



Cost Effective Opportunities to Reduce Methane Emissions and Losses

Modern Technologies of Detection and Elimination
of Methane Leakages from Natural Gas Systems
September 14-16, 2005 Tomsk (Akademgorodok, Russia)

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Introduction

- **Methane Emissions.**
 - Leakage.
 - Venting.
 - Storage Losses.
 - Incomplete Combustion (Fuel use and flaring).
- **Other Methane Losses.**
 - Increased fuel use due to avoidable inefficiencies.
 - Thermal Efficiency of Fired Equipment.
 - Compression Efficiency.
 - Tail Gas Incinerators.
 - Electric power generation.



Fugitive Equipment Leaks

- **CONTROL OPTIONS:**

- DI&M.
- Use of better performing components.
- Elimination of unnecessary components.
- Add-on control technologies.

- **NOTEWORTHY CHARACTERISTICS:**

- THC and CH₄ emissions are mostly from components in gas service.
- Emission vary greatly between sites but older facilities tend to leak more than newer ones.
- 75 to 85% of emissions economic to reduce.
- Top 10 leaks typically contribute more than 80% of emissions from leaks.
- Leak control is an ongoing effort.
- Maintenance/repair costs tend to increase with component size but leaks don't.



Fugitive Equipment Leaks

- **CHRONIC OR FREQUENT LEAKERS:**
 - Compressor Seals (34% leak).
 - Open-ended lines (vent, drain, and blowdown systems) (20% leak).
 - Components in vibration or thermal-cycling service.
 - Components in fuel gas service (18% leak).
 - Stem packings on rising stem valves.
 - PVSVs and hatches on blanketed storage tanks.
 - Pressure relief valves.



Fugitive Equipment Leaks

Facility Type	Number of Facility Surveyed	Number of Components Screened	Number of Leaks Identified	THC Emissions From Leaking Components	Methane Emissions	GHG Emissions From Leaking Components	Value of Emissions From Leaking Components
		Facility Average	Facility Average	Facility Average	Facility Average	Facility Average	Facility Average
		[components/facility]	[leaks/ facility]	[103m3/year/ facility]	[103m3/year/ facility]	[tonnes/year/facility]	[\$/year/ facility]
Gas Plant	9	15 457	435	1 874	1 353	20 505	691 781
Comp Stn	9	2 279	36	146	126	1 792	43 966
Well Site	12	362	3	0	0	5	118

- Value of emissions based on a \$6.78/GJ for natural, \$8.13/GJ for propane, and \$9.63/GJ for butane and condensate.



Storage Tanks

- **KEY EMISSION SOURCES:**

- Flashing losses at production facilities.
- Unintentional gas carry-through to storage tanks:
 - Leaking drain and dump valves.
 - Malfunctioning level controllers.
 - Inefficient upstream gas/liquid separation.
 - Piping changes resulting in unstabilized product going to tanks.
 - Non-routine storage of unstabilized product in atmospheric tanks.
- Malfunctioning vapor recovery systems:
 - Faulty blanket gas regulators or pressure controllers.
 - Fouled vapor collection lines.

- **CONTROL OPTIONS:**

- Vapour reduction (e.g., upstream product stabilization).
- Vapour recovery.
- DI&M.



Storage Tanks

- **NOTEWORTHY CHARACTERISTICS.**
 - Methane content minimal downstream of production facilities.
 - Emissions often unnoticed on site.
 - Vapors rich with NMVOCs
 - Increases value of losses.
 - More to utilize without processing.



Storage Tanks

Facility	THC Emissions [10 ³ m ³ /year]	Methane Emissions [10 ³ m ³ /year]	GHG Emissions [tonnes CO ₂ E/year]	Value of Lost Product [\$/year]
Gas Plant #1	NA	NA	NA	NA
Gas Plant #2	NA	NA	NA	NA
Gas Plant #3	1 663	57	813	441 371
Gas Plant #4	NA	NA	NA	NA
Gas Plant #5	95	93	1 325	24 559
Gas Plant #6	NA	NA	NA	NA
Gas Plant #7	NA	NA	NA	NA
Gas Plant #8	4 469	2 651	37 801	1 880 267
Gas Plant #9	NA	NA	NA	NA
TOTAL	6 227	2 801	39 939	2 346 197
AVERAGE	692	311	4 438	260 689

- Value of emissions based on a \$6.78/GJ for natural, \$8.13/GJ for propane, and \$9.63/GJ for butane and condensate.



Venting and Flaring

- **KEY SOURCES:**

- Disposal of waste associated gas at oil production facilities.
- Casing gas vents at heavy oil wells.
- Gas operated devices.
- Still column off-gas vents on glycol dehydrators.
- Leakage into vent/flare header (5-10% of valves leak and 1-2% of these contribute 75%).
- Excessive purge gas rates.
- Other: I&M activities, well testing/servicing and pipeline tie-ins.

- **CONTROL OPPORTUNITIES:**

- Control of leakage into systems (DI&M).
- Vent and flare gas recovery/utilization.



Venting and Flaring

- **NOTEWORTHY CHARACTERISTICS:**
 - High uncertainty in values:
 - Flows usually not metered and often reported as zero.
 - Vented volumes often reported as flared.
 - Leakage into vent and flare systems typically unaccounted.
 - Reliability of pilot or ignition systems sometimes a problem.
 - Many systems based on outdated gas prices.



Residual Flaring

Facility	Residual THC Flaring Rate [10 ³ m ³ /day]	THC Emissions [103m ³ /year]	Methane Emissions [103m ³ /year]	GHG Emission tonnes CO ₂ E/yea	Value of Flared Gas [\$/year]
Gas Plant #1	0.56	4	3	540	53 765
Gas Plant #2	NA	NA	NA	NA	NA
Gas Plant #3	5.28	39	28	5 136	227 445
Gas Plant #4	3.43	29	18	3 336	342 272
Gas Plant #5	NA	NA	NA	NA	NA
Gas Plant #6	2.83	21	14	5 590	219 000
Gas Plant #7	NA	NA	NA	NA	NA
Gas Plant #8	10.99	80	66	10 266	1 249 588
Gas Plant #9	NA	NA	NA	NA	NA
TOTAL	23.09	172	130	24 868	2 092 070
AVERAGE	2.57	19	14	2 763	232 452

- Value of emissions based on a \$6.78/GJ for natural, \$8.13/GJ for propane, and \$9.63/GJ for butane and condensate.



Combustion Equipment

- **KEY SOURCES OF AVOIDABLE INEFFICIENCIES:**
 - Oversized engines, heaters and boilers.
 - Poor tuning (e.g., air/fuel ratio).
 - Leakage past pistons in engines.
 - Lack of waste heat utilization.
 - Fouled burner tubes.
- **CONTROL OPTIONS:**
 - Improved performance monitoring and servicing programs.
 - Optimal loading of units.
 - Add-on control systems.
 - Waste heat recovery.
- **NOTEWORTHY CHARACTERISTICS:**
 - Low CH₄ emissions but good control economics due to value of avoided fuel/energy consumption.



Combustion Equipment Performance

Facility Type	Number of Facilities Contributing Data	Number of Engines	Engine Power	Avoidable Losses	Value of Avoidable Losses	GHG Emission Reduction Potential
		Facility Average	Facility Average	Facility Average	Facility Average	Facility Average
		[engines/ facility]	[kW/facility]	[kW/facility]	[\$/year/ facility]	[tonnes/year/ facility]
Gas Plant	3	14	13 733	2 741	585 942	10 471
Comp Stn	4	5	4 851	1 395	298 189	2 772
ALL	7	9	8 657	1 975	422 189	6 065

- Value of emissions based on a \$6.78/GJ for natural, \$8.13/GJ for propane, and \$9.63/GJ for butane and condensate.



Compressors

- **KEY SOURCES OF INEFFICIENCIES:**
 - Internal valve and cylinder leakage in reciprocating compressors.
 - By-pass/Re-circulation valve leakage.
 - Pulsation losses.
 - Non-optimal loading.
- **CONTROL OPTIONS:**
 - Improved performance monitoring and servicing programs.
 - Optimal loading of units (modify operating procedures or replace with more appropriately sized unit).
- **NOTEWORTHY CHARACTERISTICS:**
 - Low CH₄ emissions but good control economics due to value of avoided fuel/energy consumption.



Compressor Performance

Facility Type	Number of Facilities Contributing Data	Number of Compressors	Compressor Power	Avoidable Losses	Value of Avoidable Losses	GHG Emission Reduction Potential
		Facility Average	Facility Average	Facility Average	Facility Average	Facility Average
		[compressors/ facility]	[kW/facility]	[kW/facility]	[\$/year/ facility]	[tonnes/year/ facility]
Gas Plant	3	14	13 733	1 891	1 347 983	12 085
Comp Stn	4	5	4 851	1 178	839 616	6 211
ALL	7	9	8 657	1 445	1 029 987	6 065

- Value of emissions based on a \$6.78/GJ for natural, \$8.13/GJ for propane, and \$9.63/GJ for butane and condensate.



Summary Results

Facility Type	Source Category	Avoidable THC Emissions	Avoidable Methane Emissions	Avoidable GHG Emissions	Value of Avoidable Losses ¹
		[10 ³ m ³ /year/facility]	[10 ³ m ³ /year/facility]	[tonnes CO ₂ E/year/facility]	[\$/year/facility]
Gas Plant	Equipment Leaks	1 874	1 353	20 505	691 781
	Storage Tanks	692	311	4 438	260 689
	Flaring	19	14	2 763	232 452
	Combustion Equipment	ND	ND	10 471	585 942
	Compressors	ND	ND	12 085	1 347 983
	TOTAL	2 585	1 679	50 261	3 118 847
Compressor Station	Equipment Leaks	146	126	1 792	43 966
	Combustion Equipment	ND	ND	2 772	298 189
	Compressors	ND	ND	6 211	839 616
	TOTAL	146	126	10 776	1 181 771
Well Site	Equipment Leaks	0	0	5	118
	TOTAL	0	0	5	118

- Value of emissions based on a \$6.78/GJ for natural, \$8.13/GJ for propane, and \$9.63/GJ for butane and condensate.



Overall Process Performance

- **KEY SOURCES OF AVOIDABLE INEFFICIENCIES:**
 - Lack of waste heat recover and heat integration.
 - Fouled heat exchangers.
 - Poor process control resulting in increased re-processing, venting and flaring.
 - Use of low efficiency equipment.
 - Excessive chemical circulation rates in absorption processes.
 - Excessive pressure and heat losses.
- **CONTROL OPTIONS:**
 - Unit and process optimization.
 - Improved process control.
 - Improved performance monitoring and service of equipment.
 - Ongoing tracking of key process performance indicators.
 - Implementation of formal energy management programs



Energy Management

16 Plant Summary Normalized to \$5.25/GJ and \$60/MW

	Current Consumption	Potential Savings	Percent
Fuel Gas	\$90,000,000	\$11,700,000	13%
Electricity	\$33,000,000	\$3,000,000	9%
Total	\$123,000,000	\$14,700,000	12%



Conclusions & Key Findings

- **Significant cost-effective opportunities for reducing methane and GHG emissions exist at UOG facilities.**
- **Opportunities vary dramatically between facilities.**
- **A targeted auditing of facilities is the most appropriate approach for identifying meaningful control opportunities.**
- **At targeted facilities, it is usually appropriate to take a holistic approach that considers a range of control opportunities.**