**Natural Gas STAR Program**

Innovative Technologies for the Oil & Gas Industry: Product Capture, Process Optimization, and Pollution Prevention

Producers and Processors Technology Transfer Workshop

New Mexico Oil and Gas Association and EPA's Natural Gas STAR Program

Farmington, NM

February 21, 2006

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**Agenda**

- Background – U.S. Methane Emissions
- Methane Emissions in the U.S. Oil and Gas Industry
- Gas STAR Program Overview & Accomplishments
- Opportunities for Maximizing Efficiency and Profits Through Methane Reduction Projects
- Gas STAR Program Resources
The “So What” – Why are we here?

- Reducing methane emissions from the U.S. oil and gas industry has cross-cutting impacts
  - Addressing environmental and global warming concerns
  - Potential for increased profits and operational efficiency in the oil & gas sector
  - Increasing domestic natural gas supply

U.S. Greenhouse Gas Emissions – All Sources

- CO₂: 85%
- CH₄: 8%
- N₂O: 5%
- HFCs, PCs, & SF₆: 2%

*Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2003, USEPA, April, 2005*
U.S. Methane Emissions

- Landfills: 24%
- Oil & Natural Gas Systems: 26%
- Coal Mining: 10%
- Enteric Fermentation: 21%
- Other: 19%

Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2003, USEPA, April, 2005

U.S. Oil & Natural Gas Industry

- Methane losses from the U.S. oil & natural gas industry total 355 Bcf
- Accounts for 2% of total U.S. greenhouse gas emissions

U.S. Oil & Natural Gas Opportunities

- 355 Bcf of methane emissions per year amounts to
  - $3.55B in lost revenue at $10/Mcf natural gas
  - Global warming equivalent of putting over 31 million additional cars on the road in the U.S.
  - Gas supply capable of heating over 5 million U.S. households for a year
- U.S. oil and gas industry has an opportunity to cost effectively reduce these impacts

Natural Gas STAR Program

The Natural Gas STAR Program is a flexible, voluntary partnership between EPA and the oil and natural gas industry designed to cost-effectively reduce methane emissions from natural gas operations.
Gas STAR Partners & Endorsers

- 110 Program Partners across all four sectors
  - Recommended technologies and practices come directly from partner companies and industry experts
- 17 endorser associations, including
  - American Petroleum Institute (API)
  - Domestic Petroleum Council (DPC)
  - Gas Processors Association (GPA)
  - Independent Producers Association of Mountain States (IPAMS)
  - Interstate Oil & Gas Compact Commission (IOGCC)
  - Southern Gas Association
  - Colorado Oil & Gas Association (COGA)
  - Petroleum Association of Wyoming (PAW)
  - Petroleum Technology Transfer Council (PTTC)
  - Independent Producer’s Association of America (IPAA)

Natural Gas STAR Partner Accomplishments

- Natural Gas STAR Partners have reduced methane emissions by 403 Bcf
- Methane emissions from U.S. oil and gas sector below 1990 levels
Oil & Gas Methane Emissions Without Gas STAR Program (2003)

- **Production**
  - Emissions: 148 Bcf
  - Reductions: 24 Bcf

- **Transmission / Storage**
  - Emissions: 101 Bcf
  - Reductions: 18 Bcf

- **Distribution**
  - Emissions: 68 Bcf
  - Reductions: 7 Bcf

- **Processing**
  - Emissions: 36 Bcf
  - Reductions: 1 Bcf

- **Oil Downstream**
  - Emissions: 2 Bcf

Methane Emission Reduction Opportunities

- Partners have reported over 80 technologies and practices for achieving cost effective methane emission reductions

<table>
<thead>
<tr>
<th>Best Practices - Production</th>
<th>Best Practices - Processing</th>
</tr>
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<tbody>
<tr>
<td>Perform reduced emission completions</td>
<td>Conduct helicopter leak surveys</td>
</tr>
<tr>
<td>Install vapor recovery units</td>
<td>Conduct infrared leak surveys</td>
</tr>
<tr>
<td>Install plunger lifts</td>
<td>Replace glycol dehydration units with methanol injection</td>
</tr>
<tr>
<td>Install instrument air systems</td>
<td>Install electric compressors</td>
</tr>
<tr>
<td>Eliminate unnecessary equipment and/or systems</td>
<td>Use hot taps for in-service pipeline connections</td>
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<tr>
<td>Install electric compressors</td>
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Maximizing Efficiency of Glycol Dehydrators

- Triethylene Glycol is the common technology for removing moisture from produced natural gas
- Glycol also absorbs methane, VOCs and HAPs
- Glycol reboilers vent absorbed water, methane, VOCs, HAPs to the atmosphere
  - Wastes gas, costs money, reduces air quality
- Levels of glycol circulated are often 2-3 times higher than needed
  - Results in higher methane emissions and fuel use
- On average, 600 Mcf methane per glycol dehydrator is emitted each year

Emission Reduction Options

- Install flash tank separator (FTS)
  - Recovers all methane bypassed and most methane absorbed by glycol
- Optimize glycol circulation rate
  - Methane emissions are directly proportional to glycol circulation rate
Is Recovery Profitable?

Two Options for Minimizing Glycol Dehydrator Emissions

<table>
<thead>
<tr>
<th>Option</th>
<th>Capital Costs</th>
<th>Annual O&amp;M Costs</th>
<th>Emissions Savings</th>
<th>Payback Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimize Circulation Rate</td>
<td>Negligible</td>
<td>Negligible</td>
<td>130 – 1,133 Mcf/year</td>
<td>Immediate</td>
</tr>
<tr>
<td>Install FTS</td>
<td>$5,000 - $10,000</td>
<td>Negligible</td>
<td>236 – 7,098 Mcf/year</td>
<td>1 month – 4 years</td>
</tr>
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Partner Experience

- Texaco (now Chevron) has installed FTS on dehydrators in Southern Texas and Louisiana
  - Recovers 98% of methane from the glycol
  - Reduced emissions from 1,232 - 1,706 Mcf/year to <47 Mcf/year
- One partner routes glycol gas from FTS to fuel gas system, saving 24 Mcf/day (8,760 Mcf/year) at each dehydrator unit

More information available in the “Optimize Glycol Circulation and Install of Flash Tank Separators in Dehydrators” Lessons Learned document at www.epa.gov/gasstar/
Methane Losses from Storage Tank Venting

- Flash losses occur when crude is transferred from a gas-oil separator at higher pressure to an atmospheric pressure storage tank.
- Working losses - occur when crude levels change and when crude in tank is agitated.
- Standing losses - occur with daily and seasonal temperature and pressure changes.

Maximizing Efficiency Through Use of Vapor Recovery Units (VRU’s)

- Capture up to 95% of hydrocarbon vapors vented from tanks.
- Recovered vapors have higher Btu content than pipeline quality natural gas.
- Recovered vapors are more valuable than natural gas and have multiple uses:
  - Re-inject into sales pipeline
  - Use as on-site fuel
  - Send to processing plants for recovering NGLs.
Types of Vapor Recovery Units

- Conventional vapor recovery units (VRUs)
  - Use rotary compressor to suck vapors out of atmospheric pressure storage tanks
  - Require electrical power or engine
- Venturi ejector vapor recovery units (EVRU™) or Vapor Jet
  - Use Venturi jet ejectors in place of rotary compressors
  - Do not contain any moving parts
  - EVRU™ requires source of high pressure gas and intermediate pressure system
  - Vapor Jet requires high pressure water motive

Industry Experience: Chevron

- Chevron installed eight conventional VRUs at crude oil stock tanks in 1996
- At today’s gas prices, economics are very attractive

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<th>Project Economics – Chevron</th>
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<tr>
<td>Methane Loss Reduction (Mcf/unit/year)</td>
<td>Approximate Savings per Unit</td>
</tr>
<tr>
<td>21,900</td>
<td>$219,000</td>
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*Assumes a $10 per Mcf gas price; excludes value of recovered natural gas liquids. Refer to the Gas STAR Lessons Learned for more information.
Lessons Learned

- Vapor recovery can yield generous returns when there are market outlets for recovered gas
  - Recovered high heat content gas has extra value
  - VRU technology can be highly cost-effective in most general applications
  - Venturi jet models work well in certain niche applications, with reduced operating and maintenance costs
- Potential for reduced compliance costs can be considered when evaluating economics of VRU, EVRU™, or Vapor Jet

More information available in the “Installing Vapor Recovery Units on Crude Oil Storage Tanks” Lessons Learned document at www.epa.gov/gasstar/

Program Resources

- Guidance on recommended practices & technologies
  - Detailed implementation guides, including partner case studies
  - Economic analysis tools
  - Communication tools
- Available on www.epa.gov/gasstar
- Technology Transfer workshops
  - Free and open to the public
- Annual record of Partner methane savings
- One-on-one technical assistance
Workshops

- Technology Transfer Workshops (5 to 6 per year)
  - Producers and Processors Technology Transfer Workshop
    February 21, 2006
    Farmington, New Mexico, San Juan College
  - Producers and Processors Technology Transfer Workshop
    Sponsored by Western Gas Resources & Petroleum Association of WY
    May 9, 2006,
    Gillette, Wyoming
  - Producers and Processors Technology Transfer Workshop
    Sponsored by Western Gas Resources & Petroleum Association of WY
    May 11, 2006
    Rock Springs, Wyoming
  - Producers and Processors Technology Transfer Workshop
    Sponsored by ConocoPhillips
    May 25, 2006
    Alaska

White House “Methane to Markets” Initiative

- Five year activity to develop verifiable methane emissions reduction projects at landfills, coal mines and natural gas systems.
- Goal is to build long-term capacity within developing countries and economies in transition.
- Countries include: Argentina, Australia, Brazil, China, Colombia, India, Italy, Japan, Mexico, Nigeria, Russia, Ukraine and UK.
- Gas STAR will lead natural gas system-related activities, including upcoming launch of international program
- www.methanetomarkets.org
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