Best Operating Practices for Reducing Emissions

From Natural Gas STAR Partners

EPA's Natural Gas STAR Program,

Pioneer Natural Resources USA, Inc., and

The Gas Processors Association

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Why Are Company Reported Opportunities Important?

- Many processing facilities have identified practical cost effective methane emissions practices
- Processing partners have reported saving 1.6 Bcf since 1990, 100% from PRO's

Why Are Company Reported Opportunities Important?

- Partners share successes to reduce methane emissions and improve profitability
  - *BMP's*: the consensus best practices
  - *PRO's*: Partner Reported Opportunities
  - *Lessons Learned:* expansion on the most advantageous BMP's and PRO's
  - All posted on the Gas STAR website: *http://www.epa.gov/gasstar*

Gathering & Processing Best Management Practices

- BMP 1: Replace Gas Pneumatics with Instrument Air Systems
- BMP 2: Install Flash Tank Separators on Glycol Dehydrators
- BMP 3: Implement Directed Inspection & Maintenance at Gas Plants and Booster Stations
- BMP 4: Partner Reported Opportunities (PRO's)

Gas STAR PRO Fact Sheets

- PRO Fact Sheets from Annual Reports 1994-2002
  - 54 posted PRO fact sheets
  - 26 PRO's applicable to Gathering & Processing
    - 16 focused on operating practices
    - 10 focused on technology
  - Several new PRO sheets under development

Lessons Learned

- 14 Lessons Learned on website
- 8 applicable to processing
  - 3 focused on operating practices
  - 5 focused on technology
- New Lessons Learned under development
  - Composite Wrap

Operating Practice Lessons Learned

- Directed Inspection & Maintenance at Compressor Stations
- Reducing Emissions when Taking Compressors Off-line
- Reduce Glycol Circulation Rates on Dehydrators

One of the Best of the Best!

- BMP 3: Implement Directed Inspection & Maintenance at Gas Plants and Booster Stations

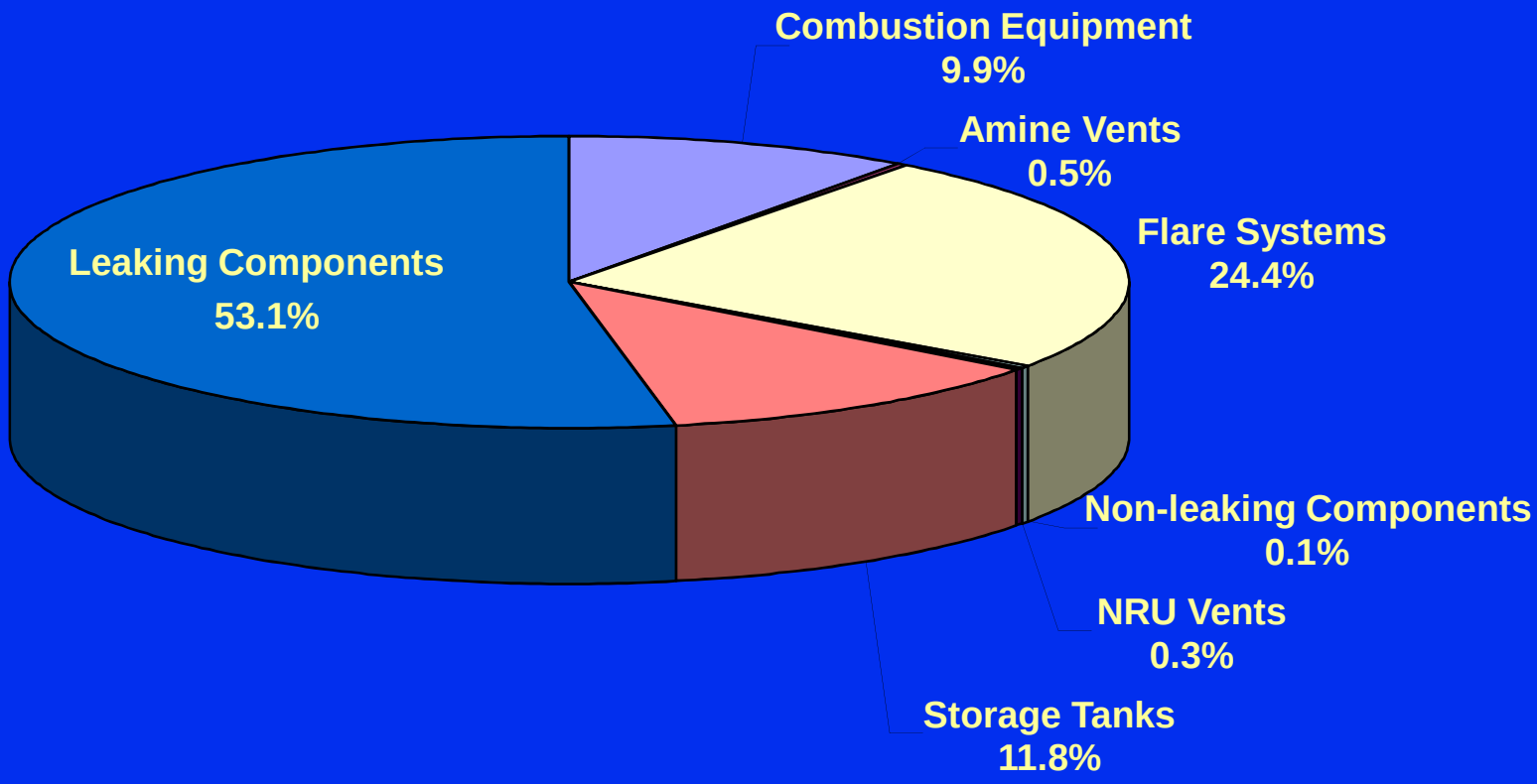
Farmington, New Mexico - Gas Booster Station

Source: http://www.surfaceproduction.com/

What is the Problem?

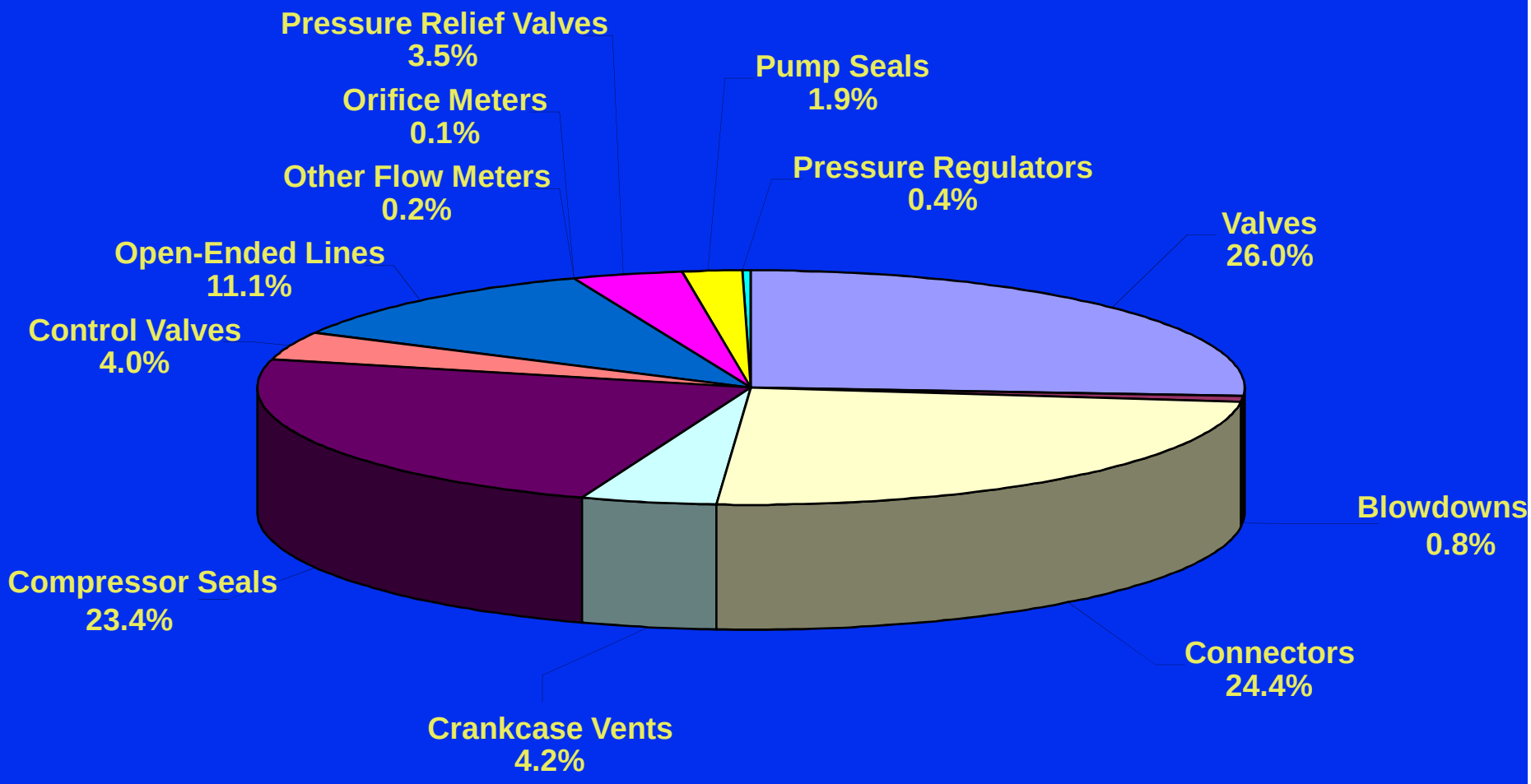
- Gas leaks are *invisible*, *unregulated* and *go unnoticed*
- STAR partners find that valves, connectors, compressor seals and open-ended lines (OEL) are major sources
  - 27 Bcf of methane are emitted per year by reciprocating compressors seals and OELs
  - Open ended lines contribute half these emissions
- Gas plant fugitive methane emissions depend on operating practices, equipment age and maintenance

Natural Gas Losses by Source



Source: Clearstone Engineering, 2002

Natural Gas Losses by Equipment Type



Source: Clearstone Engineering, 2002

How Much Methane is Emitted?

Methane Emissions from Leaking Components at Gas Processing Plants			
Component Type	**% of Total Methane Emissions**	**% Leaks**	**Estimated Average Methane Emissions per Leaking Component (Mcf/Year)**
Valves (Block & Control)	26.0 %	7.4 %	66
Connectors	24.4 %	1.2 %	80
Compressor Seals	23.4 %	81.1 %	372
Open-ended Lines	11.1 %	10.0 %	186
Pressure Relief Valves	3.5 %	2.9 %	844

Source: Clearstone Engineering, 2002, Identification and Evaluation of Opportunities to Reduce Methane Losses at Four Gas Processing Plants. Report of results from field study of 4 gas processing plants in WY and TX to evaluate opportunities to economically reduce methane emissions.

How Much Methane is Emitted?

Summary of Natural Gas Losses from the Top Ten Leakers[1].				
Plant No.	Gas Losses From Top 10 Leakers (Mcfd)	Gas Losses From All Equipment Leakers (Mcfd)	Contribution By Top 10 Leakers (%)	Contribution By Total Leakers (%)
1	43.8	122.5	35.7	1.78
2	133.4	206.5	64.6	2.32
3	224.1	352.5	63.6	1.66
4	76.5	211.3	36.2	1.75
Combined	477.8	892.84	53.5	1.85

[1]Excluding leakage into flare system

How Can These Losses Be Reduced?

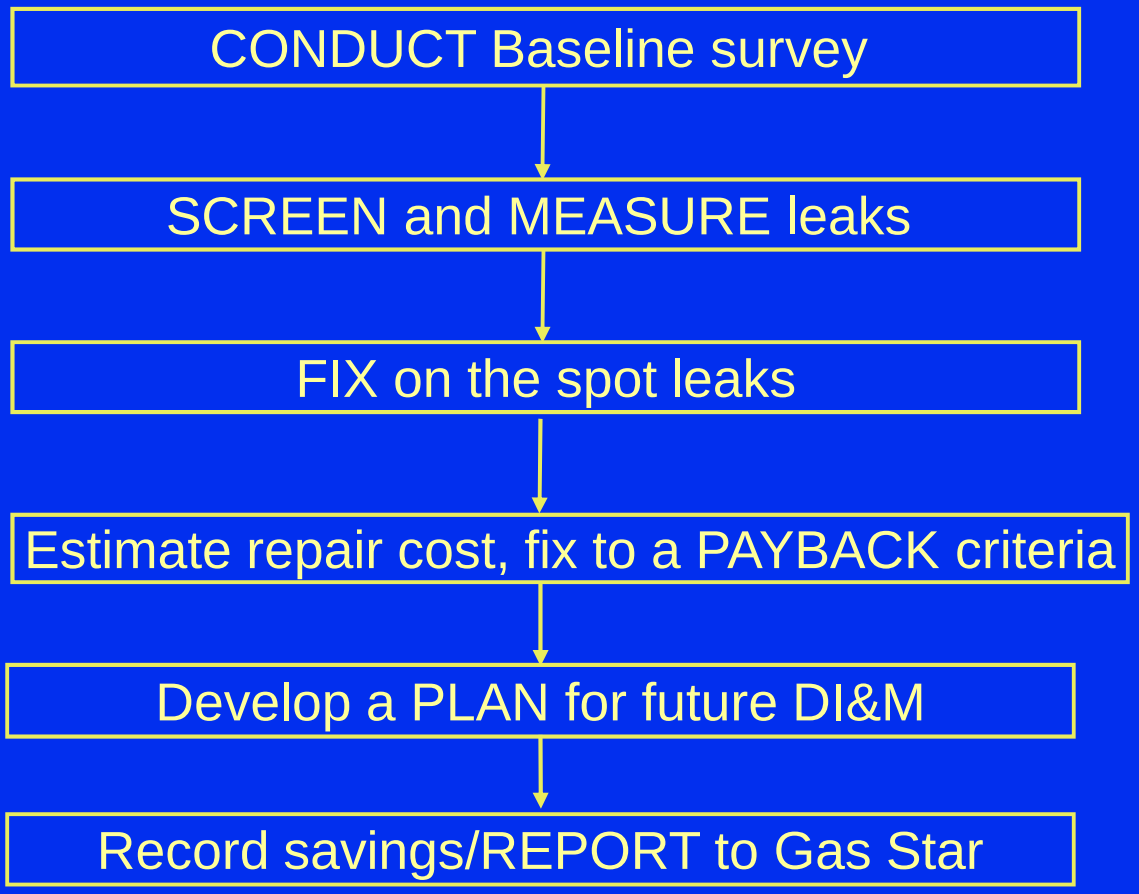
- Implement a Directed Inspection and Maintenance (DI&M) Program

Source: CLEARSTONE ENGINEERING LTD

What is a DI&M Program?

- Directed Inspection and Maintenance Program
  - Voluntary program to identify and fix leaks that are cost effective to repair
  - Outside of mandatory LDAR program
  - Survey cost pays out in the first year
  - Provides valuable data on leakers

How do you Implement a DI&M Program?



Screening and Measurement

Summary of Screening and Measurement Techniques		
Instrument/ Technique	**Effectiveness**	**Approximate Capital Cost**
Soap Solution	★ ★	$
Electronic Gas Detectors	★	$$
Acoustic Detection/ Ultrasound Detection	★ ★	$$$
TVA (FID)	★	$$$
Bagging	★	$$$
High Volume Sampler	★ ★ ★	$$$
Rotameter	★ ★	$$
Source: EPA's Lessons Learned Study		

Cost-Effective Repairs

Repair the Cost Effective Components			
Component	**Value of Lost gas[1] ($)**	**Estimated Repair cost ($)**	**Payback (Months)**
Plug Valve: Valve Body	12,641	200	0.2
Union: Fuel Gas Line	12,155	100	0.1
Threaded Connection	10,446	10	0.0
Distance Piece: Rod Packing	7,649	2,000	3.1
Open-Ended Line	6.959	60	0.1
Compressor Seals	5,783	2,000	4.2
Gate Valve	4,729	60	0.2
Source: Hydrocarbon Processing, May 2002 [1]Based on $3/Mcf gas price			

Partner Experience: Dynegy

- Surveyed 30,208 components in two processing plants
- Identified 1,156 leaking components or 3.8%
- Repaired 80 - 90% of the identified leaking components
- Methane Emissions Reductions

  = 100,000 Mcf/yr
- Savings = $300,000 /yr (at $3/Mcf)

More Operating Practices

- COMPRESSORS & ENGINES
  - Convert Engine Starting to Air
    - SAVES…1,356 Mcf/yr
    - PAYOUT…< 1 year
  - Convert Engine Starting to Nitrogen
    - SAVES… 1,350 Mcf/yr
    - PAYOUT…< 1yr
  - Reduce Frequency of Starts with Gas
    - SAVES… 132 Mcf/yr
    - PAYOUT… < 1yr
  - Lower Purge Pressure for Shutdown
    - SAVES… 500 Mcf/yr
    - PAYOUT… 3-10 yrs

What is the Problem?

Compressor starts vent methane

- How much methane is emitted?
  - Up to 135 Mcf per start
- How can these losses be reduced?
  - Alternative operating practices
    - Use air
    - Use nitrogen
  - Alternative technology
    - Use electric starters
    - Convert to electric drive

Partners Experience

Compressor starts vent methane

- Partners report 1,350 Mcf/yr savings per compressor using air or nitrogen assuming ten starts per year
  - Availability and cost of air and nitrogen are issues
  - Capital costs for electric starters reduce payout
  - Coordinating starts and shutdowns with maintenance needs
  - Modification of purge procedures to recover gas prior to venting can gain savings with no cost

More Operating Practices

- OTHER
  - Eliminate Unnecessary Equipment or Systems
    - SAVES… 2,000 Mcf/yr
    - PAYOUT… < 1yr
- PIPELINES/PIPING
  - Use Inert Gases and Pigs for Purges
    - SAVES… 90 Mcf/yr
    - PAYOUT… > 10 yrs

What is the Problem?

Unnecessary equipment or systems provide sources of methane emissions

- How much methane is emitted?
  - One unnecessary process controller vents 1 cfm or 0.5 MMcf/yr
  - Replacing multiple reciprocating compressor engines with one turbine compressor can save >2 MMcf/yr
- Other benefits
  - Increases efficiency
  - Lowers operating & maintenance costs

Partner Experience

Unnecessary equipment or systems provide sources of methane emissions

- One partner reports savings of 7940 Mcf/yr by eliminating 31 dehydrators with an average of 4 controller loops
  - Payback was < 1 year

More Operating Practices

- VALVES
  - Inspect & Repair Compressor Station Blowdown Valves
    - SAVES…2,000 Mcf/yr
    - PAYOUT… < 1 yr
  - Test & Repair RV's
    - SAVES…170 Mcf/yr
    - PAYOUT… < 1 yr
  - Test & Repair Gate Station RV's with Nitrogen
    - SAVES… 8 Mcf/yr
    - PAYOUT… >10 yrs

What is the Problem

Leaking valves are another large source

- How much methane is emitted?
  - As RV components wear or foul leakage occurs
  - Estimate 200Mcf/yr per leaker
- How can these losses be reduced?
  - Leak check & repair on a planned schedule

Partner Experience

Leaking valves are another large source

- One partner reports saving 3,907 Mcf/yr by repairing 7 valves. Payback was immediate.
- Another partner reports saving 853 Mcf/yr by repairing compressor RV's.

Discussion Questions

- To what extent are you implementing these PRO's?
- Can you suggest other opportunities?
- How could these opportunities be improved upon or altered for use in your operation(s)?
- What are the barriers (technological, economic, lack of information, regulatory, etc.) that are preventing you from implementing this technology?