Producer Best Practices and Opportunities

Lessons Learned from Natural Gas STAR

Occidental Petroleum Corporation and
California Independent Petroleum Association

Producers Technology Transfer Workshop
Long Beach, California
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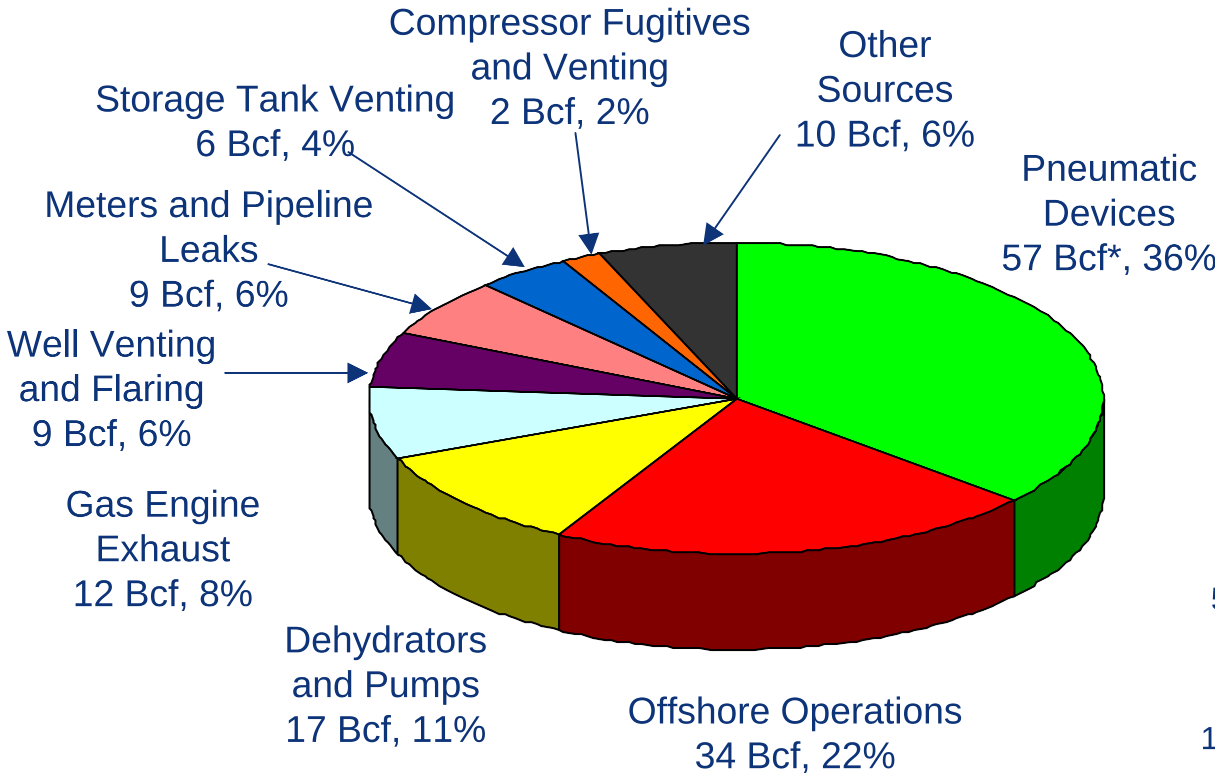
epa.gov/gasstar

Producer Opportunities: Agenda

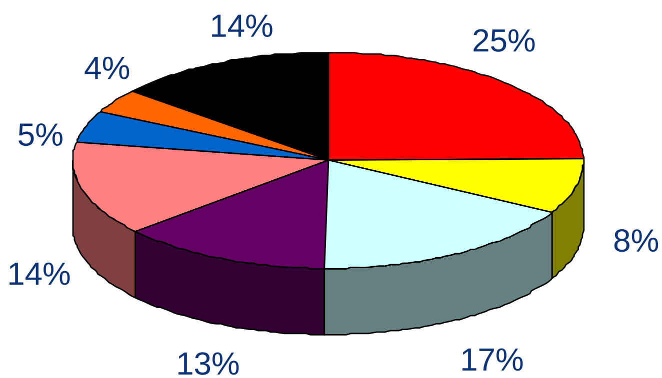
- Industry Emissions
- Recommended Technologies and Practices
- Selected Methane Saving Opportunities
  - Replace ignition/reduce false starts
  - Install electric compressors
  - Electronic pilots on flares
  - Dehydrators
    - Optimized glycol circulation rates
    - Reroute glycol skimmer gas
- Discussion

Methane Emissions from Natural Gas Production Sector (2005)



South Coast Air Quality Management District

Emission Profile



*Bcf = billion cubic feet

EPA. *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2005.* April, 2007. Available on the web at: http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissions.html
Natural Gas STAR reductions data shown as published in the inventory.

Methane Losses from Compressor False Starts

- Gas vented from depressuring the discharge header
- Gas-expansion starter motor vents gas to the atmosphere
- An ignition system in poor condition may not start promptly, or stall when the compressor is loaded
- Each engine false start results in excessive methane emissions from repeating the start-up cycle

Reduce False Starts with Electronic Ignition

- Replacing old ignition systems with a newer electronic system
  - Eliminates methane emissions from repeated false starts
  - Significantly reduces operating costs
- Electronic systems only require a small amount of electricity
  - Solar recharge battery
  - On-site power grid

Methane Recovery

- Engine starting on a reciprocating compressor
  - Gas pneumatic starters require 0.5 standard cubic feet (scf) per horsepower of natural gas stored at 250 to 350 pounds per square inch, gauge (psig)
  - One Partner reported reducing false starts from 150 to 10 per unit by replacing the ignition system, saving 1,150 scf of methane per start
- Replacing the ignition system on one 3,000 horsepower engine saves about 1,200 scf methane[1] per year
  - Based on reducing startup attempts from 15 to 1 per year
  - Payback of less than one year

Source: www.waukeshaengine.com

1 – Assuming the methane content of produced natural gas is 78.8% methane

Methane Losses from Compressor Engine Drivers

- Gas-fired engines are often used to run compressors, generators, and pumps
- Normally, a portion of the produced gas stream is used as fuel for the engines
- Methane emissions result from:
  - Leaks in the gas supply line to the engine
  - Incomplete combustion
  - System upsets (requiring compressor blowdowns)

Installing Electric Compressors

- Partners reported decreasing gas losses by installing electric motors in place of the gas-fired units
- Electric motors reduce the chance of methane leakage by:
  - Eliminating the need for fuel gas
  - Requiring less maintenance
  - Improving operational efficiency
- An electric power supply is needed
  - Remote facilities with electric power and high compressor maintenance may be good candidates for this technology

Methane Recovery

- Partners have reported methane savings ranging from 40 thousand cubic feet Mcf to 16,000 Mcf per year from installing electric compressors
- Replacing one 3,000 horsepower reciprocating engine saves about 6,300 Mcf per year
  - Methane emission factor of 2.11 Mcf per year per horsepower[1]
  - Capital and energy costs are higher for an electric motor compared to a gas driven engine
  - Electric motors increase operational efficiency and reduce maintenance costs
  - Savings on maintenance relative to cost of energy will not be justify replacement unless the engine is at the end of its economic life

1 – "Install Electric Compressors" Available at http://www.epa.gov/gasstar/pdf/pro_pdfs_eng/installelectriccompressors.pdf

Methane Losses from Flares

- Flares are used to safely dispose of combustible gas released in large quantities during emergencies
- Gas pilots can be blown out by wind causing fuel gas and/or waste gas to vent from an unlit flare
- Both situations result in excessive emissions
  - Methane
  - Volatile Organic Compounds (VOC)
  - Hazardous air pollutants (HAP)

Install Electronic Flare Ignition Devices

- Replaces the intermittently or continuously burning flare pilots with electrical sparking pilots
- Sparking pilots require low electrical power
  - Solar recharge battery in remote sites
  - Low voltage commercial power
- Facilities can also install sensors to detect the pilot flame and shut off the fuel gas if the pilot is extinguished

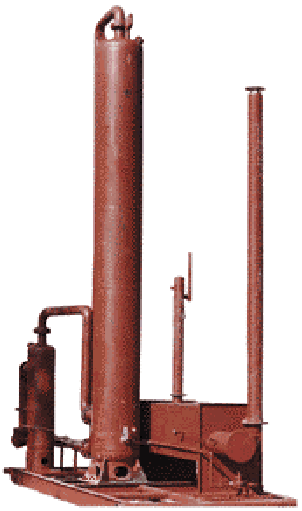
Source: www.gba-corona.com

Methane Recovery

- An extinguished flare pilot can release 70 scf per hour per pilot of methane to the atmosphere until it is relit or shut off
- One flare pilot that is blown out for 24 hours can release almost 2 Mcf of methane
- Installing an electronic flare pilot can payback in less than 3 years
  - Primary economic justification is the savings of natural gas burned in the flare pilots
  - Associated benefit is a reduction in VOC and HAP emissions

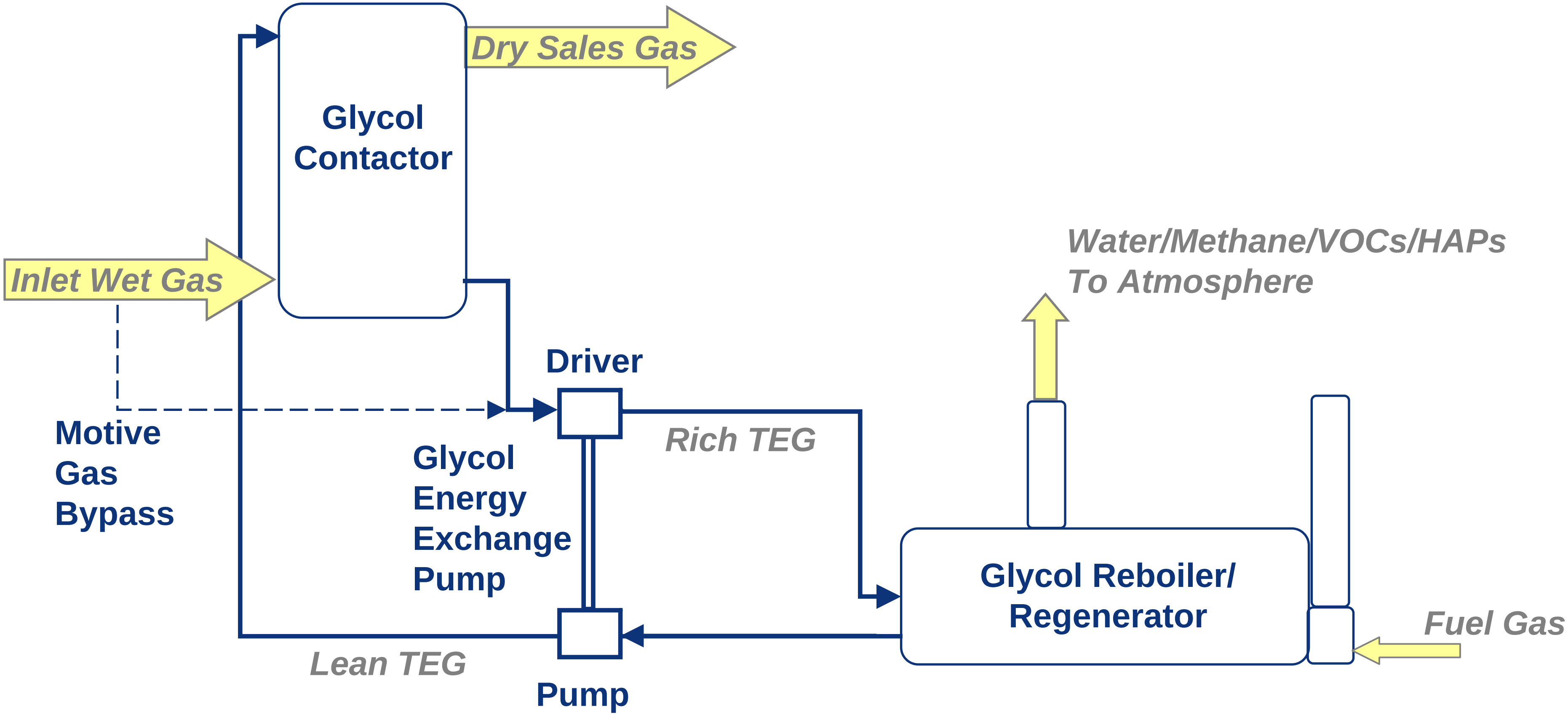
Dehydrators: What is the Problem?

- Produced gas is saturated with water, which must be removed for gas transmission
- Glycol dehydrators are the most common equipment to remove water from gas
  - 36,000 dehydration units in natural gas production, gathering, and boosting
  - Most use triethylene glycol (TEG)
- Glycol dehydrators create emissions
  - Methane, VOCs, HAPs from reboiler vent
  - Methane from pneumatic controllers



Source: www.prideofthehill.com

Basic Glycol Dehydrator System Process Diagram



Methane Recovery: Two Options

- For dehydrators with electric motor pumps, flash tank separators and vent condensers
  - Optimized glycol circulation rates
  - Reroute glycol skimmer gas

Glycol Dehydrator Unit
Source: GasTech

Optimizing Glycol Circulation Rate

- Gas pressure and flow at gathering/booster stations vary over time
  - Glycol circulation rates are often set at a maximum circulation rate
- Glycol overcirculation results in more methane emissions without significant reduction in gas moisture content
  - Partners found circulation rates two to three times higher than necessary
  - Methane emissions are directly proportional to circulation
- Lessons Learned study: optimize circulation rates

Methane Losses from Glycol Skimmer Gas

- Rich glycol is circulated through a regenerator where the dissolved water, methane, VOCs, and HAPs are vaporized and vented to the atmosphere
- Still condensers and condensate separators recover natural gas liquids and reduce VOC and HAP emissions
- Non-condensable gas from the condensate separator (mostly methane) is vented to the atmosphere

Reroute Glycol Skimmer Gas

- Partner reported rerouting the condensate separator gas (skimmer gas) to:
  - Reboiler firebox
  - Other low pressure fuel gas systems
- Reduces methane emissions
- Further reduces VOC and HAP emissions
- Increases product revenue
- Condensate separator must operate a higher pressure than the destination for skimmer gas combustion

Methane Recovery

- Rerouting glycol skimmer gas can save 250 Mcf per year of methane
  - 20 MMcf per day dehydrator
  - Vent condenser with flash tank
  - Circulating 300 gallons of glycol per hour w/ electric pump
  - Gas entrainment of 1 scf per gallon of glycol
  - Still gas contains 95% methane

Is Recovery Profitable?

Two Options for Minimizing Glycol Dehydrator Emissions

Option	Capital Costs	Annual O&M Costs	Emissions Savings	Payback Period[1]
Optimize Circulation Rate	Negligible	Negligible	394 to 39,420 Mcf/year	Immediate
Reroute Glycol Skimmer Gas	$1,000	$100 to $1,000	250 Mcf/year	10 months

1 – Gas price of $7/Mcf

Discussion

- Industry experience applying these technologies and practices
- Limitations on application of these technologies an practices
- Actual costs and benefits