

CARBON LIMITS

Statistical analysis of leak detection and repair surveys in Canada

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Background and methodology

Starting point:

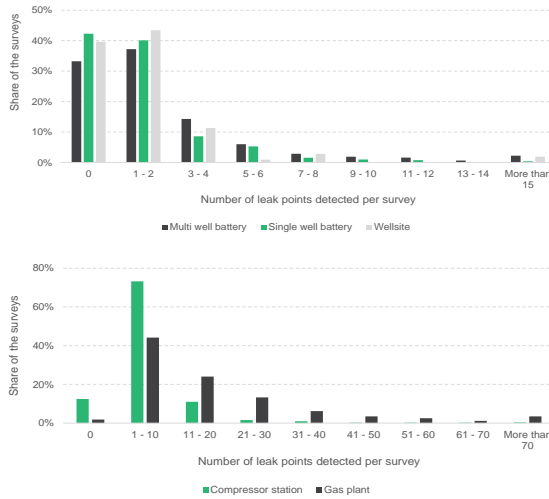
- Report published in 2013 for CATF
- Evaluated statistically the cost effectiveness of LDAR based on a **large sample of real field data.**

The analysis for Environment Canada

- Analysis based on Canadian data only
- Analysis based on **3828 surveys** in Canada (before 2013)
- The database includes 37 316 emitting component, and for each :
 - The emission point description
 - The emission rate
 - The repair recommended
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<http://carbonlimits.no/project/statistical-analysis-leak-detection-and-repair-canada/>

How many leak are detected per survey?



KEY TAKEAWAYS

- The number of leaks per site presents a skewed distribution
- The vast majority of wellsite and well batteries (75%) present less than 2 leak points and 36% presented no leak
- 86 % of the compressor stations present less than 10 leaks and
- 83 % of gas plants present less than 30 leaks

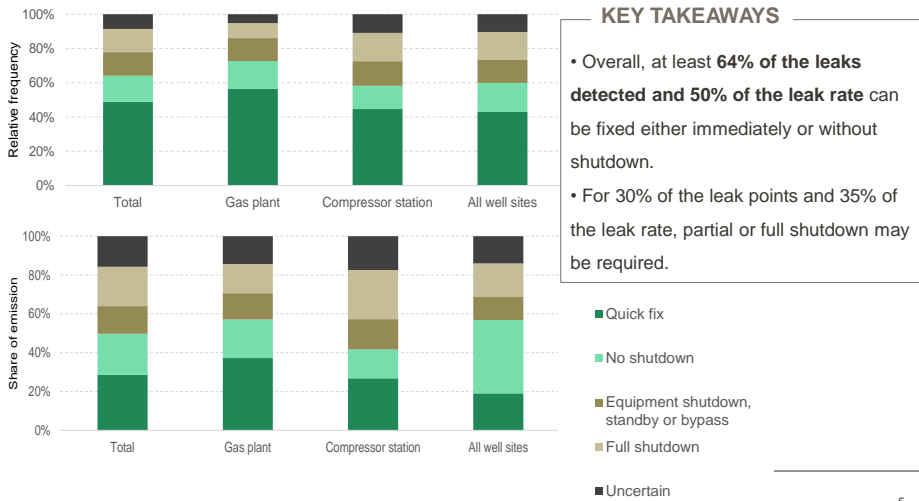
What is the relative occurrence of repairs requiring a shutdown of the facility?

APPROACH

- For each "component type" and "repair type", a repair timeline was associated.
- The classification is based on expert assessment and aims at analyzing statistically the database.
- Local circumstances may impact how each individual repair can be performed.

Repairs timeline Categories	Description
Quick fix	Stop the leak immediately, with no interruptions in operations
No shutdown	Leaking component, or seal can be repaired/replaced with no interruptions in operations. Some material may be required
Equipment shutdown, standby or bypass	The facility or unit could be operational if a bypass line or standby unit could be used. If neither of these conditions are met, partial of full shutdown might be required.
Shutdown	The facility or a unit in the facility should be shut-down in order to perform repair/replacement
Uncertain	No or inconclusive information

What is the relative occurrence of repairs requiring a shutdown of the facility?

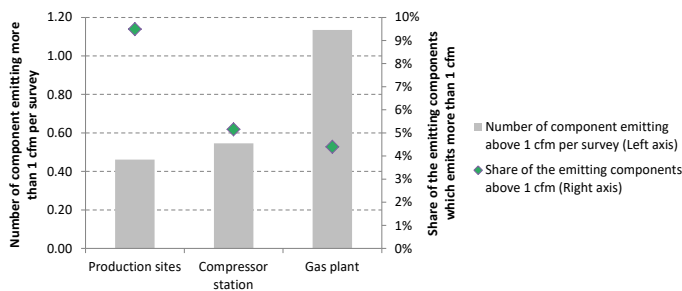


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Where are the “large emitters”?

DEFINITION

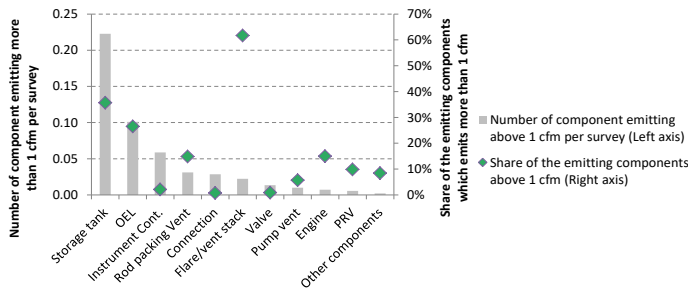
- For our analysis, large emitters include all the components emitting more than 1 cfm.
- About 6% of the emitting components
- Represent 50% of emissions



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Where are the “large emitters”?



KEY TAKEAWAYS

- Large emitters can be found in all types of facilities and for all types of components. (Though some components are more likely to become large emitters)
- As pointed out in previous documents, identifying as early as possible these large emitters will have a significant positive impact on the emissions.

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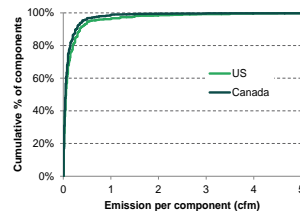
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Are components in US and Canada behaving statistically similarly?

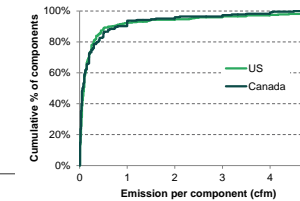
APPROACH

- The project team selected four different component types based on the following criteria:
 - Only leaks
 - Only components with a sample size higher than 200
- Finally two different “tests” have been performed to compare quantitatively the two distributions:
 - Two samples Kolmogorov-Smirnov Test or k-s test
 - Gini coefficient: The Gini coefficient is a measure of statistical dispersion.

Flange



PRV



Are components in US and Canada behaving statistically similarly?

	k-s test	Gini Coefficient		
	$\alpha = 0.1, 0.05$ or 0.01	Canada	US	Difference
Connection - Threaded	NO	64%	66%	2%
Connection - Flange	NO	71%	73%	2%
PRV	YES	77%	81%	3%
Block Valve	YES	62%	70%	8%

KEY TAKEAWAYS

- All the samples evaluated present a skewed distribution
- It is very likely that the results of leak distribution analysis performed in US at the component level are applicable to Canada .
- It is however important to also underline that emission rates are determined by a large number of factors, which may be very different between US and Canada.

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Soon Coming: New report on LDAR in Europe

MAIN QUESTIONS COVERED

- What is the distribution of emission rates and how does it vary depending on the type of components?
- How effective are repairs at reducing the emissions at the time they are implemented?
- How effective are LDAR over time?

APPROACH

- Carbon limits has gathered data from 3 measurement service providers.
- About 800 thousands measured emission points,
- More than 400 facilities surveys,
- The data cover sites in the UK, Netherlands, Spain, and Belgium