



Methane to Markets



Overview: Methane to Markets Partnership and Resources for Natural Gas Companies

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Mitigation, October 28, 2008

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Overview

- Background: Methane to Markets (M2M) and Natural Gas STAR
- Resources to Promote Methane Mitigation Based on Proven Technologies and Practices
- Major Emission Sources and Key Opportunities for Oil and Natural Gas Companies
- Partner Case Studies
- Key Factors in Analyzing and Implementing Projects

Background: Methane to Markets

- The **Methane to Markets Partnership (M2M)** is an international initiative that advances cost-effective, near-term methane recovery and use as a clean energy source in four sectors:



Oil and Gas Systems



Coal Mines



Landfills



Agricultural Waste

- The goals of the Partnership are to reduce global methane emissions to:
 - Enhance economic growth
 - Improve air quality and industrial safety
 - Reduce emissions of greenhouse gases
 - Strengthen energy security

Methane to Markets Partner Countries

Currently, there are 27 Partner Governments in the Methane to Markets Partnership, including Russia and the U.S.

North America

Canada
Mexico
United States

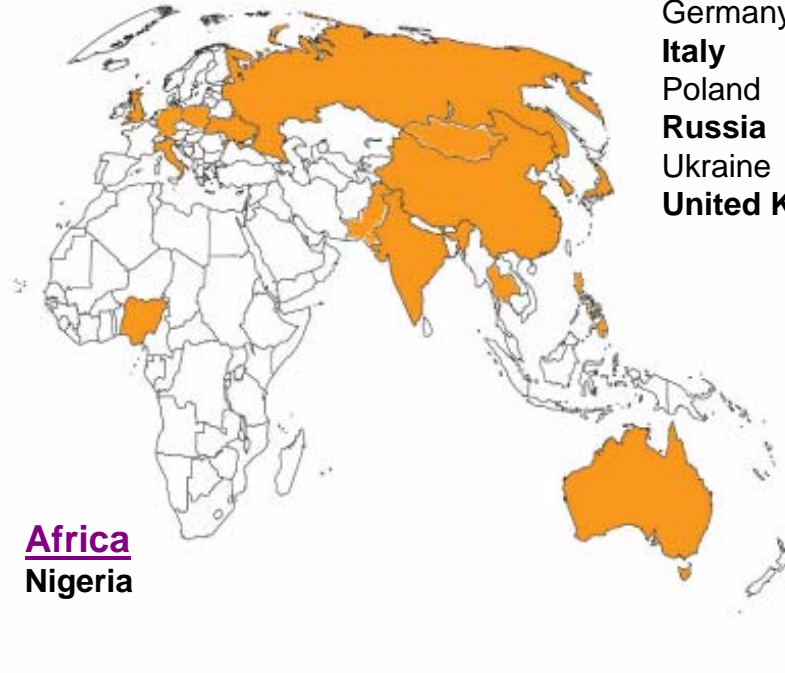
South America

Argentina
Brazil
Colombia
Ecuador



Africa

Nigeria



Europe

European Commission
Finland
Germany
Italy
Poland
Russia
Ukraine
United Kingdom

Asia Pacific

Australia
China
India
Japan
Kazakhstan
Korea
Mongolia
Pakistan
Philippines
Thailand
Vietnam

Why focus on Methane?

- **A potent greenhouse gas (GHG) with 100-year global warming potential of 23; atmospheric lifetime of ~12 years**
- **The 2nd most important GHG accounting for ~16% of total climate forcing**
- **A primary component of natural gas and a valuable, clean-burning energy source**
 - Proven, viable technologies and practices exist to reduce methane emissions cost-effectively
- **Oil and natural gas operations are a significant source (16%) of total global man-made methane emissions.**
 - EPA estimates that methane emissions are projected to grow globally by more than 33% from 2005 to 2015.

Background: Natural Gas STAR Program



- For the past 15 years (since 1993), U.S. EPA has worked with the U.S. oil and gas industry to promote proven, cost-effective, methane mitigation technologies and practices.
 - Collaborate with companies that produce, process, transmit and distribute natural gas to learn about innovative ways to reduce methane emissions;
 - Develop detailed technical information (currently on over 80 mitigation options);
 - Facilitate the sharing of that information across the industry.
- In 2006, under Methane to Markets, EPA expanded the Program to include international operations



Methane to Markets Resources: Industry Wide



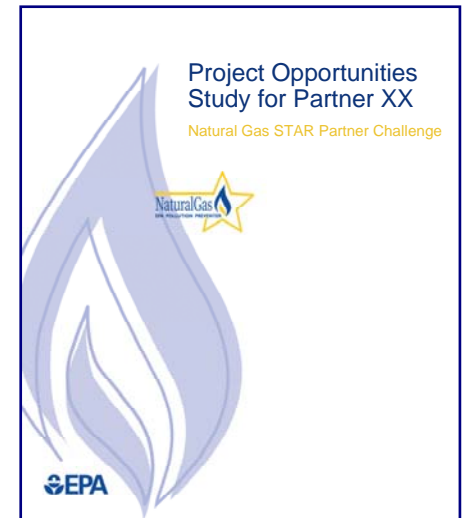
Resources to advance cost-effective oil & gas sector methane emission reductions:

- **General technology transfer, training, and capacity building:**
 - Technical documents and research outlining over 80 mitigation options, including analyses of economic, environmental and operational benefits, and
 - Workshops, conferences, and study tours
- All recommended technologies and practices are proven based on actual field implementation by partner companies.



Methane to Markets Resources: Company Specific

- **Individual technical assistance to help companies identify and assess cost-effective methane emission reduction opportunities**
 - Analysis of estimated methane emission sources and corresponding project opportunities
 - Pre-feasibility and feasibility studies
 - Leak detection and measurement studies



Overview: Methane Emissions from Oil and Gas Operations

- The majority of oil and gas methane emissions come from
 - Natural gas
 - Production
 - Processing
 - Transmission
 - Distribution
 - Oil production

- Methane emissions can be intentional or unintentional
 - Leaks
 - Process venting
 - System malfunctions

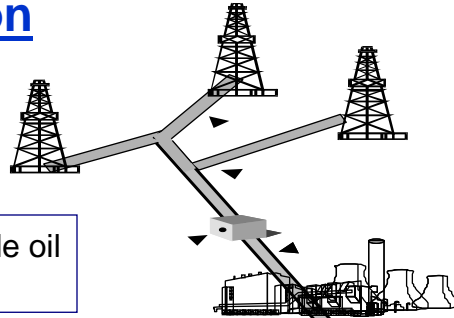


Methane Emissions from Oil and Gas Operations

Oil Production

Venting of casinghead gas

Flash emissions from crude oil storage tanks



Natural Gas Production & Processing

Well completions, blowdowns and workovers

Reciprocating compressor rod packing

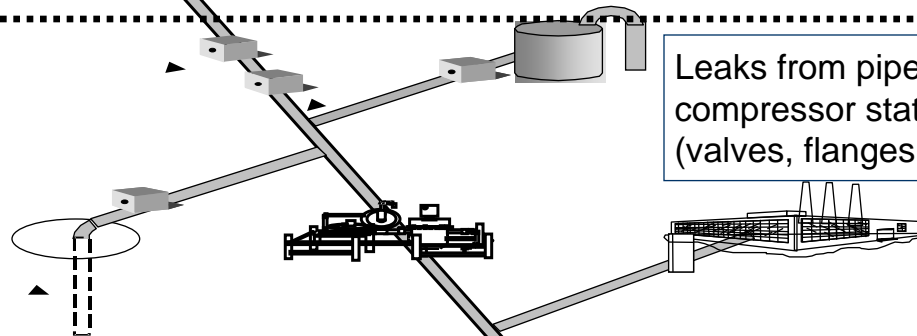
Venting from glycol reboilers on dehydrators

Processing plant leaks

Gas-driven pneumatic devices

Gas Transmission

Venting of gas for maintenance or repair of pipelines or compressors



Leaks from pipelines, compressor stations (valves, flanges, etc.)

Compressor blowdown venting

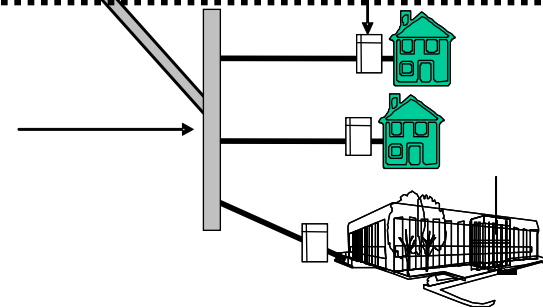
Centrifugal compressor seal oil de-gassing

Gas Distribution

Leaks from unprotected steel mains and service lines

Leaks at metering and regulating stations

Pipeline blowdowns

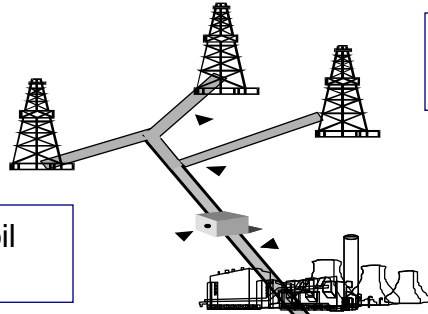


Cost-Effective Methane Mitigation Opportunities

Oil Production

Route casinghead gas to VRU or compressor for Recovery & Use or Sale

Install VRUs on crude oil storage tanks



Reduced emission well completions

Economic replacement of reciprocating compressor rod packing

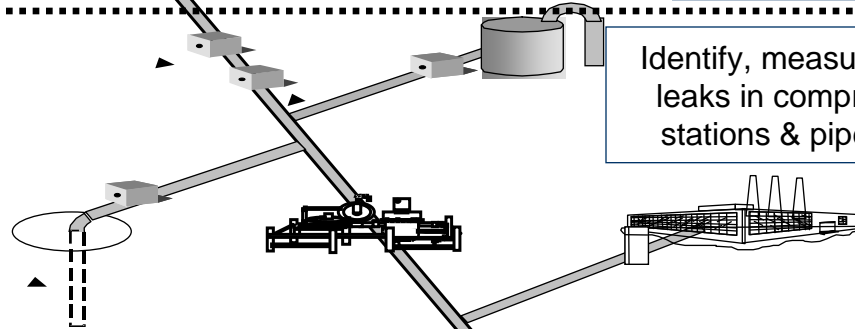
Install flash tank separators on dehydrators

Identify, measure & fix leaks in processing plants

Gas Transmission

Use pipeline pumpdown

Composite Wrap for Non-Leaking Pipeline Defects



Identify, measure & fix leaks in compressor stations & pipelines

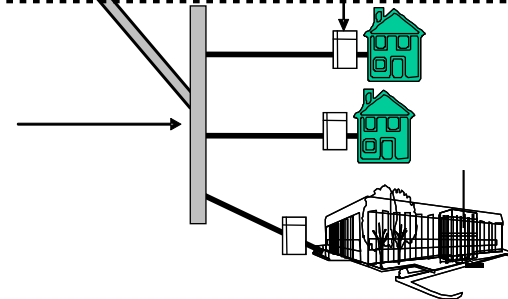
Re-route gas to fuel system or sales line or flare

Replace wet seals with dry in centrifugal compressors

Gas Distribution

Identify, measure & fix leaks in pipelines & metering and regulating stations

Inject blowdown gas into low pressure mains



Evaluating Methane Emission Sources and Opportunities

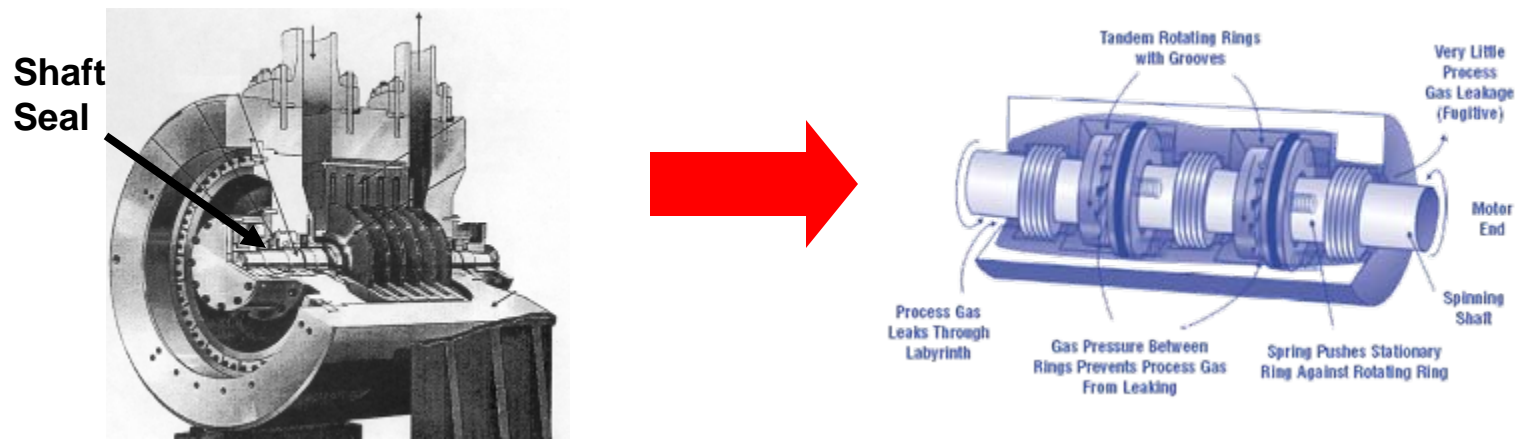
Approaches to identifying methane emission sources and reduction opportunities:

- Top Down: Some companies develop emissions inventories at the company level using emissions and activity factors
 - Benefits: Can help identify general project areas and inform mitigation programs at the company level
 - Limitations: Too general for project-based investment; uncertainty in factors and system diversity can lead to poor data

- Bottom Up: Project based equipment level analysis (desktop pre-feasibility assessments and onsite measurement studies)
 - Benefits: Produces high quality, process-specific information
 - Limitations: Covers discreet parts of the system; onsite measurement studies can be more expensive

Case Study: Pemex Mexico Centrifugal Compressors

- EPA helped PEMEX assess benefits of shifting from wet seals to dry seals on centrifugal compressors at a compressor station in Southern Mexico
- Pre-feasibility study included:
 - Preliminary estimates of benefits
 - Measurements of methane emissions from wet seals
 - Adjustment of preliminary estimations
 - Basic project economic assessment
 - Final measurements to assess performance and benefits



Case Study: Pemex Benefits

- Confirmed reduction in gas savings
 - 33.5 SCFM (57 m³/h) per seal
 - 35 MMCF (1 million m³) per compressor per year
- Environmental and economic benefits per compressor:
 - Reduction of 7,310 ton of CO₂ equivalent per year
 - US \$126,690 /year in natural gas commercial value
 - Additional revenue of US \$58,480 /year possible if presented for carbon credit
- There are at least 60 similar compressors in the PEMEX natural gas system, with a combined methane emissions reduction of 438,000 ton of CO₂e /year

Economic benefits for operational costs (power, oil and cooling water) and maintenance are not included.

Case Study: ONGC Technology Transfer

- **ONGC, India's largest oil and gas producer, joined the Natural Gas STAR International in 2007 (first state-owned partner company)**
- **EPA and ONGC conducted a series of successful technology transfer workshops at four sites to promote methane mitigation opportunities (December 2007)**
- **Based on the success of the workshops:**
 - Conducted desktop prefeasibility analyses to estimate emissions sources at seven sites
 - EPA and ONGC conducted four onsite measurement studies to assess key methane emission sources and potential mitigation measures (May 2008)
 - Presented measurement study results and recommendations to ONGC Board of Directors (September 2008)



Case Study: KyrKazGas Leak Detection and Quantification

Project: leak detection and quantification of KyrKazGas (of the Kyrgyz Republic) natural gas transmission system

- Previous methane leak inspection and repair practices resulted in overlooked product loss
- Field Study (February 2008) demonstrated state-of-the-art leak detection and measurement technologies and assessed methane emissions, product loss, and operating practices
- Resulted in expanded capacity and experience at KyrKazGas in leak detection and quantification and ability to demonstrate the viability of capital investment in methane emission reduction projects

Key Factors in Analyzing Project Opportunities

Key factors in evaluating project economics:

- Gas Value: Oil and gas companies value their gas and emission reduction differently
 - Is there a sales outlet for recovered gas?
 - Are there investor or government requirements on gas valuation?
 - Will recovered gas be used to displace onsite fuel usage?
 - Will recovered gas in one part of the system cause increased venting or flaring in another place?
- Implementation and O&M Costs: Vary greatly based on country labor rates and sources of equipment
- Additional Project Benefits: Longer equipment life, decreased maintenance, increased energy efficiency, increased production, etc.

Key Factors in Analyzing Project Opportunities, cont.

Other important considerations in evaluating project economics and implementation:

- Source and Structure of Project Financing: Internal, loans, carbon finance, etc.
- Overall System Investment and Replacement Plans: Efficiencies can be achieved when projects are factored into system-wide maintenance and engineering plans
- Potential for Carbon Credits: Can add value to projects but also take time and effort to organize
- Scalability: Do implementation of opportunities across multiple facilities make it economical? e.g. IR Camera

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