

Methane Savings from Natural Gas Compressors

Energy Management Workshop – January 16, 2007

Jim Cormack - TransCanada



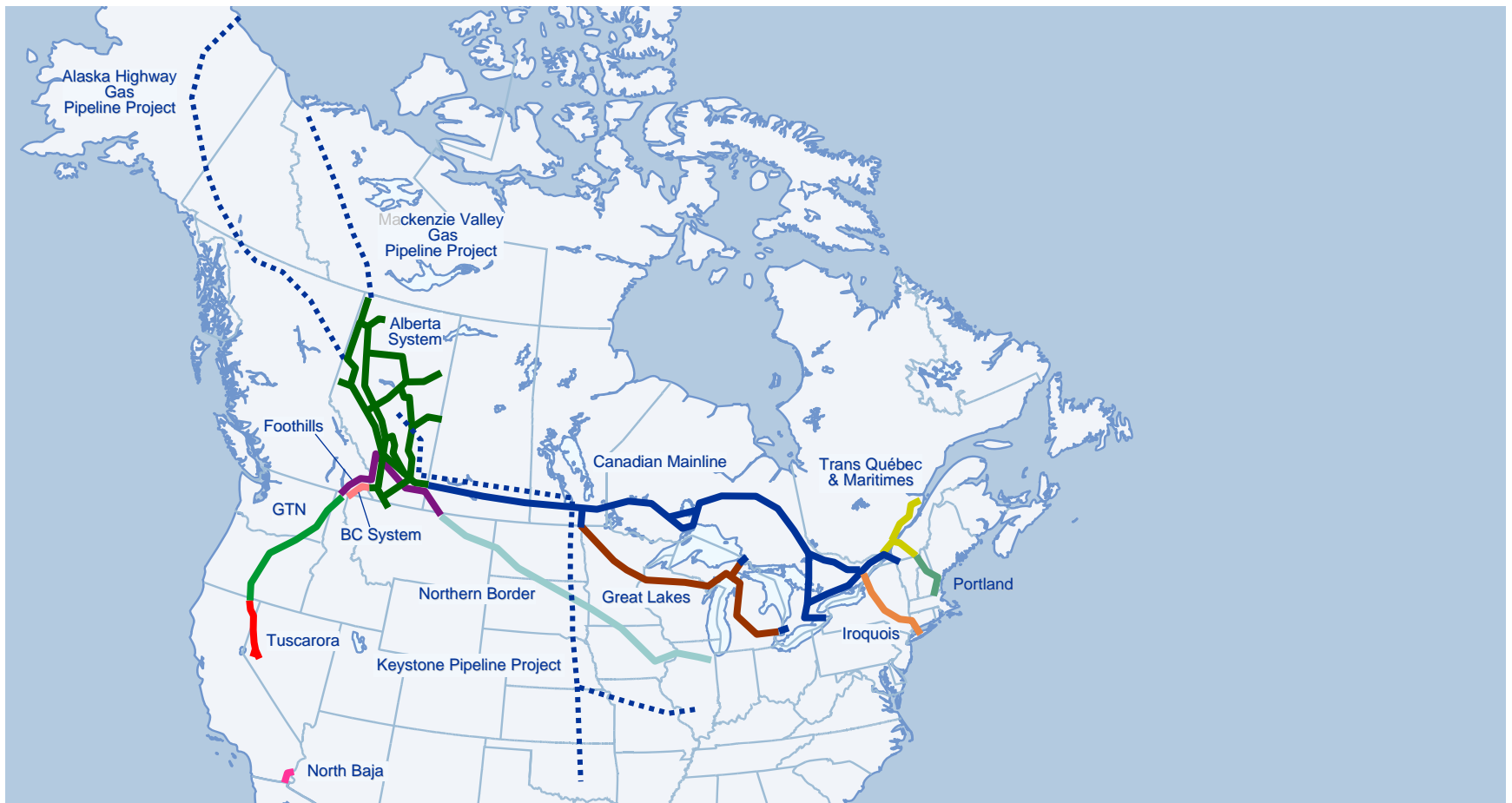
Leading North American energy company



- Competitively positioned in natural gas transmission & power services
- \$24.1 billion of premium pipe and power assets (\$Cdn at Dec. 31, 2005)
- Skilled, expert people with strong technical knowledge
- Strong financial position



Natural Gas Transmission Assets



41,000 km of wholly owned pipeline; 11.5 Bcf/day

Power Assets



14 facilities; 6,700 MW (including plants in development)

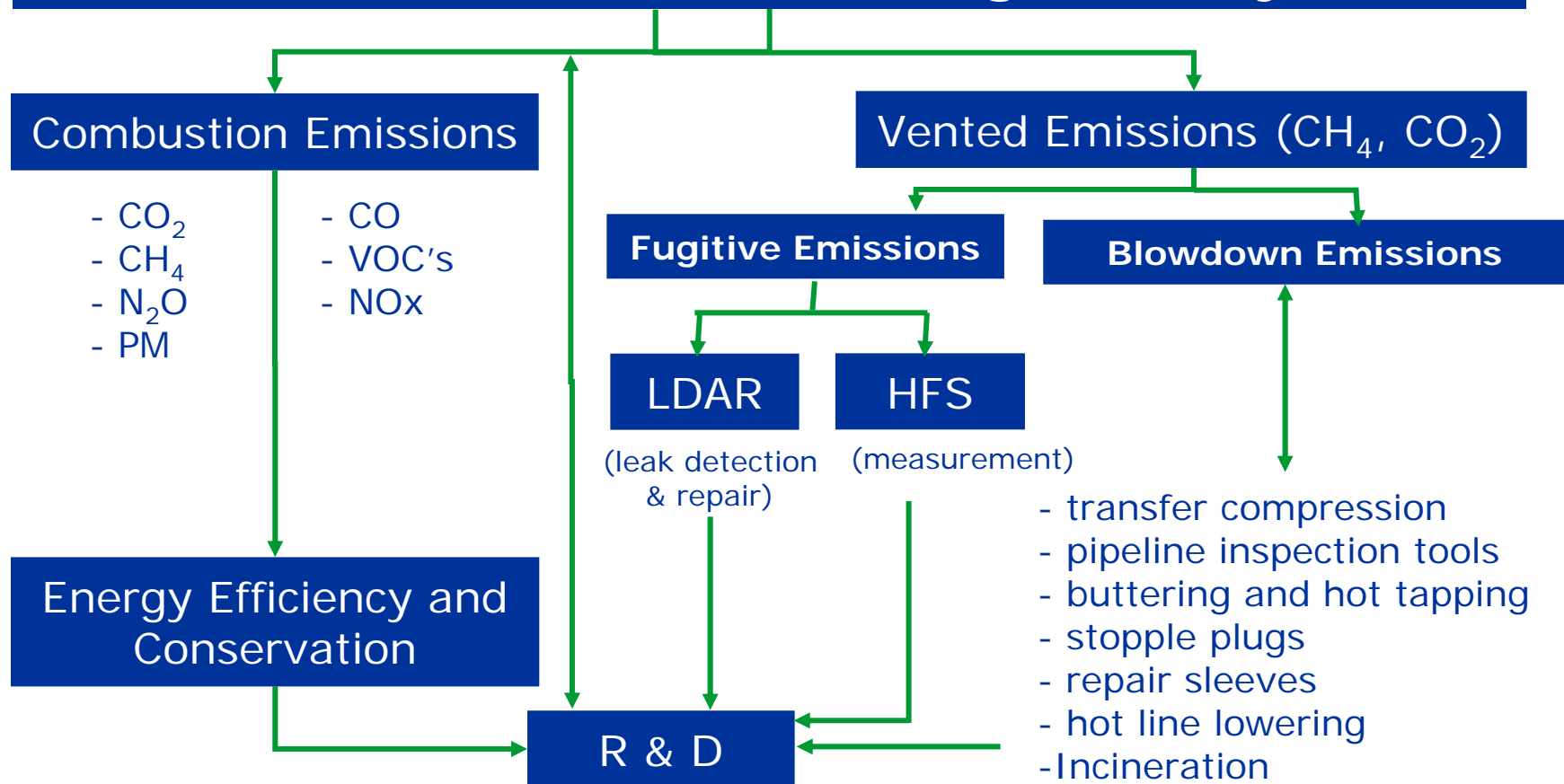
Transportation Pipeline Compressor Station



Emissions Management



TransCanada emissions management system



A Three Tier Approach to Methane Emissions Management



Tier 1 - Senior Leadership Support

Sponsorship

- provide resources
- approve management plan

Accountability

- alignment with business needs
- performance management

Tier 2 - Program Management

Development

- source identification
- quantification
- tracking system
- mitigative actions

Implementation

- pilot program
- communication

Maintenance

- trouble shooting
- annual rollout

Performance Measurement

- metric
- setting targets
- measuring progress

Continuous Improvement

- research and development

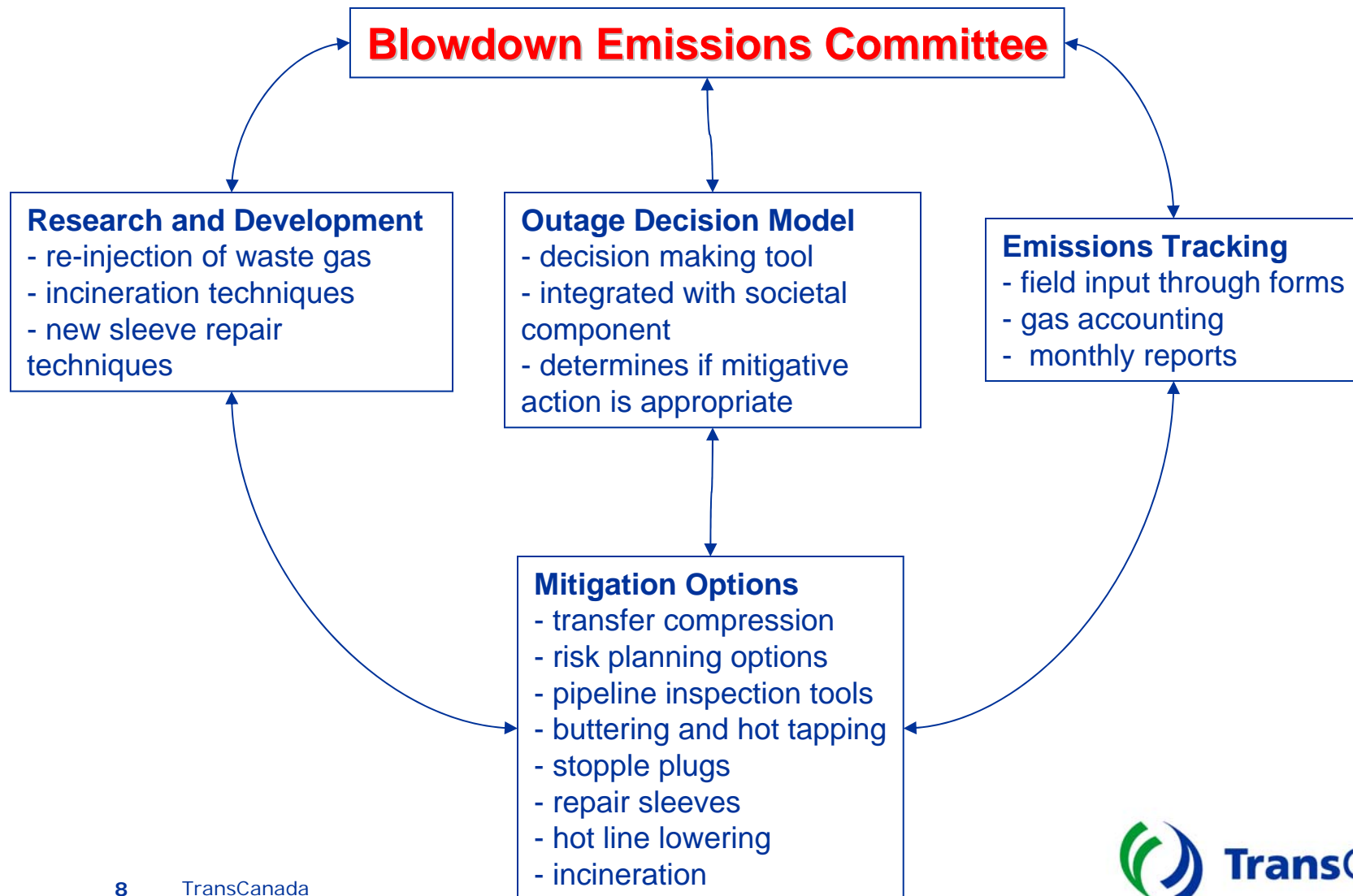
Tier 3 - Execution and Monitoring

Pilot Program

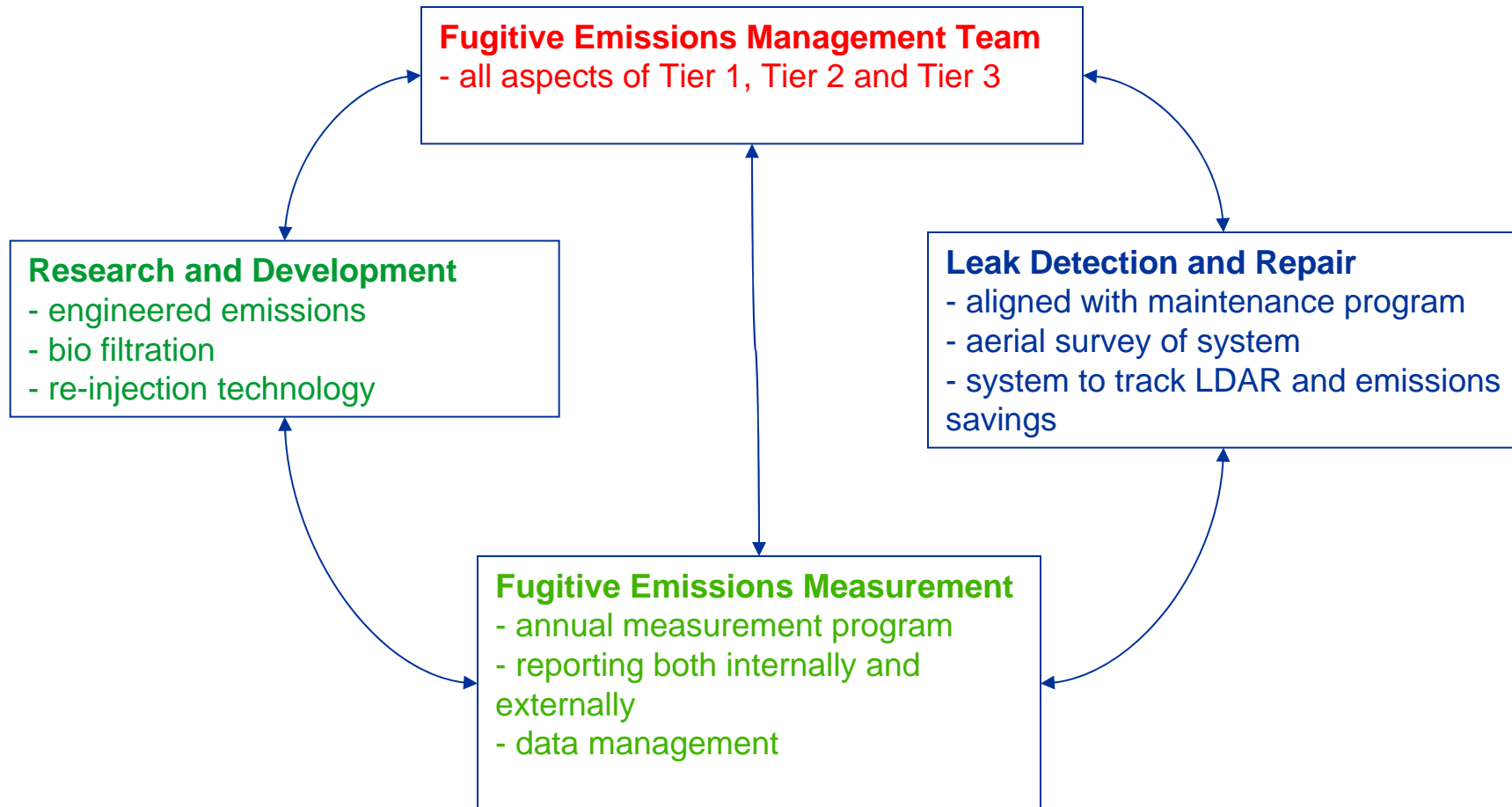
Full Scale Implementation

Monitoring

Blowdown Emissions Management



Fugitive Emissions Management



Fugitive emissions management program



- **Reduce** fugitive emissions by implementing an effective leak detection and repair (LDAR) program
- **Measure** fugitive emissions from our facilities
 - use of high flow sampler (HFS)
 - annual measurement program of 10% of all facilities
- **Reduce** engineered fugitive emissions through research and development programs in place

Fugitive emissions management



(LDAR vs measurement)

- High flow sampler measurement
 - Accuracy: +/- 10%
 - Identification of most "cost effective fixes"
- Bacharach HFS



Measurement program



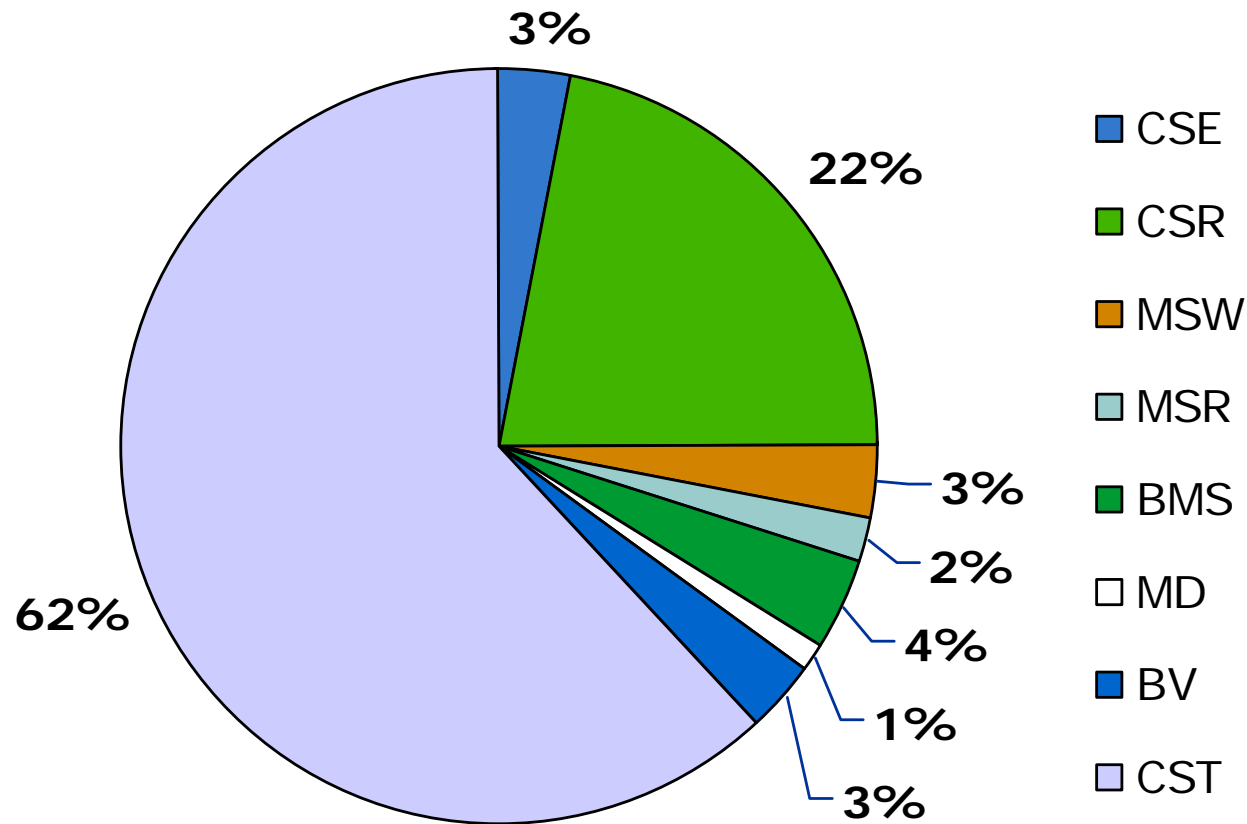
- Complete measurement of 10% of facilities per annum - with High Flow Sampler
 - **conventional bagging is 10 times slower**
- Develop annual leak rates for different types of facilities to calculate system emissions
- Measurement data allows derivation of our GHG inventories.



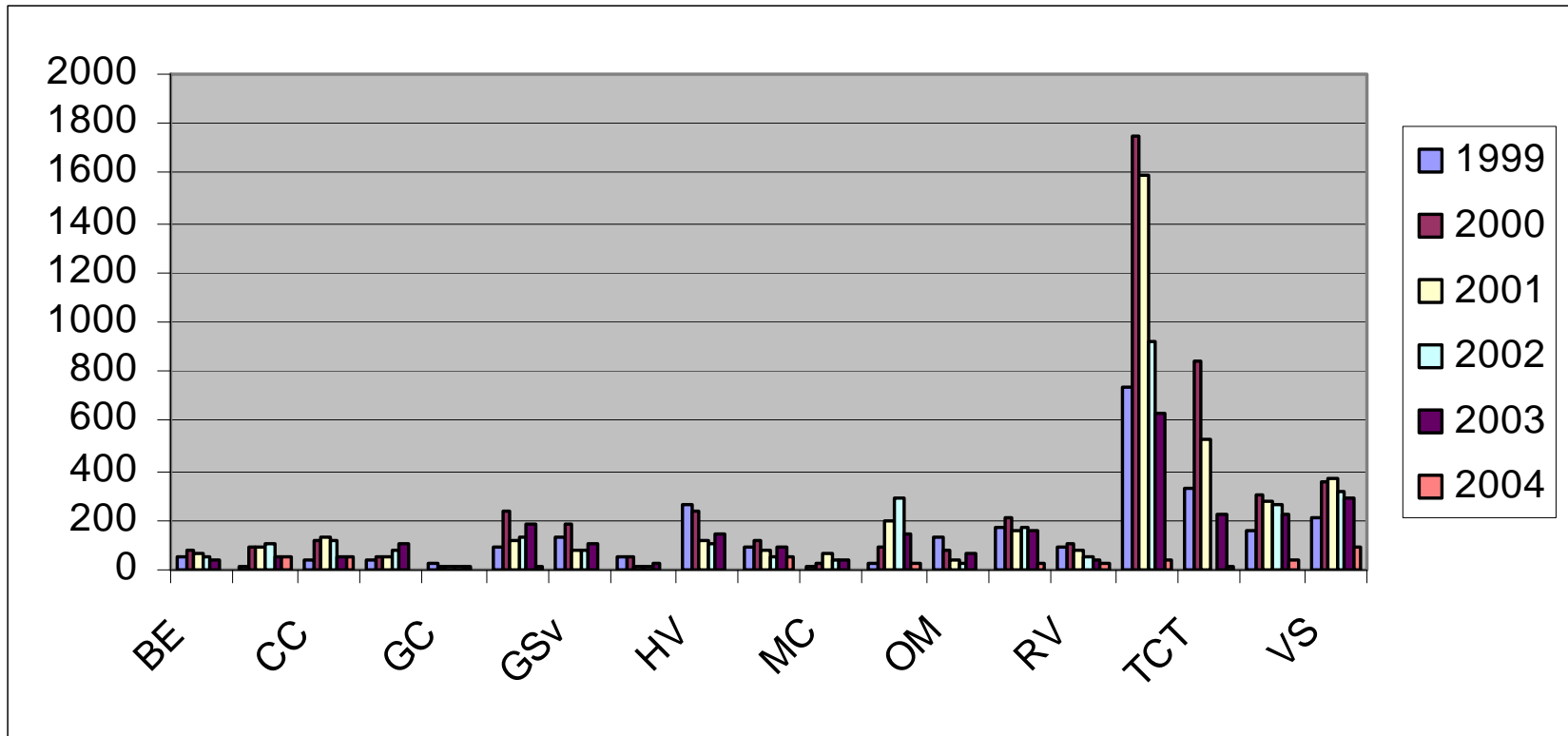
Methane emissions management



Methane emissions from pipeline system by type of facility.



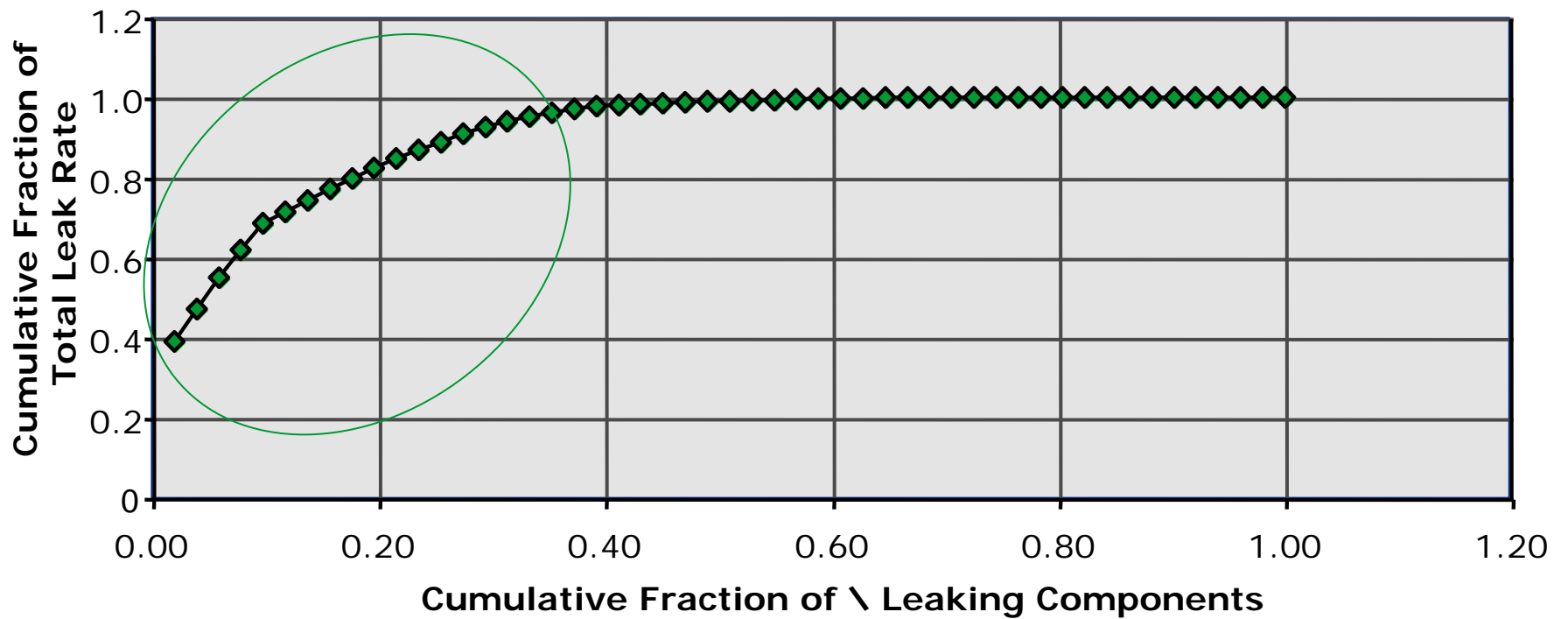
Leaking Component Inventory



Methane emissions management



Sample field measurement data analysis

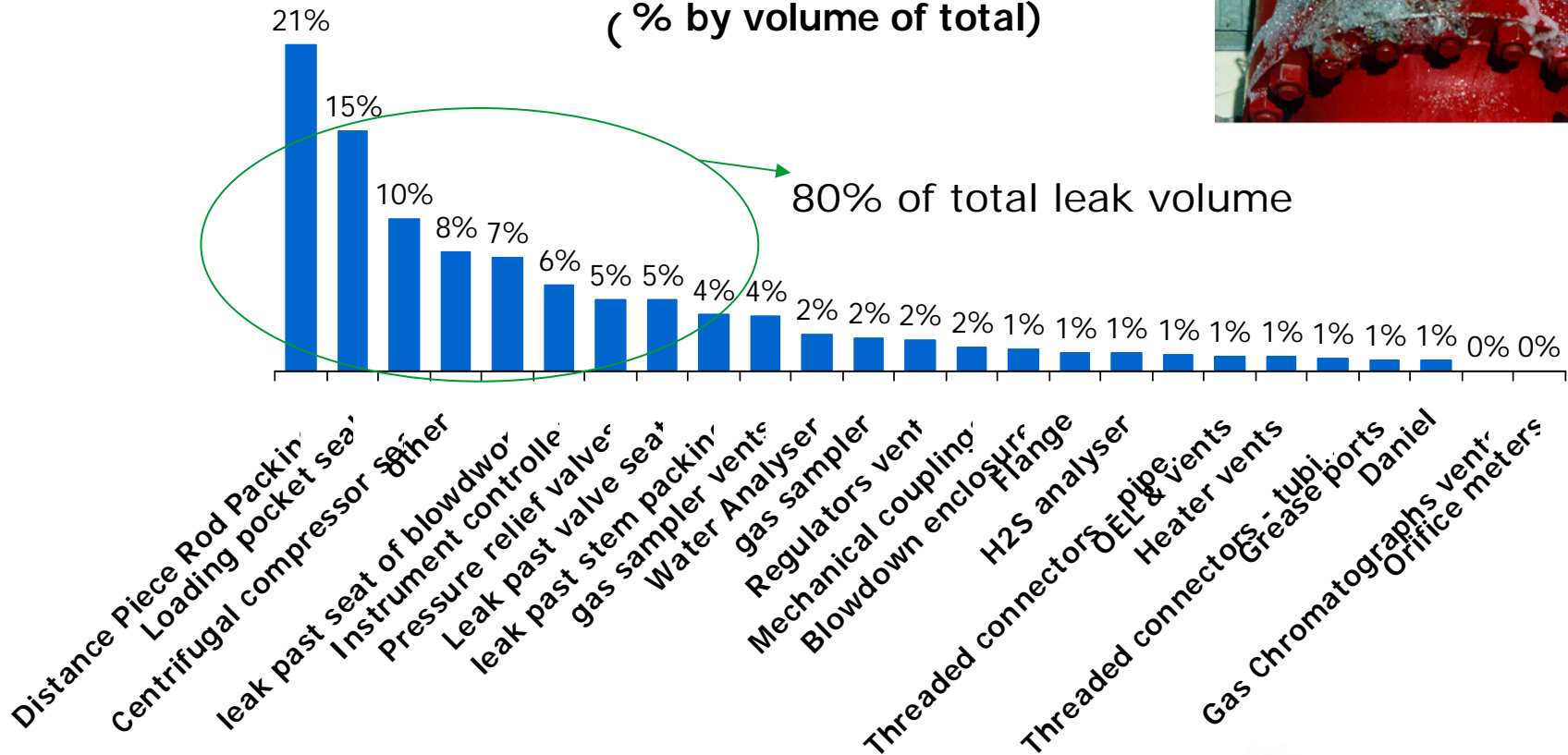


Fugitive emissions management - opportunities



Priority repairs...

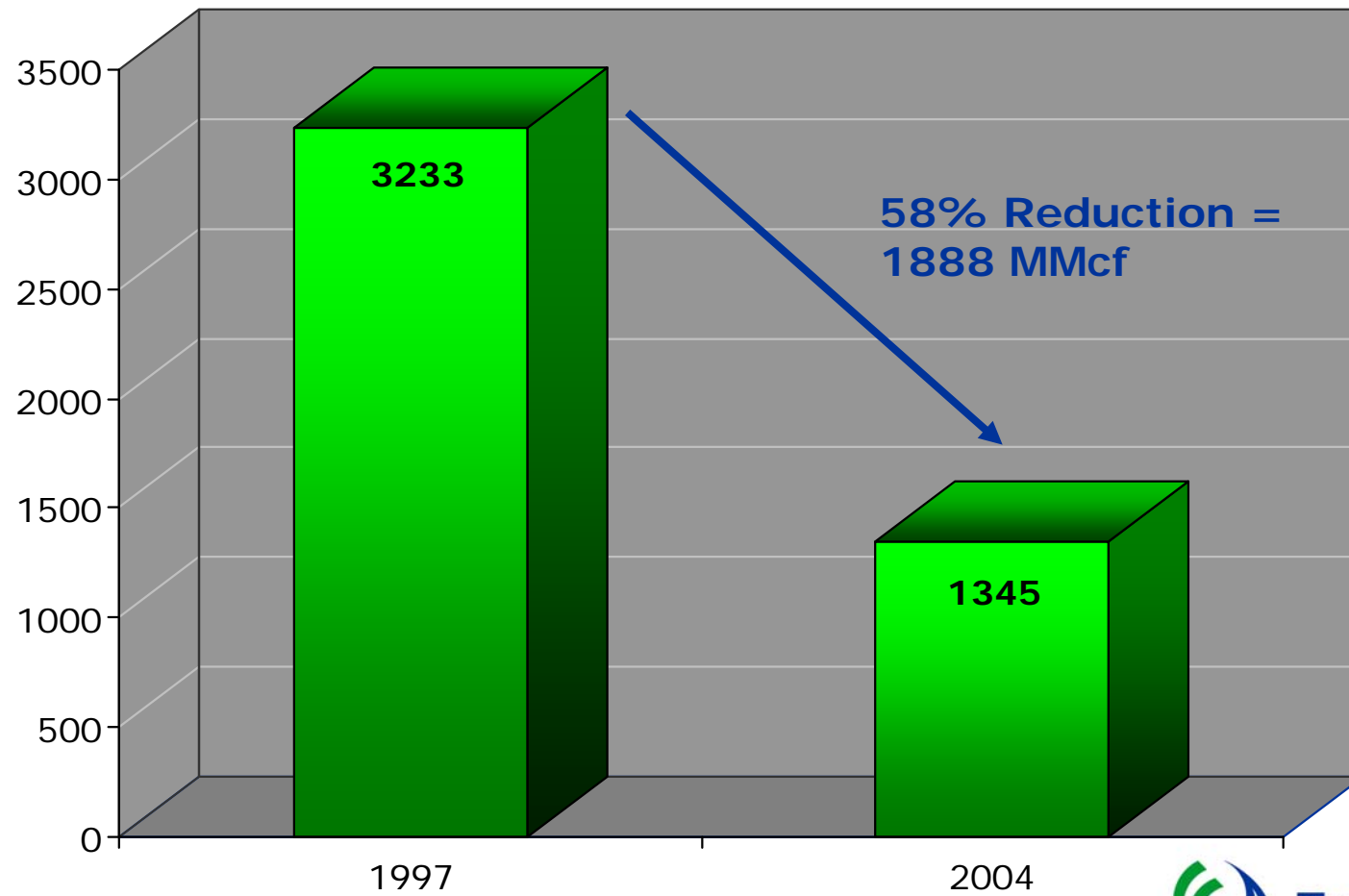
2004 HFS Leak Data by Equipment Type
(% by volume of total)



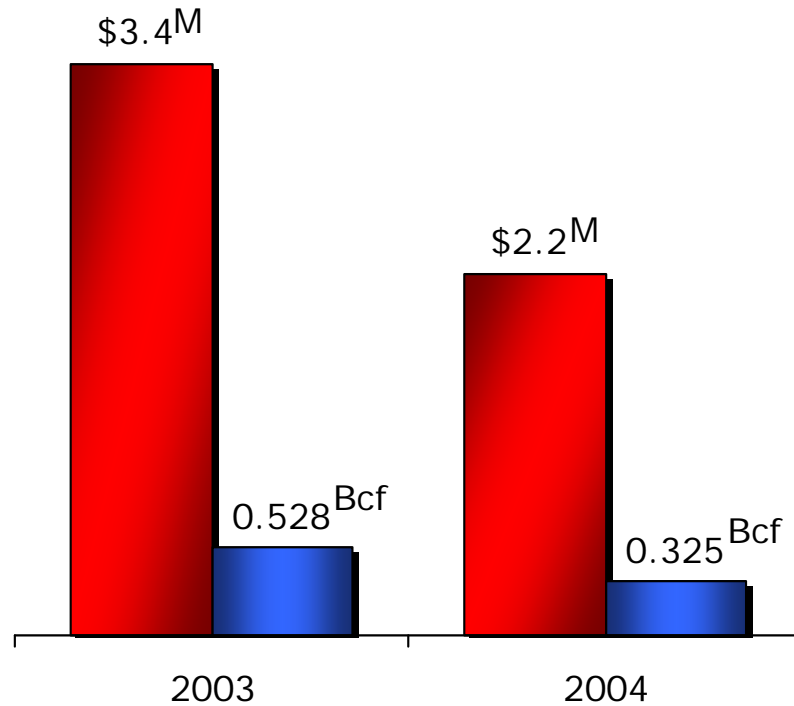
LDAR program achievement



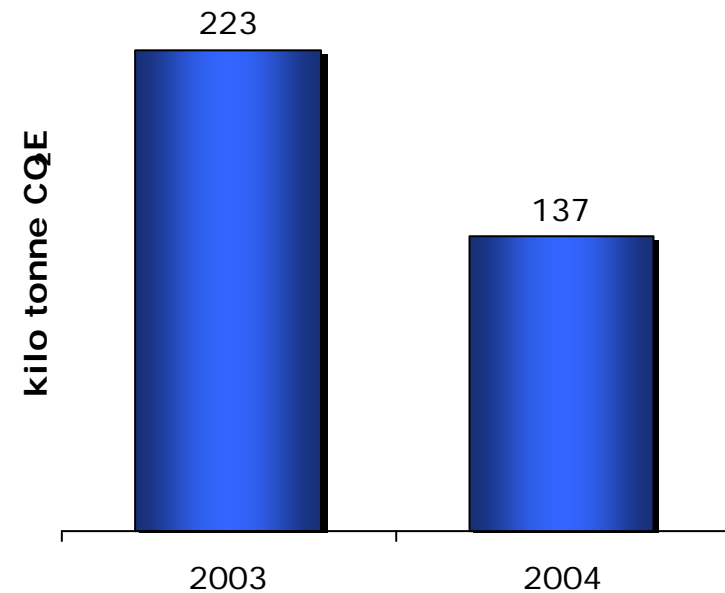
Fugitive Emissions in million ft³ CH₄



LDAR program savings



■ \$ Value of gas saved
■ Natural gas volume saved



■ Emissions saved

Emissions focus...



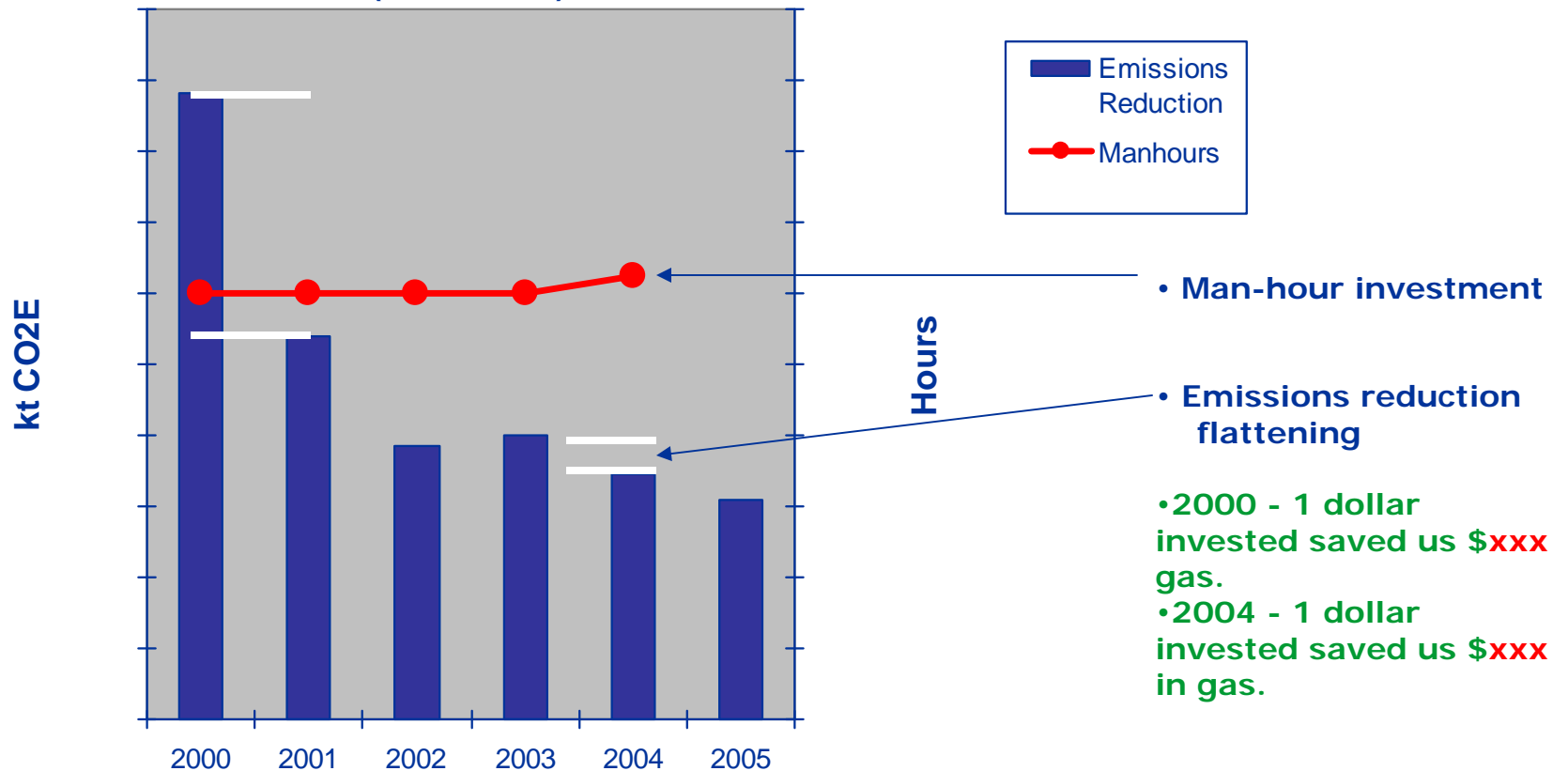
The Management System along with the data collected allows us to focus on issues which present an opportunity to improve the program and reduce overall costs.

- Reducing the frequency of the Leak Detection and Repair Task (LDAR)
- Have a better understanding of larger leaks and develop plans to address them.

O&M investment in LDAR...



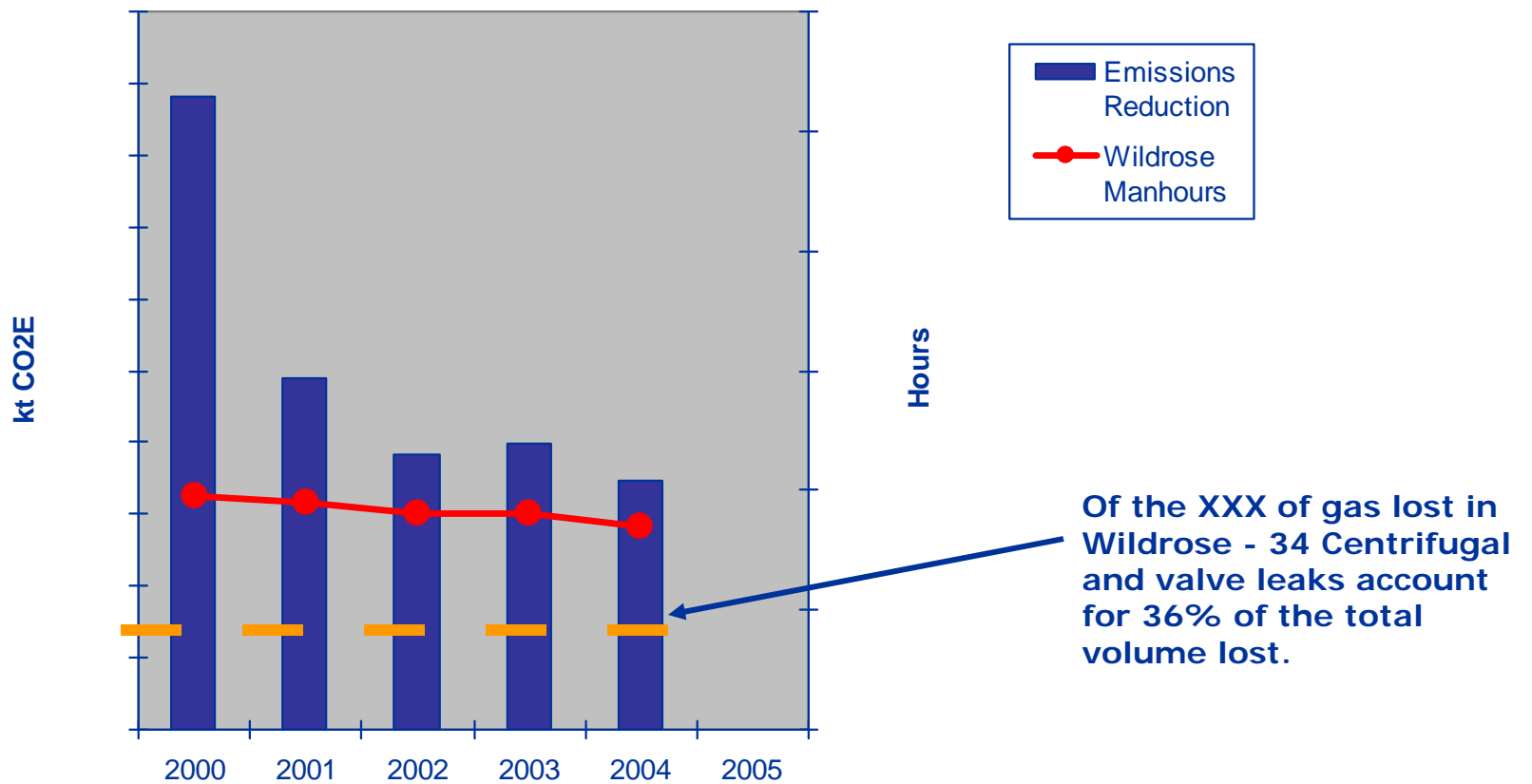
Emissions Reduction and Field operations manhours (PM and CM)



The Wildrose example...



Emissions Reduction and Field operations manhours



What can we do about leaking valves?



Build a leak priority model based on HFS reports.

- Ownership would be Regional Integrity
- Better understanding of large leaks and the source of the problem.
- Investigate suspected washed out valves.
- Determine the viability of repairs and build projects.

The screenshot shows a Microsoft Internet Explorer browser window titled "View/Edit: HFS Survey - Microsoft Internet Explorer". The address bar shows the URL: <http://geofind.tcpl.ca:7105/geofind/samplerSurveySearch.do?id=2274>. The main content area displays a table with the following columns: ID, Date, Type, Location, Size, Pressure, Volume, Leak Rate, Cost, and Repair Cost. The table contains 20 rows of data.

ID	Date	Type	Location	Size	Pressure	Volume	Leak Rate	Cost	Repair Cost
37673	1999-05-10	TCP	CompYard	1.5	2.15	5754	0%	\$31.13	\$7.29
37674	1999-05-10	TCP	CompYard	1.5	2.2	2966	0%	\$16.05	\$3.76
37675	1999-05-10	TCP	CompYard	1.5	2.45	2906	0%	\$15.72	\$3.68
37676	1999-05-10	TCP	CompYard	1.5	2.45	2906	0%	\$15.72	\$3.68
37677	1999-05-10	TCP	CompYard	1.5	2	0	0%	\$0	\$0
37678	1999-05-10	BE	CompYard	12	2.2	17846	0%	\$96.55	\$22.6
37679	1999-05-10	TCP	CompYard	0.5	2	0	0%	\$0	\$0
37680	1999-05-10	TCP	CompYard	1.5	2	0	0%	\$0	\$0
37681	1999-05-10	TCP	CompYard	1.5	2.3	449	0%	\$2.43	\$0.57
37682	1999-05-10	TCP	CompYard	1.5	2	0	0%	\$0	\$0
37683	1999-05-10	TCP	CompYard	1.5	2	0	0%	\$0	\$0
37684	1999-05-10	TCP	CompYard	1.5	2	0	0%	\$0	\$0
37685	1999-05-10	TCP	CompYard	1.5	2.15	825	0%	\$4.46	\$1.04
37686	1999-05-10	TCP	CompYard	1.5	2.2	425	0%	\$2.3	\$0.54
37687	1999-05-10	TCP	CompYard	0.5	2	0	0%	\$0	\$0
37688	1999-05-10	TCP	CompYard	0.5	2	0	0%	\$0	\$0
37689	1999-05-10	TCP	CompYard	0.5	2.3	225	0%	\$1.22	\$0.28
37690	1999-05-10	BL	CompYard	16	5.9	1835700	18%	\$9931.14	\$2325.1
37691	1999-05-10	BL	CompYard	16	9.6	5309677	54%	\$28725.35	\$6725.24
37692	1999-05-10	TCT	CompYard	0.5	2.2	425	0%	\$2.3	\$0.54
37693	1999-05-10	TCP	CompYard	0.5	2	0	0%	\$0	\$0
37694	1999-05-10	TCT	Scrubber	0.5	2.35	231	0%	\$1.25	\$0.29
37695	1999-05-10	TCT	Scrubber	0.5	2.35	231	0%	\$1.25	\$0.29
37696	1999-05-10	TCP	UtilGS	1.5	2	0	0%	\$0	\$0

Benefits of a team developing the system...



- Reduction in emissions by focusing on the larger “more complicated” leaks
- Increase the value of the task by removing redundancy
- Spend less time repairing leaks that account to very little of the total volume lost.
- Improve shipping reliability - benefits producers.
- Using the HFS gives us a better understanding of gas loss and value.
- Would help employees determine what leaks they should concentrate their efforts on based the volume being lost.



Gas-Gas Ejector for low press. Gas

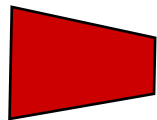
- Gas-gas ejector for dry gas seal leak capture
- Use of gas-gas ejector to recompress seal gas emissions
- Designing a gas-gas ejector to capture seal gas emissions
- Re-injecting to high pressure system
- Negligible operating cost

Gas-gas ejector for dry gas seal compressors leak capture - (research and development project)



Compressor dry gas seal emissions mitigation research project

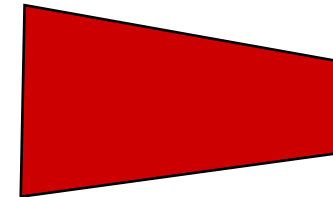
653 t CO₂ E/yr.



1 seal

227 kt CO₂ E/yr.

(538 MMCF/yr)



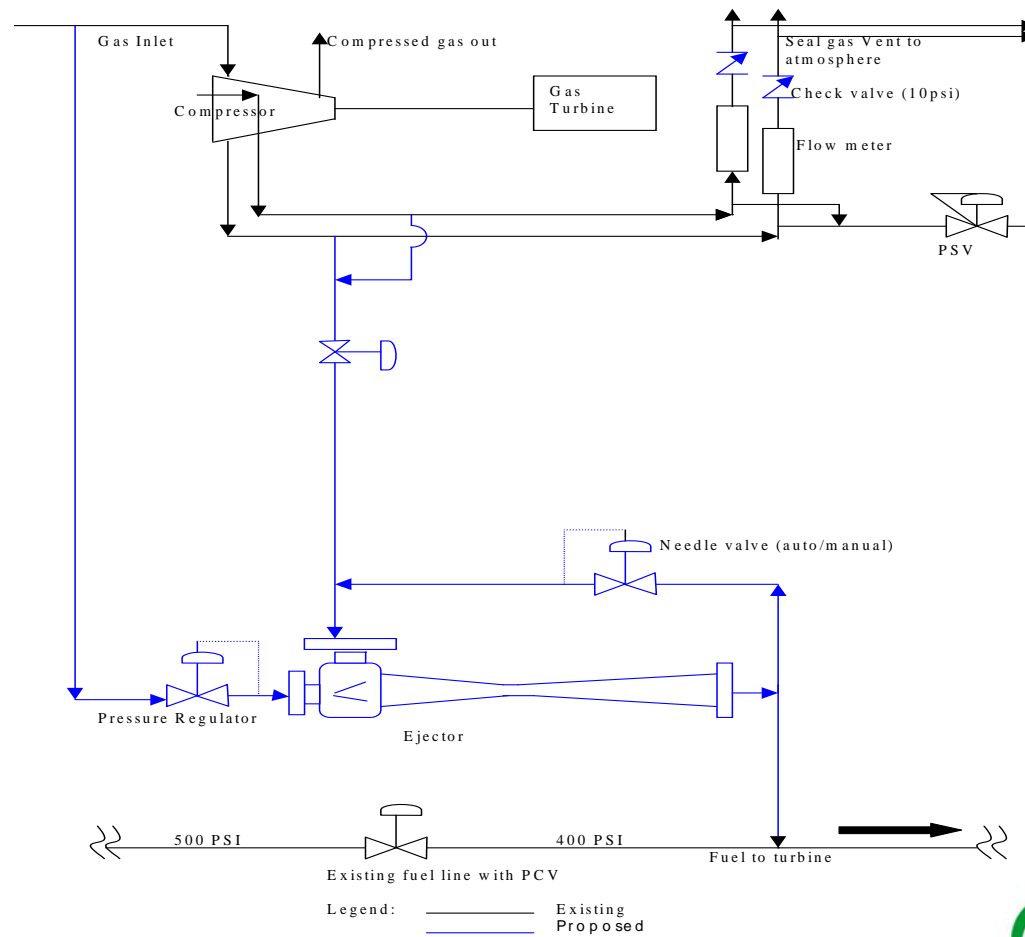
348 seals

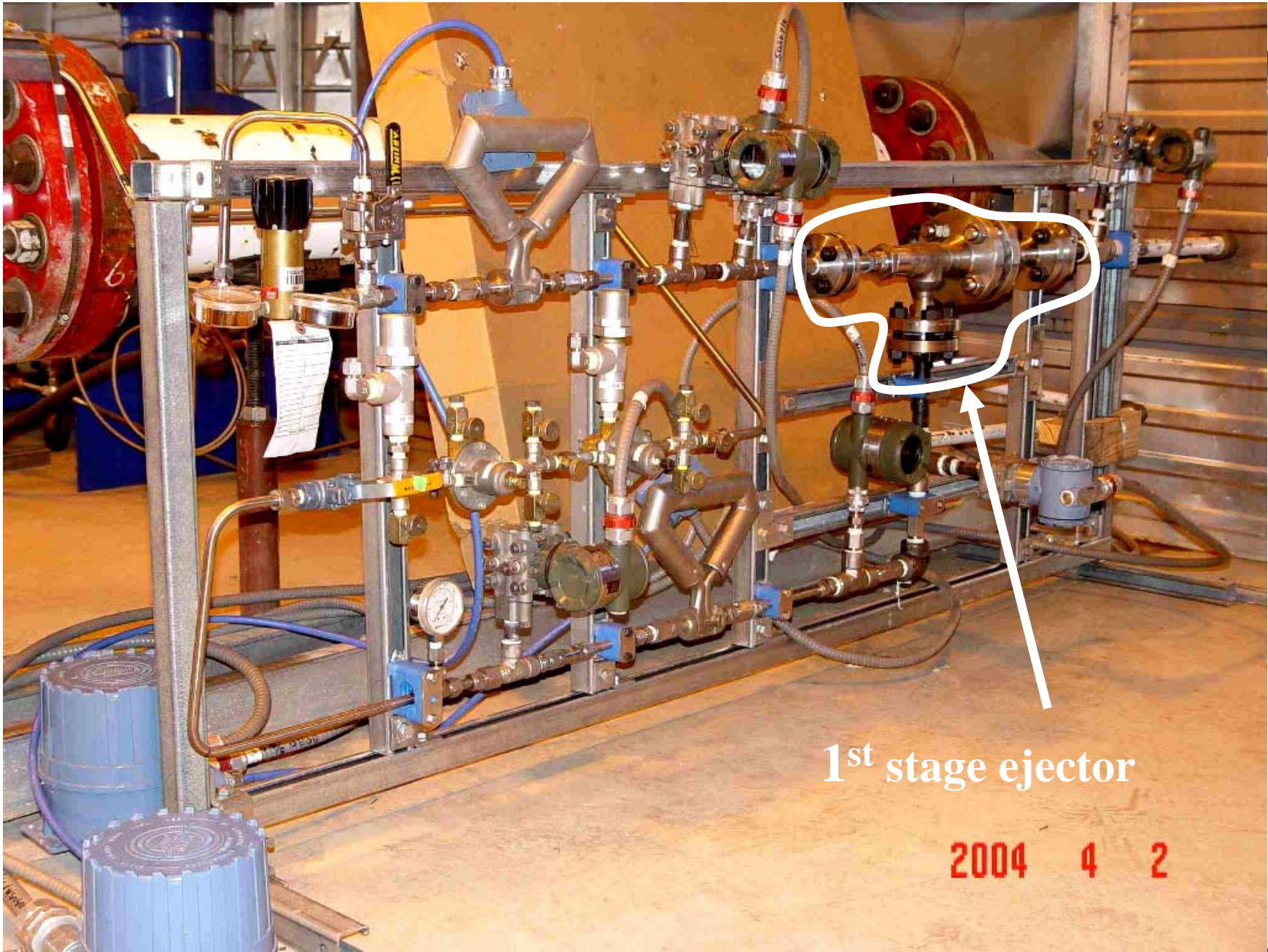
Market value of gas = \$ 3.70MM
@ \$6.84/1000 ft³

Process Flow Diagram (continuous process)



DRY GAS SEAL VENT UTILIZATION PROPOSAL CONCEPTUAL FLOW DIAGRAM (Sept. 24, 2001)





1st stage ejector

2004 4 2

Conclusions



Multi stakeholder team to manage emissions:

- source identification
- quantification
- tracking systems to analyze
- monitoring progress
- setting targets
- mitigative actions
- pilot programs
- continuous improvement (r&d)

Methane emissions management at TransCanada



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