



**Management of Fugitive Emissions at Above -Ground
Natural Gas Transmission, Storage
And Distribution Facilities**

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Background

In Canada, all levels of government are keenly interested in establishing policies, codes of practice and regulations to reduce Green House Gas (GHG) emissions. With respect to the natural gas sector, there is particular interest in reducing fugitive emissions as methane is a relatively potent GHG. Of particular relevance to the issue of fugitive emissions is the potential development by Environment Canada of a Code of Practice to Control Fugitive Emissions of Air Contaminants for Oil and Gas sectors. A second initiative of relevance to fugitive emissions is the consideration by Provincial Governments of the implementation of a carbon cap and trade systems.

The natural gas industry in Canada is very supportive of the need to reduce GHG emissions. However, they are also anxious to ensure that the policies, codes of practice and regulations being contemplated are appropriate and will be effective at achieving the desired results. Therefore, through the Canadian Gas Association (CGA), the Canadian Energy Partnership for Environmental Innovation (CEPEI) and other industry organizations, considerable effort is being made to demonstrate that the industry has already been proactively managing fugitive emissions for some time and are continuing to work to improve in this area.

Chart 1 below shows the 2007 Pipeline Sector GHG Emissions as a Percent of Canada's National Inventory. The chart illustrates that the Pipeline sector represents only 1.5% of the national inventory of GHG emissions.

Chart 1

2007 Pipeline Sector GHG Emissions as a Percent of Canada's National Inventory (megatonnes CO₂e)

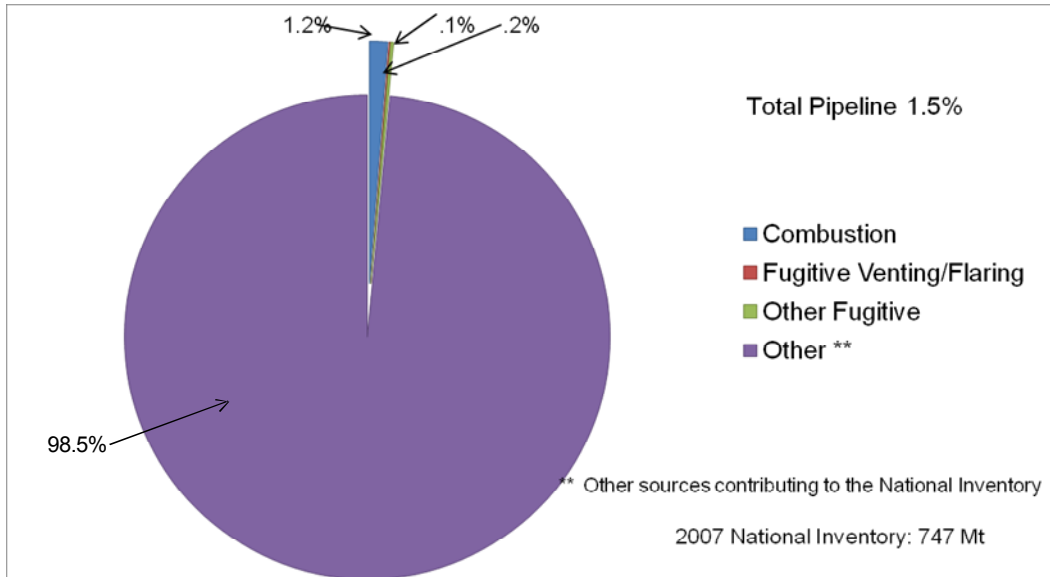
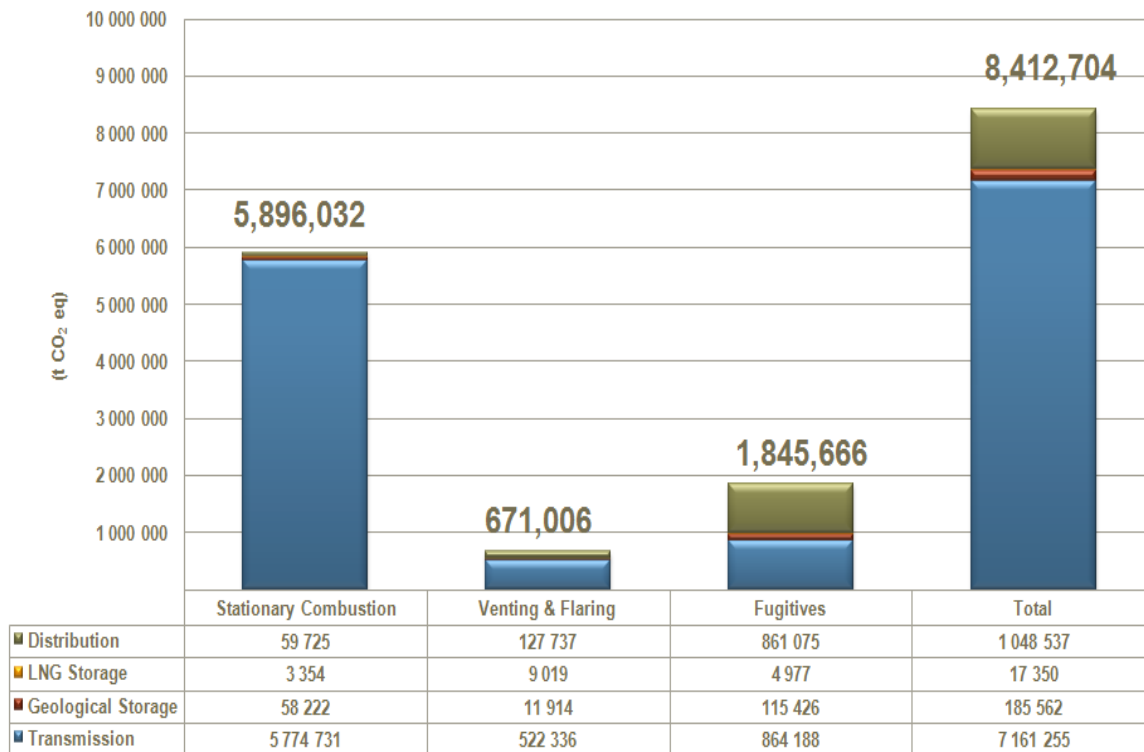


Chart 2 below shows the 2009 GHG Emissions Summary by Pipeline Segment and Emission Source Category. The Chart illustrates that Fugitive Emissions is less than 22% of the industries total GHG Emissions.

Chart 2

2009 GHG Emissions Summary by Pipeline Segment and Emission Source Category

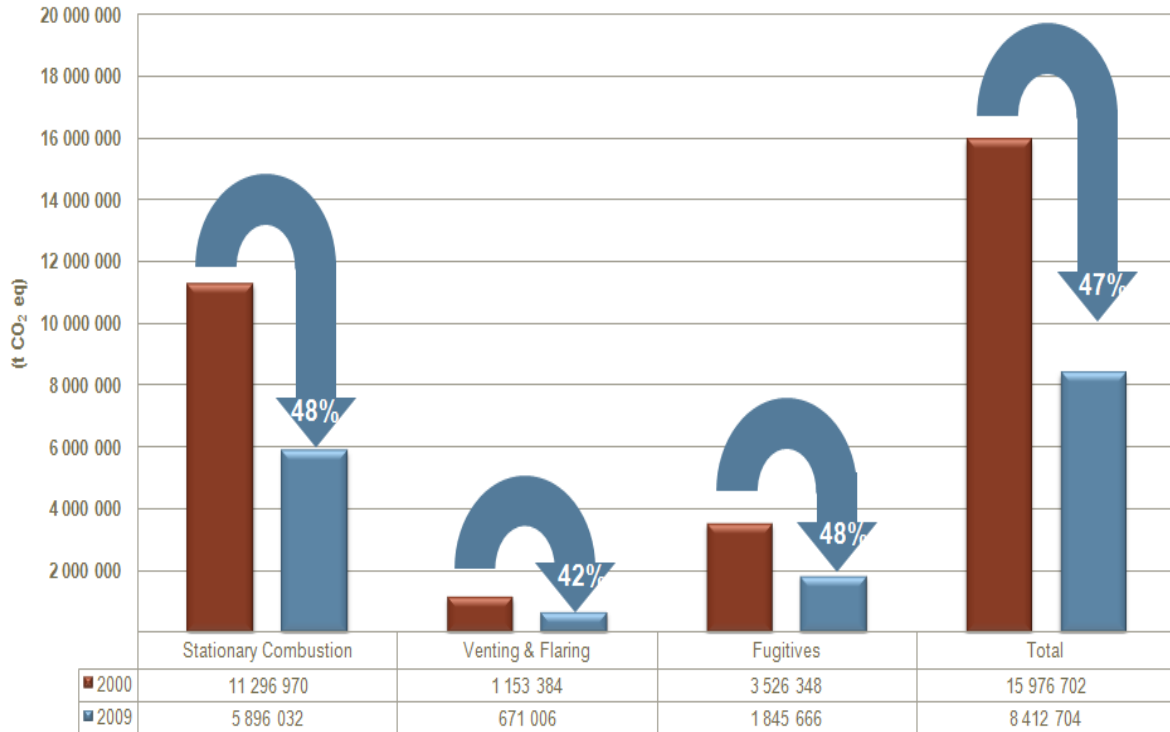


Canadian Natural Gas Transmission and Distribution Companies
2009 Greenhouse Gas Inventory

Chart 3 below shows a Comparison of 2000 and 2009 GHG Emissions by Emissions Source Category. The chart shows that the industry has achieved significant reductions in all sources of GHG emissions over the period from 2000 to 2009. Specifically with respect to fugitive emissions, the industry has reduced these by 48% over this period.

Chart 3

Comparison of 2000 and 2009 GHG Emissions by Emissions Source Category



Canadian Natural Gas Transmission and Distribution Companies
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Although the industry feels that it has done a good job of managing fugitive emissions, it continues to strive to further improve. In particular, with respect to reducing fugitive emissions from underground pipelines, the industry has been developing and implementing a “One Call” system for utility locates, including three digit dialing (i.e. 811), to help reduce third party damages. The industry has also been advocating “Call -Before-You-Dig” legislation with enforcement policies. And, with respect to fugitive emissions from above ground natural gas transmission, storage and distribution facilities, the industry has developed an Industry Guidance document for use by natural gas companies in developing company and site -specific plans for the management of above ground fugitive emissions. A review of the approach taken in this Industry Guidance document will be the primary subject of this paper.

Aims

The Canadian natural gas industry would prefer not to have legislated codes of practice governing the management of fugitive emissions, particularly if these codes are prescriptive. Rather, the industry considers the effective management of fugitive emissions an important element of an overall asset management system. Industry standards in Canada are increasingly based on "management system approaches". And there is a growing consensus among regulators that the use of management systems is necessary to achieve goals and effectively manage risks. The Canadian natural gas industry therefore believes that Asset Management, with its inherent risk based and goal oriented approach, provides an effective framework for managing fugitive emissions.

Accordingly, the Industry Guidance for the management of fugitive emissions has been developed with these principals and objectives in mind. The overall aim of the document is to provide practical guidance to operators for developing customized approaches to manage fugitive emissions at individual natural gas facilities, while giving consideration to each facility's specific circumstances.

With the development of this guidance document, the industry hopes to demonstrate that it is capable of and committed to the effective management of fugitive emissions without the need for prescriptive government legislation.

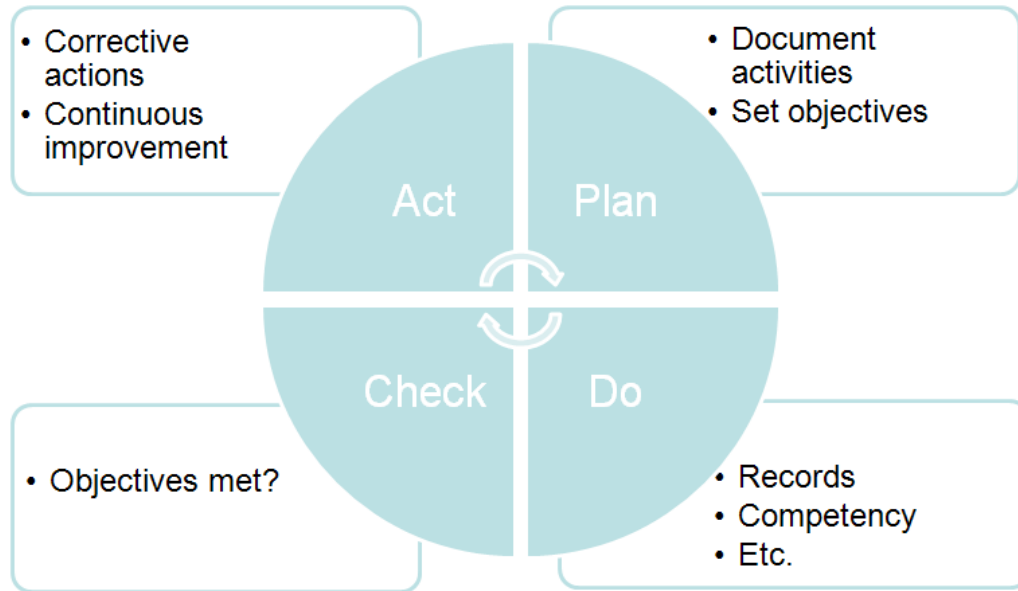
With respect to the possible implementation of cap and trade systems, the industry feels that the challenges in accurately measuring fugitive emissions suggests that fugitive emissions should not be included in cap and trade systems. Once again, to support this opinion, the industry feels that it must demonstrate that it is capable of and committed to effectively managing fugitive emissions without the need for incentive mechanisms such as a cap and trade system. Once again, the development of the Industry Guidance document is intended to demonstrate this capability and commitment.

Methods

The current practice in asset management is based on using a management system approach based on a "Plan, Do, Check, Act" methodology. This approach strives to make optimal asset management decisions by taking a total life cycle view of the asset and by approaching asset management decisions with the objective of achieving an appropriate balance of risk, cost and performance. Diagram 1 below illustrates this management systems approach.

Diagram 1

Management Systems Approach



This approach is adaptable as program objectives change over time and as new technology or methods are adopted. It is also results oriented, requiring operators to determine how they intend to meet objectives and requiring performance measurement to track progress.

The Industry Guidance document uses this approach to outline a management system for the effective management of fugitive emissions at above-ground natural gas transmission, storage and distribution facilities. In defining this management system a number of reference sources were used including the findings from industry and government sponsored studies of fugitive equipment leaks at Canadian natural gas facilities, a review of fugitive emissions measurement data available for Canadian natural gas facilities, current industry practices and an examination of available and emerging fugitive emission detection, quantification and control technologies.

Results

The Industry Guidance for the Management of Fugitive Emissions at Above-Ground Natural Gas Transmission, Storage and Distribution Facilities developed by the Canadian Gas Industry was completed in June 2010. The document specifies the key elements for effective management of fugitive emissions including the application of appropriate technology and standards, implementation of management systems and corporate commitment.

The natural gas industry in Canada is characterized by many smaller facilities distributed over a large area rather than a few large, centrally located facilities; consequently, a practical approach is warranted which focuses on those facilities, components and service applications most likely to offer significant cost-effective emission control opportunities.

The potential for fugitive emissions from leaking equipment components is greater at natural gas transmission and storage facilities than at natural gas distribution facilities, thus warranting a different management approach in each of these sectors. This difference is attributed largely to the fact that natural gas is typically odourised in distribution applications, allowing early and easy detection of leaks. In addition, these facilities tend to lack some of the key high-leak-potential components (e.g., compressor seals and high-pressure blow down systems) more commonly encountered in transmission and storage applications. Furthermore, leak studies have shown that when components do leak, they leak, on average, less in distribution service applications. Also, distribution facilities are typically much smaller in size, less likely to be manned or frequently visited and, therefore, lack the same economies of scale for implementing leak management programs.

It should also be recognized that fugitive emissions management requires ongoing attention. Leaking components, even after successful repair, will eventually reoccur without proper inspection and maintenance. It is also recognized that different types of components and service applications have different leak potentials, and therefore, will require different levels of attention.

Recognising these requirements, the guidance document outlines the need for companies to develop a fugitive emissions management plan designed to ensure effective and verifiable management of fugitive emissions at above-ground natural gas facilities while complying with all applicable regulations.

The key elements of a fugitive emissions management plan, as stated in the document, include :

- A written fugitive emissions management plan endorsed by senior management which documents initial baseline fugitive emissions or leak management performance, and that establishes the scope of the program, clear performance targets, ongoing performance monitoring requirements, critical areas and component categories on which to focus efforts, quality control and quality assurance measures, and the responsibilities of management, operations and maintenance personnel as well as any contractors.
- A system for managing all leak monitoring and repair records, relevant training records, and the calibration and maintenance records for all leak detection and quantification equipment used during each leak survey.
- Documentation of the basis for any ongoing noteworthy refinements to the company specific management plan such as performance-based changes to leak monitoring frequencies for specific component categories.

In the guidance document, the typical key sources of fugitive equipment leaks at natural gas facilities are identified, important considerations and constraints are noted, improved operating practices are suggested, and relevant technologies for the detection, measurement and control of fugitive emissions are identified.

The guidance document proposes that the basic management strategy for effectively managing fugitive emissions at above-ground natural gas facilities requires the implementation of an effective leak management program. The document describes an effective leak management program as follows:

Plan

Companies shall define and document the activities they undertake on their above-ground piping systems for leak detection, investigation, and repair. Planning shall also include the setting of performance objectives. To ensure appropriate consideration of the environmental consequences of leaks, programs shall define objectives and measure performance with respect to fugitive emissions.

Do

Companies shall ensure that defined activities are implemented in accordance with company requirements (e.g., creation and management of required records and competency requirements).

Check

Companies shall review their leak management program to ensure that objectives are met.

Act

Companies shall take action to correct areas where objectives may not be met. In addition, companies shall review their entire leak management program to identify opportunities for continuous improvement. This would include ensuring the ongoing appropriateness of objectives and performance measures.

The guidance document then goes on to describe a number of considerations for above-ground natural gas facility leak management programs including:

Leak Definition

It is important that an objective leak definition be established for application in a leak management program and that this definition meets or exceeds common industry or regulatory standards. A leak at surface facilities is the loss of process fluid past a seal, mechanical connection or minor flaw at a rate that is in excess of normal tolerances allowed by the manufacturer or applicable health, safety and environmental standards. Those leaks in the first category should be fixed wherever this is economical to do (i.e., based on direct repair or

replacement costs and the value of the process fluid being lost), while those in the latter category must be fixed regardless of the cost.

Directed Inspection and Maintenance (DI&M)

DI&M is one methodology that should be considered for a leak management program of above - ground natural gas facilities. DI&M involves the following:

An assessment of system components to determine their susceptibility to leaks (likelihood considerations).

An assessment of system components to determine consequences, should a leak occur (consequence considerations may include volume of gas predicted to be lost in the event of a leak).

Development of leak management activities (leak detection, preventative maintenance, repairs and record keeping) with focus given to higher risk components.

Leak Management Activities

A DI&M program should include the following leak management activities:

Comprehensive Leak Surveys to verify the effectiveness of a facility's overall fugitive emissions management program and provide a check of any components not specifically targeted by other methods.

Targeted Leak Surveys of components identified through the leak susceptibility and leak consequence assessments.

Permanent Instrumented Leak Detection for difficult -to-access components.

Leak Checks upon Equipment Installation and Following Maintenance or Adjustments to ensure that required equipment performance has been achieved.

Component Accessibility

When developing a leak management program, accessibility of the components requiring leak testing should be considered. Visual, audible or olfactory indications of leakage may be deemed appropriate for selected applications.

Tagging Components

To assist with subsequent identification during planned follow -up activities (e.g., re-survey or repair), it is recommended that leaking components be tagged.

Leak Quantification

Leak rates need only be quantified where this is deemed necessary by operations and maintenance personnel for the purposes of evaluating the feasibility of the applicable repair, replacement or control option, or where it is decided to provide quantitative tracking of fugitive emissions (e.g., for use in greenhouse gas reporting). Where it is decided to quantify a leak rate, the accuracy should be sufficient for the required evaluation (e.g., within ± 25 percent or enough to clearly establish a positive net financial benefit for repair decisions). The application of emission factors or leak rate correlations, while appropriate for the development of company-wide and regional emissions inventories are not generally considered to offer adequate accuracy when evaluating individual components. Depending on the type of component and information available, potentially improved quantification methods may include, but are not limited to, process modeling, material balances, flow capture and metering systems, duct sampling techniques, tracer tests and some types of remote sensing methods.

Permanent Leak Detection Systems

The use of permanent leak detection systems should be considered for appropriate applications (i.e., chronic leaking and key difficult-to-access components and vent and blow down lines) to facilitate regular leak detection. Permanent leak detection systems may include the installation of screening ports and sample lines, end-of-pipe flow indicators or in-line flow indicators (such as flow switches or vapour sensors), or other systems appropriate for the selected application.

Leak Repairs

The determination of whether or not to repair a leak should be based primarily on the current and foreseeable health and safety risk. Other factors that should also be considered include the following:

- Impact to the business (e.g., repair costs, including both direct and indirect costs).

- Impact to the environment.

When determining environmental impact, consideration of emission reduction requirements can be accomplished by analysis of a cost-per-tonne of greenhouse gas emitted, or an anticipated cost-per-tonne where emission pricing is not in place. In general, emission reduction plans target the lowest cost-per-tonne leaks first, with higher cost emission reductions being of lower priority.

Records Management

Operators should have appropriate records management in place to support their leak management program. Proper records assist in ensuring that leaking components are identified,

and that appropriate follow-up actions are taken. This information will also assist in justifying modified screening frequencies for targeted leak surveys.

Personnel Training and Competency

Operating companies should ensure that the personnel who perform leak detection and measurement work, whether in-house staff or third-party contractors, have the appropriate competencies for critical tasks.

Examples of topics that should be considered for training and competency programs include:

- Leak detection and measurement techniques.

- Component identification.

- Quality control and quality assurance requirements (e.g., calibration, daily functional checks and maintenance of the employed instruments).

- Safety requirements.

Operating companies should consider periodic audits of work as a method of evaluating the effectiveness of training, and to ensure the completeness and accuracy of completed work.

Quality Assurance and Quality Control (QA/QC)

Fugitive emission programs that do not apply proper care, attention and resources may not identify significant leaks, may result in incomplete emission capture during measurements, and therefore may understate the amount and extent of fugitive emissions. QA/QC measures should be considered within the leak management program.

Measuring the Performance of Leak Management Programs

Review and continuous improvement of leak management programs relies on the development of effective objectives and measures, as well as the ongoing tracking of program performance. Key performance indicators may include leak frequencies, repair success rates, percent of leakers repaired within a defined timeframe, as well as the percent of components scheduled for

repair at the time of major facility turnarounds. As indicators provide an opportunity to trend program performance over time, they should be recorded and reviewed at appropriate periodic intervals (which may vary depending on the measure).

The actual guidance document goes into more detail on all of these topics and provides other guidance such as a sample targeted leak survey program and component-specific control options. The summaries provided in this paper are intended to illustrate the overall approach taken in the guidance document and the scope of topics covered.

Summary/Conclusions

Natural gas pipeline companies in Canada have been proactively and successfully managing and reducing greenhouse gas emissions, including fugitive emissions, since the mid 1990's. The development of the Industry Guidance document outlined as part of this paper is part of the industry's ongoing efforts to improve the management of fugitive emissions. The guidance document is intended to:

- Provide operators with an improved understanding of fugitive emissions and impacts.
- Provide operators the ability to adapt to changes in technologies, methods, business drivers or other areas.
- Support the alignment of environmental risk management with safety, integrity, security and other business risks.
- Facilitate a dialogue with regulators by requiring documented objectives and measured performance.

The guidance document has been presented to government authorities to positively influence the development of potential government policies, codes of practice and regulations governing fugitive emissions in Canada.

References

1. Clearstone Engineering Ltd. For CEPEI and the CGA. INDUSTRY GUIDANCE - Management of Fugitive Emissions at Above -Ground Natural Gas Transmission, Storage and Distribution Facilities. June 2010.

