Methane to Markets

Processing Best Practices

Technology Transfer Workshop

PEMEX &
Environmental Protection Agency, USA

April 25, 2006
Villahermosa, Mexico

Methane to Markets

Processor Opportunities: Agenda

- Mexico Industry Emissions
- Processing Best Management Practices (BMPs)
- Selected Methane Saving Opportunities
  - Pipe Glycol Dehydrator to Vapor Recovery Unit
  - Acid Gas Removal
  - Convert Gas-Driven Chemical Pumps to Instrument Air
- Project Summaries for Mexico
- Discussion Questions

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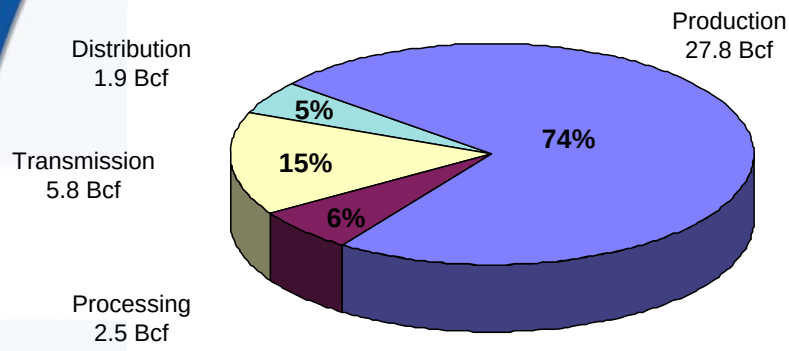
Mexico Oil and Gas Industry Methane Emissions in 2000



Sources: *US Natural Gas STAR program success points to global opportunities to cut methane emissions cost-effectively*, Oil and Gas Journal, July 12, 2004

Bcf = billion cubic feet

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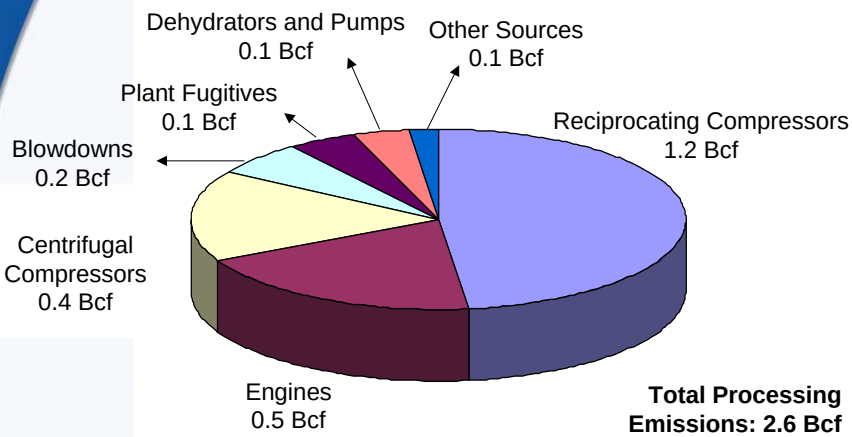
Mexico Processing Sector Methane Emissions (2000)



Total Processing Emissions: 2.6 Bcf

Sources: *US Natural Gas STAR program success points to global opportunities to cut methane emissions cost-effectively*, Oil and Gas Journal, July 12, 2004
Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004

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Best Management Practices (BMPs)

- Convert Gas Pneumatic Controls to Instrument Air
  - Gas pneumatic controls bleed methane to the atmosphere
- Install Flash Tank Separators in Glycol Dehydrators
  - Glycol regeneration vents methane
- Directed Inspection & Maintenance (DI&M) at Gas Processing Plants and Booster Stations
  - Equipment leaks cause methane emissions

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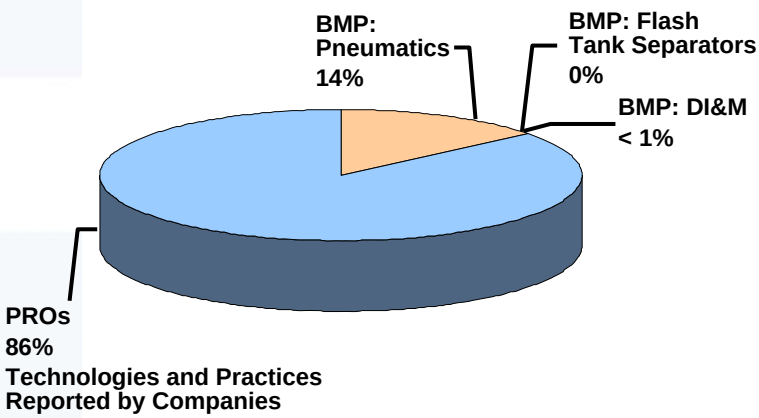
Processor BMPs

- 86% of the processing sector reductions came from PROs



Technologies and Practices Reported by Companies

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Recommended Technologies and Practices

- Additional valuable information
  - Facilitate technology transfer
  - One page
  - Easy to review
- 29 Partner Reported Opportunities (PROs) apply to Processing sector
  - 17 focused on operating practices
  - 12 focused on technologies
- PRO Fact Sheets are derived from Annual Reports 1994-2003
  - Total 63 posted PRO Fact Sheets at epa.gov/gasstar/pro/index.htm

Overview of Recommended Technologies and Practices

- Sample of Processing PROs
  - Acid Gas Removal
  - Begin DI&M at Remote Facilities
  - Convert Gas-Driven Chemical Pumps to Instrument Air
  - Eliminate Unnecessary Equipment and/or Systems
  - Install Electric Starters
  - Pipe Glycol Dehydrator to Vapor Recovery Unit
  - Recycle Line Recovers Gas During Condensate Loading
  - Replace Ignition – Reduce False Starts
  - Use Inert Gases & Pigs to Perform Pipeline Purges
  - Use of Composite Wrap Repair

Operating Practice PROs

- Pipe glycol dehydrator to vapor recovery unit
- Rerouting of glycol skimmer gas
- Eliminate unnecessary equipment and/or systems
- Inspect and repair compressor station blowdown valves
- Begin DI&M at remote facilities

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Pipe Glycol Dehydrator to Vapor Recovery Unit

- What is the problem?
  - Glycol dehydrators use gas assist pumps, which vent methane to the atmosphere
- Partner solution
  - Pipe vented methane to Vapor Recovery Unit (VRU)
- Methane savings
  - Based on a 10 million cubic feet per day dehydrator
- Applicability
  - No limitations when the VRU discharges to a sales line or compressor suction

Methane Savings

3,300 Mcf per year

Mcf = Thousand cubic feet

Project Economics

Project Cost	$1,000 - $10,000
Annual O&M Costs	>$1,000
Payback	0-1 years

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Pipe Glycol Dehydrator to Vapor Recovery Unit

- Other Benefits
  - Piping glycol dehydrator vent to VRU not only reduces methane but also volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) vented from the reboiler
  - Quick payback and low capital cost of piping
  - At 7.5 cents per kilowatt hour, electrical power cost would be about $340 per million cubic feet (MMcf) per year of gas recovered

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Technology PROs

- Acid gas removal
- Install pressurized storage of condensate
- Use ultrasound to identify leaks
- Recycle line recovers gas during condensate loading
- Convert gas-driven chemical pumps to instrument air

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Acid Gas Removal

- What is the problem?
  - Diethanol amine (DEA) units absorb CO_2 and H_2S which are corrosive to pipelines, compressors, and other equipment
- Partner solution
  - Several options with one being to install a Kvaerner membrane where CO_2 is separated from methane
- Methane Savings
  - Based on emissions saved from average amine unit in the U.S.
- Applicability
  - Can replace any DEA unit but contaminants from feed line must be removed

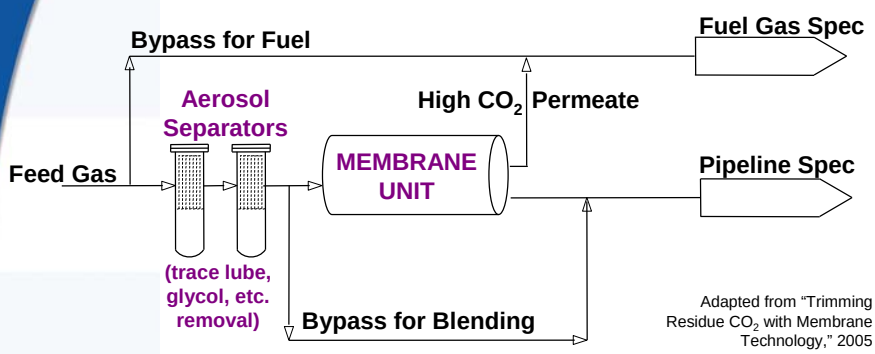
Methane Savings

6 Mcf per day

Project Economics

Project Cost	>$10,000
Annual O&M Costs	>$10,000
Payback	3-10 years

Acid Gas Removal (Kvaerner Process)



Adapted from "Trimming Residue CO_2 with Membrane Technology," 2005

Acid Gas Removal

- Duke Energy Experience
  - Kvaerner process installed at Mewborn processing plant in Colorado, 2003
  - Membrane chosen for other advantages; zero emissions is added benefit
    - 65% less capital cost than amine unit
    - <10% less operating cost
    - <10% less operator man hours
    - 1/3 footprint of amine unit
    - Less process upsets
    - Less noise
    - Less additional infrastructure construction
  - Costs
    - Conventional DEA Acid Gas removal would cost $4.5 to $5 million capital, $0.5 million in operating and maintenance (O&M)
    - Kvaerner Membrane process cost $1.5 to $1.7 million capital, $0.02 to $0.05 million O&M

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Convert Gas-Driven Chemical Pumps to Instrument Air

- What is the problem?
  - As part of normal operations, pneumatic devices release natural gas into the atmosphere (more than 6 cubic feet per hour)
- Partner solution
  - Replace High-bleed devices with devices that run on instrument air
- Methane Savings
  - Based on average savings from converting devices from one facility to instrument air
- Applicability
  - Must install compressors, power source, dehydrators and volume tanks to convert to instrument air

Methane Savings

20,000 Mcf/year

Project Economics

Project Cost	>$10,000
Annual O&M Costs	>$10,000
Payback	0-1 years

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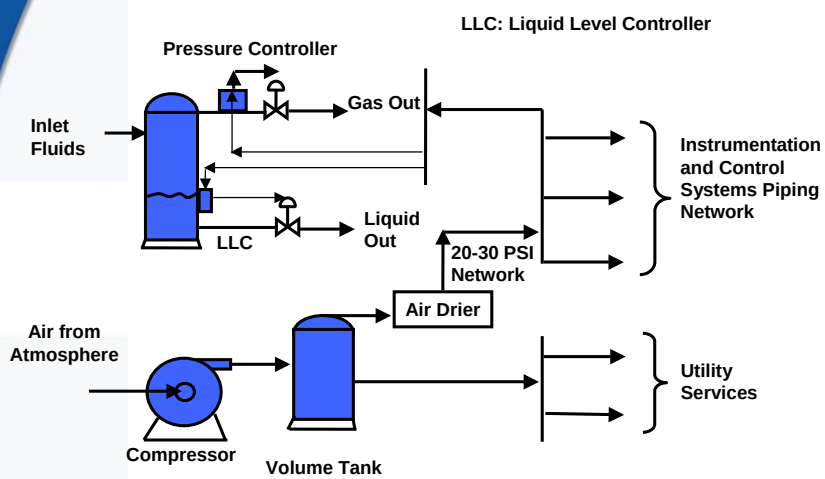
Convert Gas-Driven Chemical Pumps to Instrument Air - Schematic



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Convert Gas-Driven Chemical Pumps to Instrument Air

- Installed compressed air system to drive pneumatic devices in ten South Louisiana, U.S. facilities
- Project Cost = $40,000
- Emissions Reductions = 23,000 Mcf/year
- Savings = $161,000 / year
- Payback Period ~ 3 months

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New PROs

- Broad dissemination of PROs is key to program success and effective peer-based technology transfer
  - Zero Emission Dehydrators
  - Recover Gas from Pipeline Pigging Operations
  - Nitrogen Rejection Unit Optimization

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Project Summary for Mexico

- Pipe Glycol Dehydrator to Vapor Recovery Unit

Project Description: Pipe methane from 10 MMcf per day dehydrator to Vapor recovery unit	
Methane Saved:	$3,300 Mcf per year (93 thousand cubic meters per year)
Sales Value:	$17,300 ($5.25 per Mcf gas)
Capital and Installation Cost:	($1,000)
Operating and Maintenance Cost:	($0) Negligible
Payback Period:	Less than 1 month
Additional Carbon Market Value:	$40,000 ($30 per tonne of CO_2e)

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Project Summary for Mexico

- Acid Gas Removal

Project Description: Replace DEA unit with Kvaerner membrane unit

Methane Saved:	2,190 Mcf per year (62 thousand cubic meters per year)
Sales Value:	$11,500 ($5.25 per Mcf gas)
Capital and Installation Cost[1]:	($1,700,000)
Operating and Maintenance Cost[2]:	($13,000)
Payback Period:	4 years

Additional Carbon Market Value:	$26,500 ($30 per tonne of CO_2e)

1 - A $3,300,000 cost savings over typical DEA unit
2 - A $450,000 operating cost savings over typical DEA unit

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Project Summary for Mexico

- Convert Gas-Driven Chemical Pumps to Instrument Air

Project Description: Converting high-bleed pneumatic devices at one facility to instrument air

Methane Saved:	20,000 Mcf per year (565 thousand cubic meters per year)
Sales Value:	$105,000 ($5.25 per Mcf gas)
Capital and Installation Cost:	($45,750)
Operating and Maintenance Cost:	($4250)
Payback Period:	6 months

Additional Carbon Market Value:	$240,000 ($30 per tonne of CO_2e)

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Methane to Markets

Discussion Questions

- To what extent are you implementing any of these PROs?
- What are the barriers (technological, economic, lack of information, regulatory, etc.) that are preventing you from implementing any of these technologies?

Reference: Unit Conversions

1 cubic foot =	0.02832 cubic meters
Degrees Fahrenheit =	(°F – 32) * 5/9 degrees Celsius
1 inch =	2.54 centimeters
1 mile =	1.6 kilometers
14.7 pounds per square foot =	1 atmosphere

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