Cost-Effective Methane Emissions Reductions for Small and Midsize Natural Gas Producers

Annual Implementation Workshop
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Houston, Texas
Agenda

- U.S. Natural Gas Production Sector
- Cost-Effective Methane Emissions Reduction Options
- Calculating Economics
- Conclusions
U.S. Natural Gas Production Sector

- Independent producers drill 85% of new gas wells
- 80% of these companies have fewer than 20 employees
- Natural gas prices have hit record highs
- Gas losses are becoming more attractive to recover considering potential benefits
- While most small and midsize producers are not Gas STAR Partners, they regularly attend workshops and report applying Best Management Practices (BMPs)
Emissions from production sector are ~150 Bcf/year.

- Pneumatic Devices: 61 Bcf
- Dehydrators and Pumps: 17 Bcf
- Gas Engine Exhaust: 12 Bcf
- Meters and Pipeline Leaks: 10 Bcf
- Storage Tank Venting: 9 Bcf
- Other Sources: 21 Bcf
- Well Venting and Flaring: 18 Bcf
- Other Sources: 21 Bcf

Bcf = Billion cubic feet

## Cost-Effective Methane Emissions Reduction Options

<table>
<thead>
<tr>
<th>Technologies &amp; Practices</th>
<th>Equipment Cost</th>
<th>O&amp;M Cost $/yr</th>
<th>Saleable Gas Savings Mcf/d</th>
<th>Operating requirements</th>
<th>Basis for Cost &amp; Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing Vapor Recovery Unit on Crude Oil Storage Tanks</td>
<td>$26,500</td>
<td>$5,000</td>
<td>12</td>
<td>Electrical power supply for VRU compressor</td>
<td>Installing one 25 Mcfd VRU on crude oil or condensate storage tank(s)</td>
</tr>
<tr>
<td>Connect Casing to VRU</td>
<td>$1,000</td>
<td>$3,400</td>
<td>27</td>
<td>Pressure Regulators may be required</td>
<td>Connecting one casing to an existing stock tank with VRU, O&amp;M cost is incremental electricity</td>
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<tr>
<td>Pipe Glycol Dehydrator Vapor to VRU</td>
<td>$1,000</td>
<td>$3,000</td>
<td>9</td>
<td>Existing VRU with excess capacity</td>
<td>Dehydrator throughput = 20 MMcfd Operating cost is incremental electricity</td>
</tr>
<tr>
<td>Aerial Optical Leak Imaging</td>
<td>N/A</td>
<td>$450/hr travel plus $65/mile</td>
<td>2,000</td>
<td>Operating location ≤5 hours helicopter travel time from service provider base</td>
<td>Surveillance of 500 miles of flowlines, identifying leaks totalling 2% of 100 Mcf/d production</td>
</tr>
<tr>
<td>Begin DI&amp;M at remote facilities</td>
<td>N/A</td>
<td>$1 per component screened</td>
<td>1</td>
<td>Soap solution and/or Gas Detector</td>
<td>Screening 200 components, repair leaks in one open-ended blowdown valve and one control valve stem seal</td>
</tr>
</tbody>
</table>

Cost-Effective Methane Emissions Reduction Options

★ Options for small to midsize producers range from fixing fugitives to installation of new technologies

★ With high gas prices, more options are becoming economically attractive for producers

★ Two examples of technologies that have great potential to increase profits:
  - Vapor recovery units
  - Aerial optical leak imaging
Vapor Recovery Units (VRUs)

☆ Capture up to 95% of hydrocarbon vapors vented from oil storage 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
Characteristics of VRUs

☆ Conventional vapor recovery units
  ◆ Use rotary compressor to suck vapors out of atmospheric pressure storage tanks
  ◆ Require electrical power or engine

☆ Gas savings can range up to 12 Mcf/d for a 25 Mcf/d size unit

☆ Other methane reduction options can be implemented as a result of installing a VRU:
  ◆ Connecting a casinghead vent to a VRU instead of venting to the atmosphere can further reduce emissions
  ◆ Piping a glycol dehydrator regenerator vent stack and pneumatic devices to an oil tank equipped with a VRU can further reduce emissions
Vapor Recovery Unit Calculation

★ Goal: Install 50 Mcf/d VRU unit on crude oil tanks

★ Basis for cost and savings:
  ◆ Basis size: 25 Mcfd VRU
  ◆ Equipment cost = $26,500
  ◆ O&M cost = $5,000
  ◆ Gas savings = 12.0 Mcf/d

★ Scaleable calculation:
  ◆ Calculation 1
    ▪ Equipment cost = square root \((\text{your size} \div \text{basis size}) \times \text{basis cost}\)
    ▪ \(= \sqrt{(50 \text{ Mcf/d} \div 25 \text{ Mcf/d}) \times ($26,500)}\)
    ▪ \(\approx $37,100\)
  ◆ Calculation 2
    ▪ Your O&M cost = \((\text{your size} \div \text{basis size}) \times \text{basis O&M cost}\)
    ▪ \(= (50 \text{ Mcf/d} \div 25 \text{ Mcf/d}) \times ($5,000)\)
    ▪ \(= $10,000\)
Vapor Recovery Unit Calculation

★ Scaleable calculation continued:

◆ Calculation 3
  ▪ Your gas savings = (your size ÷ basis size) * basis gas savings
  ▪ = (50 Mcf/d ÷ 25 Mcf/d) * 12.0 Mcf/d * 365 days
  ▪ = 2 * 12 * 365
  ▪ = 8,760 Mcf/yr

◆ Calculation 4
  ▪ Payback = Equipment cost ÷ ((Annual gas savings * Price of gas) - 1 year O&M)
  ▪ = $37,100 ÷ ((8,760 Mcf/yr * $5/Mcf) - $10,000)
  ▪ ≈ 1.1 years (13 months)
Aerial Optical Leak Imaging

★ Real-time visual image of gas leaks
  ◆ Quicker identification & repair of leaks
  ◆ Screen hundreds of components an hour
  ◆ Screen inaccessible areas simply by viewing them
★ Gas savings can range up to 2,000 Mcf/d depending on the size of the area surveyed
★ Other methane reduction practices can be used in conjunction with Aerial Optical Leak Imaging:
  ◆ Directed Inspection & Maintenance (DI&M) at remote facilities
  ◆ DI&M at compressor stations
Aerial Optical Leak Imaging
Calculation

★ Goal: Inspect ~200 miles of gas flowlines for leaks
★ Basis for cost and savings
  ◆ Basis size: inspect 500 miles of flowlines
  ◆ Equipment cost = N/A (leased service)
  ◆ O&M cost = $450/hr travel to/from helicopter base plus $65/mile
  ◆ Gas savings = 2,000 Mcf/d
★ Directly proportional calculation:
  ◆ Calculation 1
    ▪ Equipment cost = N/A
  ◆ Calculation 2
    ▪ Assume ~5 hours helicopter travel to/from pipeline and surveillance of ~200 miles of flowlines
    ▪ Your O&M cost = (Helicopter cost * hours to/from base) +
       (Surveillance cost * miles traveled)
    ▪ = ($450/hr * 5 hr) + ($65/mile * 200 miles)
    ▪ = $15,250
Aerial Optical Leak Imaging Calculation

Directly proportional calculation continued:

- **Calculation 3**
  - Your gas savings = (your size ÷ basis size) * basis gas savings
  - = (200 miles ÷ 500 miles) * 2,000 Mcf/d * 365 days/year
  - = ~290,000 Mcf/yr

- **Calculation 4**
  - Revenue = Your gas savings * cost of gas
  - = 290,000 Mcf/yr * $5/Mcf
  - = $1,450,000 per year

- Revenue up to $1,450,000 per year provides an ample payback of the $15,250 cost to find leaks and cost to repair those leaks
  - Partners have reported finding flow line leaks over 10% of the product flow using aerial optical leak imaging
Conclusions

★ Each volume of gas not vented or leaked to the atmosphere is a volume of gas sold.

★ With increasing natural gas demand and high prices, emissions reductions will result in increased sales and greater revenue.

★ New technologies can also lower operating costs.

★ VRUs and Aerial Optical Leak Imaging are only two of twenty-five technologies identified for small and midsize producers.
Discussion Questions

★ To what extent are you implementing these technologies?

★ How can the Gas STAR technical documents be improved upon or altered for use in your operation(s)?

★ What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing this technology?