- Providing access to capital markets



Figure 3: CMM as vehicle fuel, Ukraine.

The Methane to Markets Partnership brings the collective resources and experience of partners together to facilitate technology transfer and demonstration, policy support, capacity building and market development necessary to realize implementation of these projects, and further reductions in CMM emissions. By focusing international expertise and resources, the Partnership will work to:

- Engage all facets of the coal industry to improve awareness of emission reduction opportunities and the value of the recovered methane
- Advance technology transfer to ensure the broad adoption of emission reduction technologies and management practices
- Improve and facilitate access to capital to support project investment

- Cooperate with country partners to improve markets and provide legal and regulatory frameworks that encourage project development

For years, methane in coal mines was viewed as a nuisance and a safety hazard that had little intrinsic value. Recent projects have shown that the opposite is true: CMM is an energy product and a commodity that, when captured, can provide many benefits to the mine; the local, regional, and national communities; and the global environment.

### Project Case Study: Jincheng Anthracite Mining Group Shanxi Province, China

The Jincheng Anthracite Mining Group, Inc., located in Shanxi Province, China, produces high-quality anthracite coal at several mines that generate substantial volumes of methane. In 1995, methane from seven CMM wells was used to fuel a power plant with a capacity of 1.6 megawatts (MW). In early 2002, the company increased the capacity to 4 MW by building a second CMM-generated power plant. Together, the power plants reduce greenhouse gas emissions by about 40,000 tons of carbon equivalent per year.

Based on its success thus far, the Jincheng Group is developing a third CMM power plant, with 120 MW generating capacity and based on internal combustion engines, at the Sihe Mine. The project will utilize the latest technologies to boost CMM and coalbed methane production to fuel this power plant, which will generate electricity for use at the mine. In addition, the project will capture CMM from other mines for distribution to residential, commercial, and industrial consumers in the Jincheng area. By 2008, the project will use at least 166 million cubic meters of CMM per year to serve about 90,000 households and various commercial and industrial establishments in the area. About 410,000 people in Jincheng will directly benefit from the cleaner CMM-based energy, reducing indoor and atmospheric pollution. Together, the new power generation capacity and the planned natural gas distribution will avoid emissions of about 500 million cubic meters per year, or 40 MMTCO<sub>2</sub>E over 20 years.



Electric generators operating on CMM:  
Jincheng Anthracite Mining Group, China.