

TOWARDS EFFECTIVE MANAGEMENT OF METHANE EMISSIONS FROM NATURAL GAS PIPELINES

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ABSTRACT

Methane emissions from TransCanada's pipeline operations can be categorized into fugitive losses and vented emissions. There are a number of facets to TransCanada's methane emissions management program: source identification, quantification, tracking system, mitigative actions, pilot program, full scale implementation, monitoring progress, and continuous through research and development. In 2002, TransCanada's methane emissions management program avoided 1.1 millions tonnes of carbon dioxide equivalent from being emitted to the atmosphere. This paper documents TransCanada's methane emissions management strategy, its implementation and results obtained from source identification to research and development.

1.0 INTRODUCTION

TransCanada PipeLines Ltd. (TransCanada) is Canada's largest natural gas pipeline company combined with a growing power generation business. TransCanada owns and operates a 37000 kilometer pipeline system that contains more than 110 gas compression facilities, 1200 gas metering facilities and over 5000 valve sites. The gas compression facilities have a combined capacity of nearly 4000 megawatts. TransCanada's Canadian facilities emit nearly nine million tonnes of carbon dioxide equivalent. Based on 2002 data, approximately nine per cent of TransCanada's greenhouse gas (GHG) emissions originate from methane losses along its pipeline network. Without the methane emissions management program in place TransCanada's GHG emissions would be 11 per cent higher (equal to 20 per cent of total GHG emissions). Carbon dioxide (89 per cent) and nitrous oxide (two per cent), result from combustion processes that take place at the compression facilities contribute to the remaining of 91 per cent of GHG emissions.

2.0 A METHANE EMISSIONS MANAGEMENT MODEL

The management of methane emissions at TransCanada is part of TransCanada's overall strategy towards Climate Change. The Climate Change strategy is guided by several principles developed by TransCanada, of which one principle is dedicated towards the development and implementation of a GHG emissions reduction program. The methane emissions management model (Figure 1) at TransCanada can be broken down into three tiers: i) Tier 1 - Senior Leadership Support, ii) Tier 2 - Program Management, and iii) Tier 3 - Execution and Monitoring. This model is based on TransCanada's experience in the development and implementation of a methane emissions management program. It was developed in order to maintain future methane emissions reduction efforts on natural gas pipeline system.

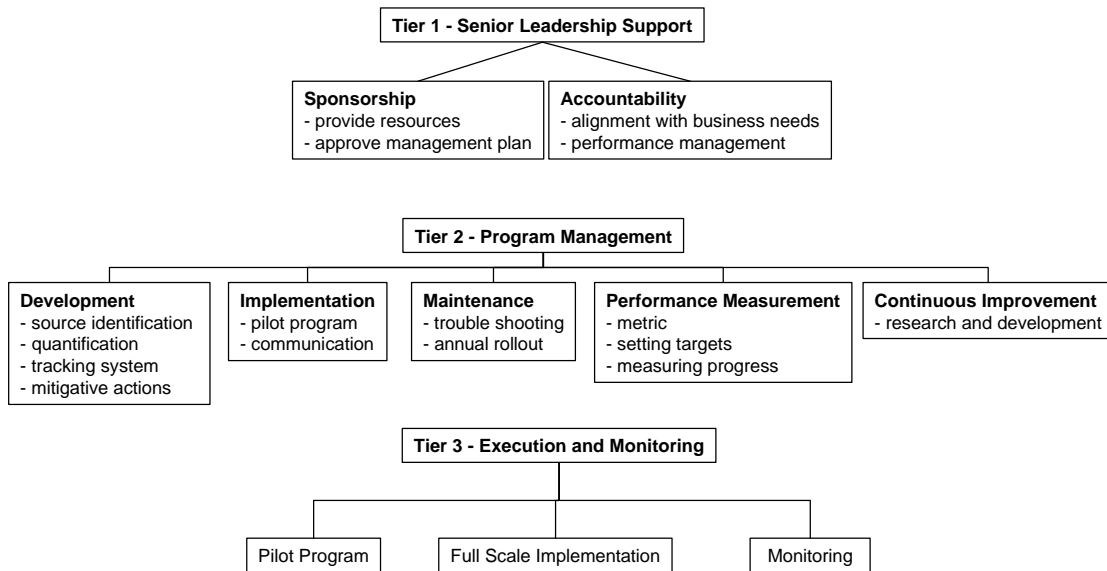


Figure 1: A Three-Tier model for methane emissions management from natural gas pipeline.

Tier 1 provides the necessary leadership and resources needed to carry out the management program. There are two key elements to Tier 1, sponsorship and accountability. One senior level leader within the firm is assigned the role of championing the program. This champion's role is to obtain support from leaders of the various departments that influence decision making with respect to methane emissions and control strategies. The other key role for this champion is to provide accountability for the program. That is, making sure that the program is aligned with business needs and that it becomes a measure of business performance. This alignment demonstrates to all parties that management of methane emissions is an important part of the business cycle.

Tier 2 and Tier 3 are carried out by a multi stakeholder team from the various interested departments across the firm. There are several components within Tier 2; development of an emissions management program is the first step and it involves identification of emissions sources, quantification of emissions, development of a system to track emissions and take mitigative actions. The identification emission sources leads to the development of techniques for emissions quantification. In some cases, quantification means the use of standard engineering calculations to quantify emissions. While in other cases, it may involve research and development work to develop procedures and protocols to quantify emissions. In order to control and effectively manage methane emissions mitigative actions need to be investigated and implemented. The next step in the management plan is it's "Implementation." There are two components to this stage, development of a pilot program and a communication plan. The pilot program should be a focused effort that attempts to address possible issues that will arise in the full scale implementation of the management program. Some considerations for the pilot program are, geographical area,

audience, sites for field testing the quantification and tracking systems, and evaluating mitigation options. This communication needs to be focused on all levels of management and employees involved with the program.

The management program will require ongoing "Maintenance." This maintenance needs to be carried out with a mechanism for trouble shooting during the annual roll out of the program. The annual roll out is an opportunity for communicating messages and addressing issues that arise in the previous year. Performance measurement is an important component in the overall management plan. The first step is to determine a metric for the performance, the next is establishing both short term and long term targets and then establishing a periodical system of measuring progress. Continuous improvement is a business value as well as an environmental ideal. Research and development is an important tool for achieving this ideal. Special effort needs to be put forth so that new and innovative ideas for emissions quantification, mitigation and management are continually sought after.

The final stage of the model, Tier 3, is Execution and Monitoring. There are three components to be considered at this point: implementing a pilot program, full scale implementation and ongoing monitoring. The pilot program phase is really the opportunity to assess the program and its effectiveness on a small scale. A comprehensive pilot program is needed before full-scale system implementation. Another important element is monitoring, where a process is put in place to assess the program on continuous basis.

3.0 THE TRANSCANADA EXPERIENCE

Methane is emitted to atmosphere during the construction and operation of gas metering stations, gas compressor stations, valve sites and from the pipeline itself. There are two categories of methane emissions arising from TransCanada's operations; fugitive losses and vented emissions. Fugitive losses are either engineered emissions of methane or leakages that occur on equipment such as valves and flanges. Vented emissions of methane arise from the evacuation of natural gas (which is mainly composed of methane) from pipelines, losses from compressor starts to purging of pipelines. The methane emissions management program is facilitated by the Department of Community, Safety and Environment. However, it is not a completely integrated system of methane emissions management. This is shown in Figure 2. Fugitive losses from TransCanada's pipeline network are managed by a multi stakeholder team, known as the Fugitive Emissions Management team (FEMT) and the vented emissions are managed by the Blowdown Emissions Team.

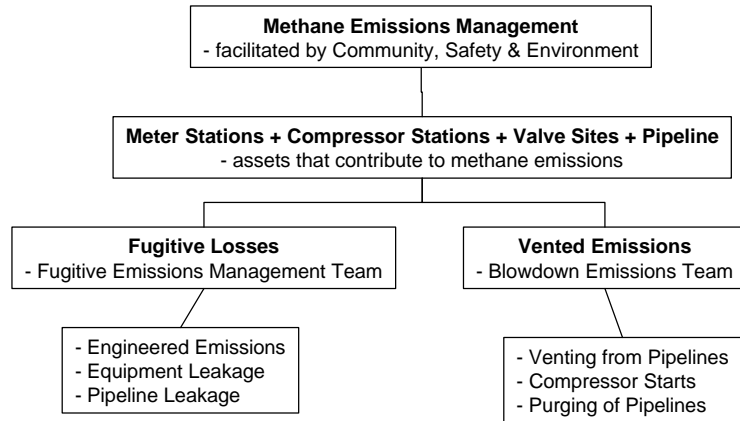
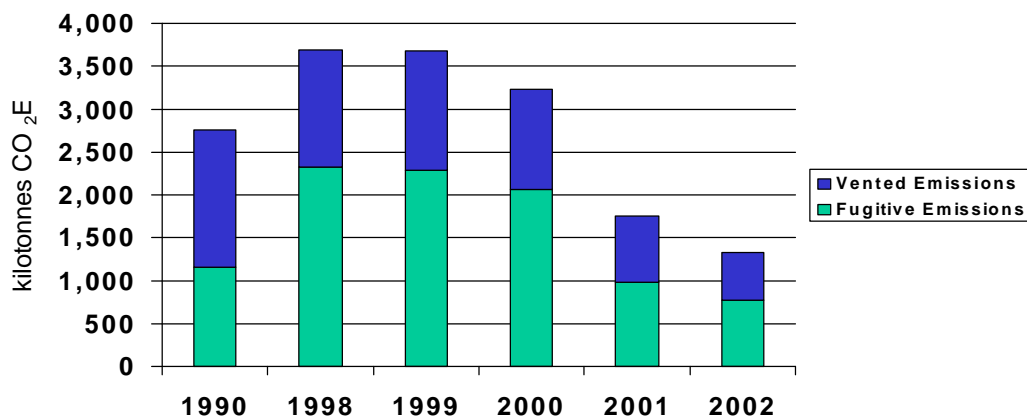


Figure 2: The methane emissions management structure at TransCanada is divided into managing fugitive losses and vented emissions.

The system to manage methane emissions is not fully integrated because both fugitive emissions and vented emissions require a different approach to management. In the case of fugitive losses, they are small sources of emissions from thousands of continuous leaking components. These need to be identified, prioritized and repaired in order to manage them effectively. Vented emissions are large single events of methane releases to atmosphere. In many instances, vented emissions are avoided or greatly minimized by applying a mitigation options. In 1990, fugitive losses accounted for 42 per cent of methane emissions and in 2002 fugitive losses accounted for 74 per cent of methane emissions. Over all methane emission declined significantly, 72 per cent, between 1990 and 2002 (Graph 1).



Graph 1: The contribution of vented and fugitive emissions to total methane losses from TransCanada's pipeline operations.

3.1 Management of Fugitive Losses

The FEMT is comprised of management and personnel from engineering, representatives maintenance regions across TransCanada and the environment department. The team is sponsored by a senior management representative.

There are three major areas of program development and management for the FEMT. This is shown in Figure 3.

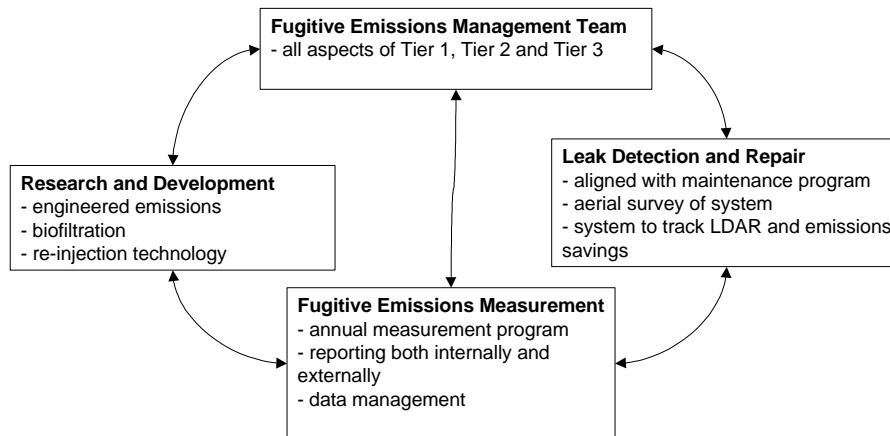


Figure 3: The fugitive emissions management team has three major areas of management responsibilities, research and development, fugitive emissions measurement and implementing a leak detection and repair program.

The key element behind the measurement program is the device High Flow Sampler, which was developed through collaborative research with government and industry groups. This technology has allowed TransCanada to accurately measure fugitive losses. Approximately 20 per cent of the facilities are subjected to High Flow Sampler measurements annually. The data collected from these measurements are used to develop emission factors for TransCanada facilities and are used to report emissions internally within TransCanada and externally. It also provides the basis for setting annual targets for fugitive emissions reductions.

In parallel with the measurement program, is the Leak Detection and Repair (LDAR) program. This program is closely aligned with TransCanada's preventive maintenance program and is administered through this process. The LDAR program is an annual activity for selected facilities across Canada. A system has been implemented using the FEMT to track the LDAR progress and resultant savings in emissions from mitigation activity.

There are two research initiatives underway to address engineered emissions. One is a biofiltration project, where methane is oxidized in a biofilter cell into carbon dioxide. This reduces global warming impacts by 85 per cent. The other major initiative is research into the re-injection of engineered emissions into the pipeline system. In 2002, approximately 191,000 kilotonnes of carbon dioxide equivalent of fugitive losses were avoided from being emitted to the atmosphere.

3.1 Management of Vented Methane

The management of vented methane is a shared responsibility between the engineering and operations department. The Blowdown Emissions Team

monitors and facilitates the management of the vented emissions. A senior management representative sponsors this team and a variety of stakeholders are represented on this committee.

A tool called the Outage Decision Model (ODM) is a tool that has been developed by TransCanada's operations planning group to facilitate how pipeline and system outages are addressed. Construction and maintenance activity along the pipeline facilities often require the system to come off line. In the past, this has been synonymous with the venting of methane. Outages along the system also have a financial impact to TransCanada in the form of the value of natural gas that is vented and lost revenue during the outage time.

Tracking of methane fall into two categories, actual emissions emitted to atmosphere and the emissions saved by implementing mitigative measures. The volume of methane emissions saved is captured by the emissions tracking system that is managed by the operations planning group. The methane vented is captured in TransCanada gas accounting system. When an outage is required, a request is put forth to the operations planning group. The ODM is used to determine the best course of action for the outage, which includes mitigation techniques (Table 1). During the outage itself, field personnel are required to fill out forms that provide detailed operations information that allow the gas accounting system and the emissions tracking system to determine the volume of methane vented and saved.

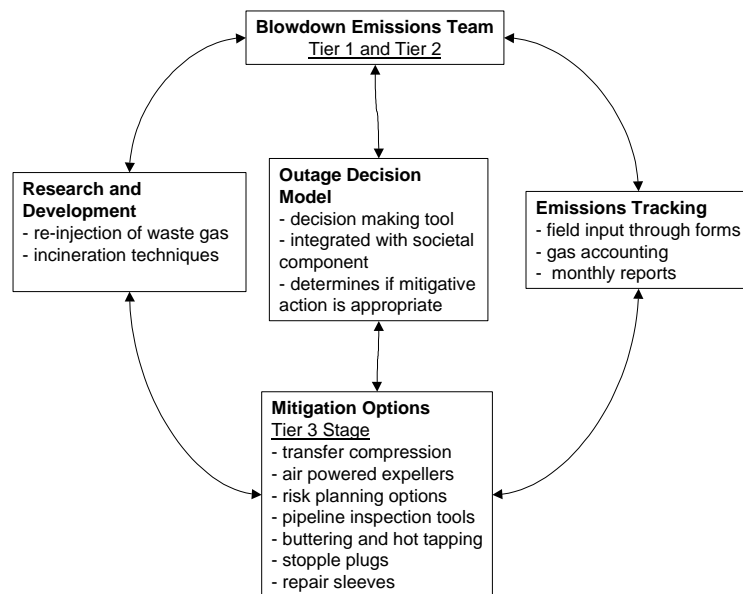


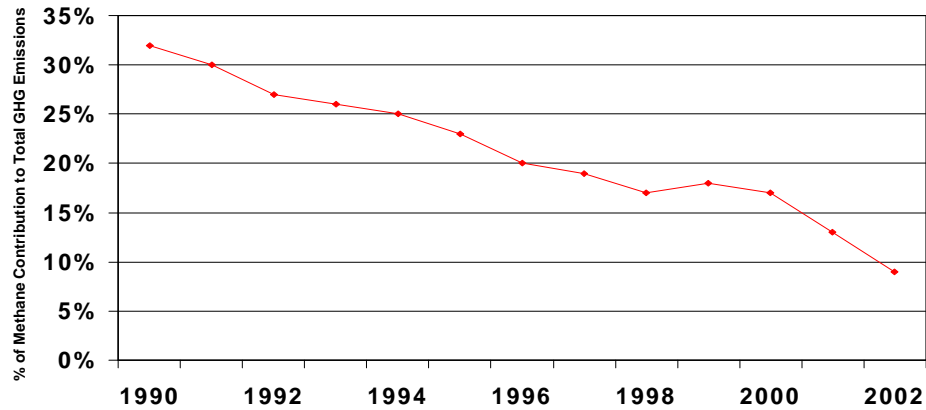
Figure 4: Venting of methane emissions to atmosphere, the application of the appropriate methane mitigation options and savings from emissions reduction activities are monitored and managed by the Blowdown Emissions Team.

Table 1: Summary of Mitigation Options and Savings for Vented Emissions

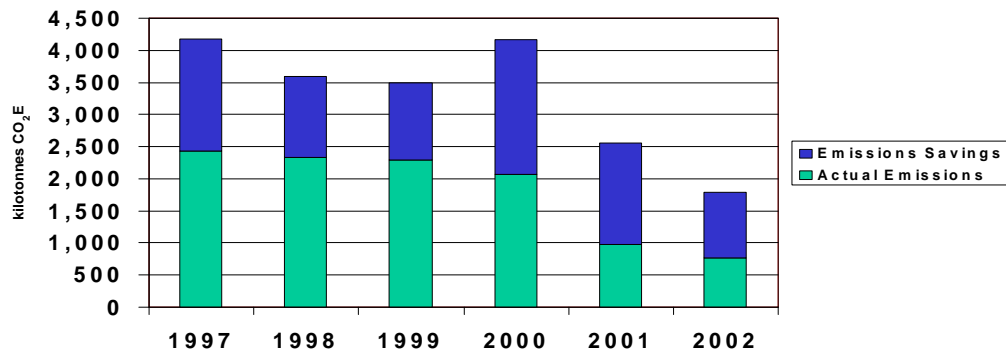
Mitigation Option	Description	2002 Savings (tonnes CO₂E)
Transfer Compressors	When a section of pipeline is taken out of service for construction or maintenance, one or more transfer compressor is used to pump gas from the isolated section to a pipeline that is still in service.	362,000
Air-Powered Expellers	After transfer compression has been completed, small amounts of residual methane remain in the affected pipeline section. The methane is removed using a fan-type expeller that draws off the residual gas from the pipeline section being repaired. Air is used to drive the expeller, instead of methane.	5,730
Incineration	Some methane left in pipelines after the use of transfer compressors. The remaining gas is usually vented to atmosphere. Incineration allows for the remaining methane to be oxidized and lower the GHG emissions emitted to atmosphere. A pilot test was conducted in 2002.	1,100
In-Line Inspection Tools	These are tools, called "pigs," that are commonly used to inspect the internal condition of pipelines. TransCanada has enhanced this tool so that it can detect stress corrosion and cracking. Thereby, reducing the need to vent gas to atmosphere and reducing methane emissions.	Not Quantifiable
Valve Sealing	This is a TransCanada derived procedure that allows the application of a special sealant and avoids the need to vent gas from a pipeline.	12,540
Buttering and Hot Tapping	These are procedures that allow for a section of pipe to be added on a existing section without the need to vent gas to atmosphere.	374,000
Repair Sleeves	These are fibre or steel enforced sleeves that are used to repair corrosion on a pipeline system and avoid the need to vent methane to atmosphere.	220,000

4.0 RESULTS

The baseline year for GHG emissions has been established at 1990 in accord with the Kyoto protocol. In 1990, methane emissions contributed to 32 per cent GHG emissions from pipeline operations (Graph 1). Since then, due the implementation of a methane emissions management program, the total methane emissions have declined, contributing to only nine percent of total GHG emissions in 2002. Methane emissions, in some past years, would have been double or more without the implementation of the existing management plan for vented and fugitive losses (Graph 2).



Graph 1: The contribution of methane emissions to total GHG emissions has declined steadily since the baseline year of 1990



Graph 2: Methane emissions would have doubled without the implementation of reduction and management program.

5.0 CONCLUSIONS

There are a number of facets to TransCanada's methane emissions management program: source identification, quantification, tracking system, mitigative actions, pilot program, full scale implementation, monitoring progress, and continuous through research and development. The management of methane emissions is coordinated through a multi stakeholder team that consists of personnel from engineering, field operations, environment and system operations.

6.0 REFERENCES

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