Baseline Development and Economic Analysis

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April 17, 2008

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Introduction to RTI International

Magnitude of Methane Emissions Reduction Potential in the Oil and Gas Industry

Measuring Baseline Emissions

Evaluating Cost-Effective Emissions Reduction Opportunities

Supplemental Funding Sources
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- Energy and the environment
Importance of the Oil and Gas Sector

Global CH₄ Emissions in 2010 = 6,875 MtCO₂e

- Agriculture, 43%
- Coal, 6%
- Wastewater, 9%
- Other, 11%
- Landfills, 11%
- Oil and Gas, 20%
Methane Emissions Reduction Opportunities Exist in China and Many Countries Worldwide

Global CH4 Emissions in 2010 = 1,354 MtCO2e

- Russia, 13%
- United States, 11%
- Mexico, 8%
- Africa, 7%
- Latin America, 7%
- Middle East, 15%
- Southeast Asia, 10%
- Rest of World, 28%
- China, 1%
China’s Methane Emissions In the Oil and Gas Sector

- Oil Production, 358 MMm³/yr (39%)
- Gas Production, 324 MMm³/yr (35%)
- Gas Distribution, 147 MMm³/yr (16%)
- Gas Processing, 22 MMm³/yr (2%)
- Gas Transmission & Storage, 53 MMm³/yr (6%)
- Oil Transport & Refining, 17 MMm³/yr (2%)
- Other (10%)
Cost-Effective Opportunities Exist

- It is estimated that \(\frac{1}{3}\) to \(\frac{1}{2}\) of methane emissions in the oil and gas industry are profitable.

- This means that the value of the captured methane as an energy source pays for the emissions reduction project (equipment and labor).

- Supplemental funds are available through carbon markets to make even more emissions reduction projects profitable.
Estimated Cost of Methane Emissions Reduction in China

Natural Gas MAC—China ($/tCO₂e)
To identify and evaluate the profitability of potential emissions reduction projects, several steps are needed:

- Estimate baseline emissions
- Conduct benefit-cost analysis
Baseline Emissions Estimation

- The baseline describes the level of methane emissions prior to the introduction of the proposed project activity.

- Typical emission factors are available from sources such as the 2006 IPCC Guidelines Tier 1 approach for countries with economies in transition.

- However, uncertainty of Tier 1 emission factors is high (± a factor of 3) as emission factor ranges often span an order-of-magnitude due to system specific characteristics.

- Field survey of selected equipment components are used to identify leaking components and then measure the emissions rate of selected leaks.
Many factors influence the accuracy of methane fugitive leak estimates, including:

- the type of leak measurement technique used,
- instrument calibration methods,
- how the leak measurement is performed (how far from the potential leaking areas the probe or device is, how background factors are accounted for, etc.), and
- how the instrument response is correlated to an emission rate.
To determine the cost effectiveness of a potential emissions reduction project, a simple benefit-cost analysis can be conducted. This involves comparing the one-time (equipment) costs and the annual (operating and maintenance) costs of a project with the annual benefits (value of gas and carbon credits). It is important to account for the full lifetime of the project and discount both benefits and costs appropriately.
Components of Benefits and Cost

Cost and benefit components relevant to the analysis will vary by emissions reduction project.

Costs Include:
- One-time costs: equipment expenditures, labor hours for planning and installation, permits.
- Annual costs: labor for maintenance and inspection, materials for operation, energy consumption, and other reoccurring costs.

Benefits include:
- Value of methane captured as natural gas or as converted to electricity or heat.
- Value of carbon credits generated from reduced greenhouse gas emissions.
Once the benefit and cost components have been quantified, several measures of economic return are available to evaluate potential projects. The most common are:

- **payback (PB) period**, \( PB \)
- **benefit-cost ratio (B/C)**, \( B/C \)
- **net present value (NPV)**, \( NPV \)
- **internal rate of return (IROR)**, \( IROR \)

Each measure has its advantages and disadvantages.
The payback period is the number of years it takes for the annual net revenue to cover the initial one-time costs of the project and is expressed as

\[ PB = \frac{\text{One-time costs}}{\text{annual benefits} - \text{annual costs}}. \]

Payback period is the simplest measure to calculate.
Acceptable project paybacks vary by company but typically range from 2 to 4 years.

However, the payback calculation does not account for the life expectancy of the project and hence tends to undervalue capital intensive projects with long life expectancies.
The B/C, NPV, and IROR measures of economic return all take into account the time value of money by discounting the time series of annual benefits and annual costs. Discounting future benefits and costs is a standard practice in financial analysis and accounts for the opportunity cost (alternative investment opportunities) of capital funds.
The **benefit-cost ratio** is interpreted as the number of dollars returned per dollar invested, and is expressed as:

\[ B/C = \frac{\sum (\text{annual benefits})/(1+r)^t}{\text{one-time costs} + \sum (\text{annual benefits})/(1+r)^t} \]

where \( n \) is the life expectancy of the project and \( r \) is the discount rate.
Net Present Value and Internal Rate of Return

- A project with a **net present value** greater than zero indicates a profitable investment. The NPV of a project can be expressed as

  \[ NPV = \text{one-time costs} + \sum (\text{annual benefits} - \text{annual costs})/(1+r)^t. \]

- The **internal rate of return** is the value of \( r \) that sets the NPG equal to zero.

- Most companies have a “hurdle” rate of return (e.g., 7%, 10%) below which they will not pursue investments. In other words, they will not invest a project with an IROR below their hurdle rate because they have better opportunities for which to use their investment capital.
Emissions markets and carbon trading are international initiatives to mitigate global warming which can provide incremental funds to make projects more profitable.

By assigning a monetary value to emissions, market mechanisms can be used to increase the cost effectiveness of reducing greenhouse gas emissions.

Methane emissions reductions in China have the potential to be a significant source of greenhouse gas emissions credits, which in turn can be sold on international markets to help finance projects.

There are several market exchanges currently trading carbon credits, including the European Climate Exchange, the Chicago Climate Exchange, and Nord Pool.
Thank You

For more information on estimating baseline emissions or benefit-cost analysis, contact

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