# Conducting CMM Project Pre-Feasibility Studies

Training by the U.S. EPA in Support of the
Global Methane Initiative (GMI)

# Welcome

The United States Environmental Protection Agency (EPA) developed this course in support of the GMI and in conjunction with the United Nations Economic Commission for Europe (UNECE). What is the GMI?

This course introduces principles for assessing the potential of developing projects to capture and/or use Coal Mine Methane (CMM). The introduced general approach should be underpinned by mine-specific data and analyses, allowing the principles to be tailored to the unique conditions at each mine. Ideally, such an assessment will lead to project development and implementation.

# What Is the Global Methane Initiative?

Global Methane Initiative

The Global Methane Initiative (GMI) is a voluntary, multilateral partnership that aims to reduce methane emissions and to advance the abatement, recovery, and use of methane as a clean energy source.


GMI Partner Countries account for nearly 70% of total global manmade methane emissions, which is equivalent to approximately 5,000 MMT$CO_2e$.

# Conducting CMM Project Pre-Feasibility Studies: Course Modules

Module 1: Introduction and Objectives
Module 2: Mine Background Information and Evaluation
Module 3: Resource Assessment
Module 4: Forecasting Methane Production from Gas Drainage Systems
Module 5: Improvements to Gas Drainage
**Module 6: Quantifying the Benefits of Improvements to Methane Drainage Systems**
Module 7: Market, Risk, and Financial Analyses
Module 8: Case Study – Liulong Mine, China

# Module 6

# Quantifying the Benefits of Improvements to Methane Drainage Systems

# What You Will Learn

In this module, you will learn about:

- Methods used to quantify the benefits of proposed improvements to methane drainage systems (as discussed in *Module 5 – Improvements to Gas Drainage*).
- How to assess the value of proposed improvements and the impact of these improvements relative to the performance and cost of current gas drainage system practices.

Time needed to complete this module:

Approximately 25 minutes

# Metrics to Quantify Methane Drainage System Improvements

Project developers/operators can obtain metrics to help quantify the benefits of proposed improvements to methane drainage systems.

*Mine Entrance, Liulong Mine, China*

**Key metrics include:**

- Quantity and quality of the recovered, or produced, gas attributed to the improvements
- Cost of implementing the improvements compared to current practices
- Benefits of improvements on coal production
- Benefits of improvements on mine safety
- Value of increased gas production rates at higher gas quality

# Benefits of Quantifying Improvements to Methane Drainage

Quantifying benefits before or after they are implemented allows stakeholders to make better decisions related to:

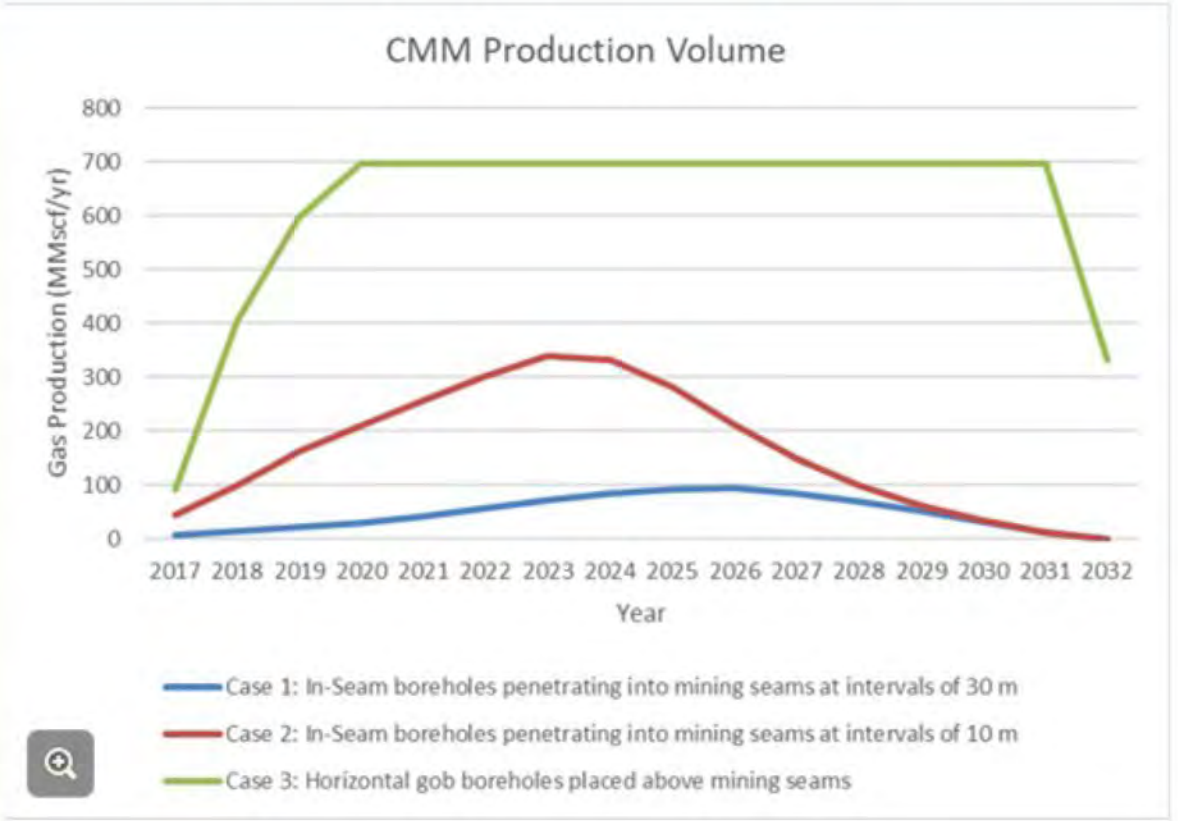
- Future mining plans
- Coal production targets
- Capital investments
- Project end-use options
- Project economics
- CMM project investments

# Example of Quantifiable Benefits

This graph illustrates an example of a quantifiable benefit of improving methane drainage systems:

- In-seam boreholes that are not spaced closely together (Case 1 in the graph) produce less volumes of gas compared to in-seam boreholes that are closely spaced together (Case 2 in the graph).
- Horizontal boreholes above the gob area (Case 3 in the graph) produce the greatest volume of gas compared to other types of boreholes.

## Gas production rates for in-seam boreholes and horizontal gob boreholes



# Steps to Quantify Improvements to Gas Drainage: Overview

The following steps are commonly used in a pre-feasibility study to determine the benefits of improvements to gas drainage systems:

Step 1 - Develop gas production and gas quality forecasts for the proposed improvements.

Step 2 - Compare key performance metrics of the current gas drainage system to the improved gas drainage system.

Step 3 - Conduct a comparative analysis of associated costs (explored in *Module 7 - Market, Risk, and Financial Analyses*).

Completing these steps will help project managers summarize the benefits of improving gas drainage systems, as identified during the pre-feasibility stage.

# Step 1: Methane Production Forecasts

During the pre-feasibility stage, project developers/operators can use methane production forecasts to assess the potential benefits of methane drainage improvements.

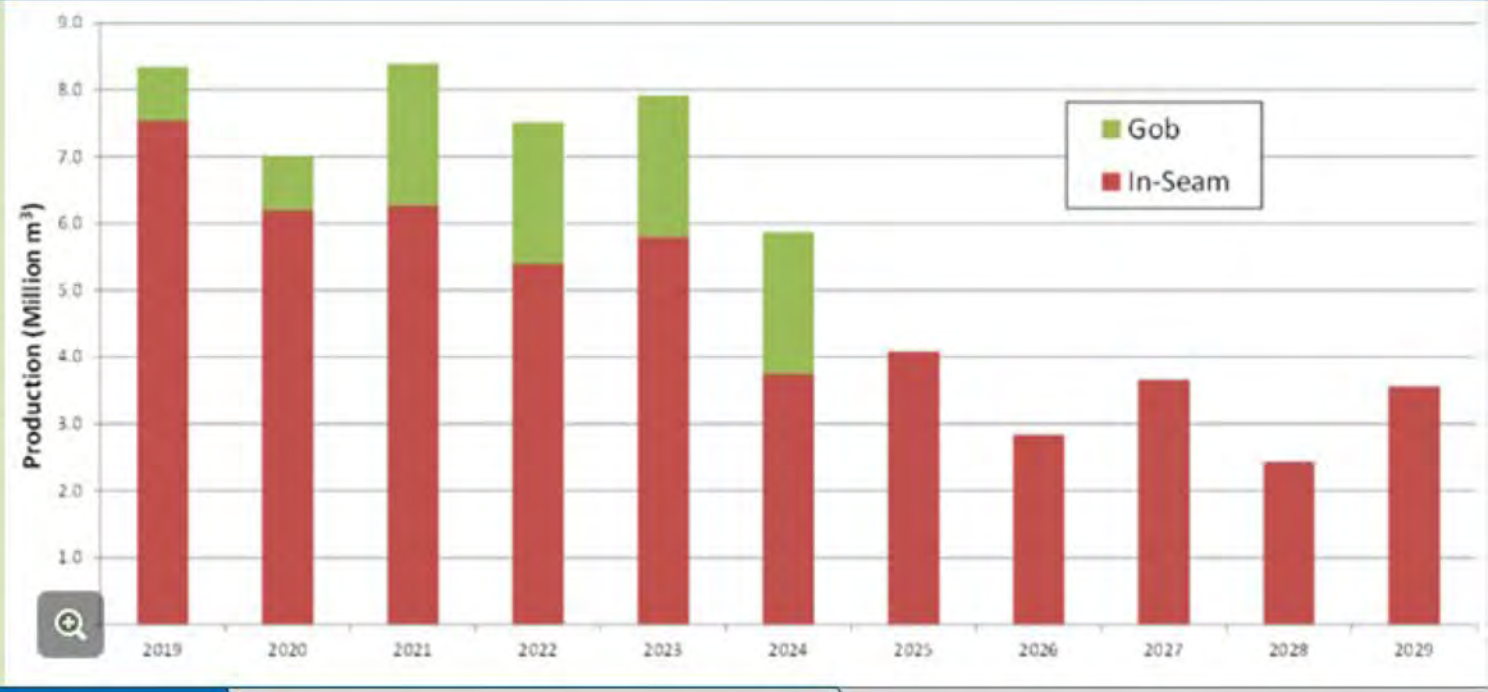
Methane production forecasts are projections of the quantity and quality of recovered gas based on various factors, such as:

- Mine plan for the project period
- Projected coal production rates for developments and longwalls
- Gas content of mined and adjacent seams (e.g., the gas resource that will be affected by mining) of the current and future mining districts

# Example Methane Production Forecast

Accurate production forecasting relies on the use of current methane drainage rates and gas quality, considering planned improvements to the gas drainage system.

## Annual Methane Production Forecast




Quantify Improvements to Gas Drainage

Step 1. Methane Production Forecast

Step 2. Performance Analysis

Step 3. Comparative Analysis of Costs

# Methane Production Forecast Models

Methane drainage production forecasts are developed using forecast methods (described in Module 4), and if feasible, reservoir simulation models, to predict gas production within the project area.

Methane production depends on borehole spacing and configurations:

- Reservoir simulation models can help optimize methane production.
- Optimized designs should also consider the drainage times and/or residual gas content targets.

Ideally, project developers obtain input parameters for simulation models from geologic and reservoir data that are derived from the gas-bearing strata at the mine. Analysts may have to use supplemental data from analogous projects, where appropriate.

# Methane Production Forecast Parameters

The most important reservoir parameters to use for reservoir simulations include:

- Permeability
- Langmuir volume and pressure
- Gas content
- Relative permeability
- Coal seam depth and thickness
- Reservoir and desorption pressure
- Porosity and initial water saturation
- Sorption time
- Fracture spacing
- Borehole spacing
- Completion
- Well operation

When developing gas production forecasts, it is important to conduct simulations using historic production data (a process known as history matching) to calibrate the reservoir model so that the model can be confidently used to predict future production.

*CMM Vacuum Pump System, Poland*

# Step 2: Performance Analysis

Project developers/operators can analyze the following typical performance metrics to identify the effectiveness of the current methane drainage system:

- Mine safety record
- Historical methane-related incidents
- Mine development and production advance rates
- Methane-related coal production delays
- Methane drainage infrastructure requirements
- Total cost of methane drainage and ventilation
- Cost of coal production delays

**A detailed analysis of performance metrics might not be possible during the pre-feasibility study stage. However, some of these performance metrics should be readily known by the mine, and could therefore be considered in the pre-feasibility study.**

*An active longwall mining operation*

# Step 3: Comparative Analysis of Costs

A cost comparison between current practices and proposed drainage improvements will help quantify the economic benefit of the proposed improvements.

The following must be considered when determining the cost of current methane drainage practices:

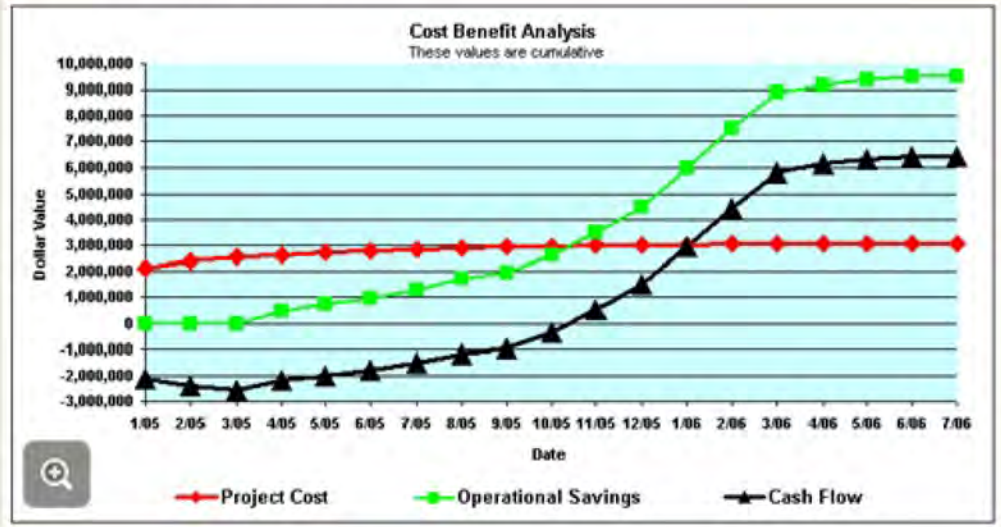
- Capital costs, including those for mine infrastructure developed specifically for methane drainage
- Operating costs, including those for mine ventilation and the gas drainage system
- Costs associated with methane-related coal production delays
- Costs for the continued implementation of current practices through the course of the evaluation period

# Example: Determining the Cost of Improvements

The following must be considered when determining the cost of improvements:

- Capital costs of implementing the improvements
- Operating costs (mine ventilation and methane drainage) as a result of implementing the improvements
- Estimated costs of implementing the improvements through the course of the evaluation period
- Estimated value of the coal production and safety benefits of the improvements

The chart below shows project costs and increased cash flow from operational savings. In this example, the project pays for itself and increases cash flow from operational savings.



# Module 6 Summary

This module presented a high-level overview of quantifying the potential benefits of improvements to methane drainage systems. Quantifying improvement benefits can help identify the best options for optimizing cost production.

After quantifying benefits of improving the system, project developers will have to decide whether to implement the identified improvements. Overall, the decision to improve methane drainage systems should be influenced by gas production, key metrics, and costs.

Other factors that contribute to decision-making include the availability of technology and equipment, as well as environmental and mining regulations. If the technology or equipment is not readily available, then there may be delays in implementing the identified improvements. The timeframe is project-dependent, as each mine is unique.

**Example**: If making decision "x" will incur significant costs when compared to decision "y," then a project developer will have to balance the associated costs with the incremental improvement that is attributed to making such a decision.

# Next Steps

After quantifying the benefits of improvements to a methane drainage system, each developer will need to:

- Evaluate all of the factors.
- Make decisions that affect project development.
- Proceed to consider the effects of current market conditions, associated project risks, and financial analysis, as well as determining the potential end-uses for the produced methane.

**Looking Ahead**

Module 7 cover how to evaluate the potential market, risk, and financial aspects that affect project development.

# Thank you!

You have completed Module 6.