

From: Chris Keating, Keating Research, Inc.

Date: April 10, 2016

**Re: *The Colorado Case Study On Methane Emissions: Conversations With The Oil And Gas Industry*
Key Findings From Interviews With Representatives Of Companies That Are Conducting Site
Inspections To Detect Methane Leaks At Oil and Gas Operations In Colorado**

These key findings are based on 30 minute telephone interviews among 10 representatives of oil and gas companies and 3rd party suppliers that are conducting site inspections to detect methane gas leaks at oil and gas operations in Colorado as required under Colorado's Regulation 7. Interviews were conducted with representatives from larger oil and gas producers, smaller producers and leading companies in the third party service provider industry. These interviews were conducted on behalf of the Center For Methane Emissions Solutions by Keating Research from December 7, 2015 to January 31, 2016.

To complete these 10 interviews, Keating Research contacted 35 oil and gas companies in Colorado and invited each of them to be interviewed about their experience with Colorado's Regulation 7. Interviews were completed with representatives of all of the oil and gas companies that expressed a willingness to participate in this research.

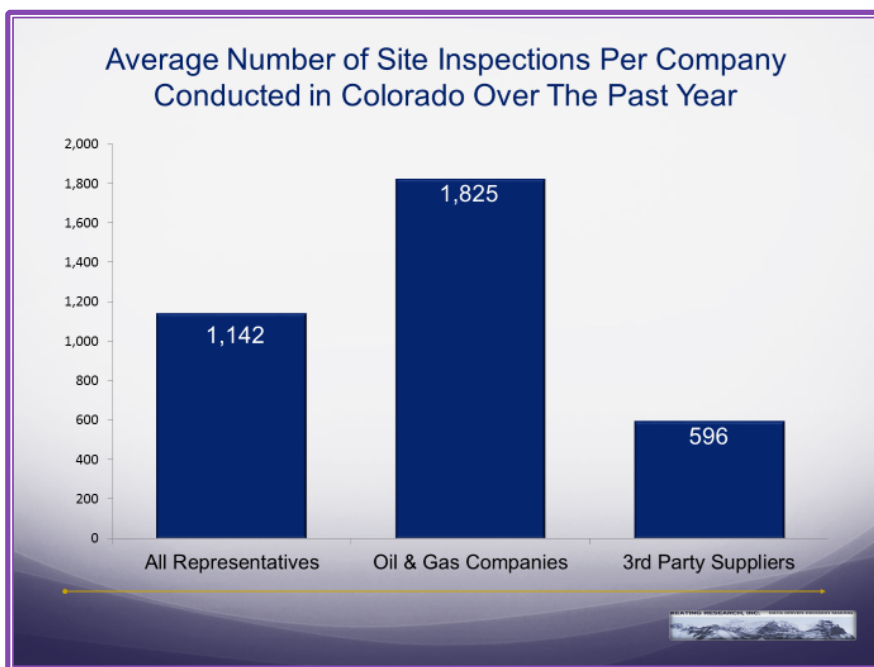
Colorado oil and gas companies have conducted thousands of site inspections over the past year as required under Colorado's Regulation 7.

In fact, the companies interviewed here conducted more than 1,100 site inspections on average at their oil and gas operations in Colorado over the past year.¹

The inspections are working to help find methane leaks. When we ask representatives to tell us how many methane leaks they are finding during a *typical* site inspection, **they report finding 2 to 3 methane gas leaks on average, and they find at least one methane gas leak in 9-out-of-10 typical site inspections.**

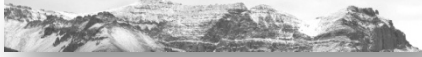
As a result of these site inspections over the past year, these representatives tell us, on average, that their company found more than 800 methane leaks in Colorado.

The equipment most predominately used to detect these methane leaks during a site inspection is an *infrared gas imaging and detection camera*. Eight-of-ten representatives say they commonly use an infrared gas imaging and detection camera to detect leaks, while the remaining say they most often use a portable methane detector unit.



¹ A site inspection is defined as when they go out to an area or property with oil and gas operations to do an inspection for methane gas leaks.





The infrared gas imaging camera does not allow the user to determine how much methane was leaking by volume, so representatives were unable to give us specifics on exactly how much methane was escaping from the leaks that they found.

Most of the methane leaks are described as small and easily fixed within a few days.

The vast majority (88%) of methane leaks that were found during site inspections over the past year are described as a small leaks, while about 1-in-10 are described as large, significant leaks.

In 9-of-10 cases the representatives agree that the cause of the leak is typically something simple such as an open valve or a loose connection or seal, while only 1-in-10 of the leaks are considered more problematic than that.

When it comes to fixing the leaks, if the repair is simple enough an attempt is made to make the repair right then on the spot, and **nearly all of the leaks are either *fixed right there on the spot* (30%) or *fixed within a few days* (66%).**

In fact, representatives indicate that a repair technician typically moves around with the team finding and repairing the methane leaks. Only a very small proportion of the leaks take longer than a few days to fix.

Representatives tell us that the small methane leaks are primarily found in *regulators / controllers, separators, valves and tank hatches*.

The cause of the leak is typically *debris*, a *loose connection* or *wear and tear* on the equipment. Specific examples given in the survey of equipment that was found to be leaking and the cause of the leak include the following:

T-12 thermostat regulator. The cause was dirt or debris in the component.

Packing on a valve. It was caused by a loose bolt.

High low controllers. The controller was faulty.

Loose fittings on separators. Most common is tanks.

Valve and flow line. It was caused by the age of the equipment.

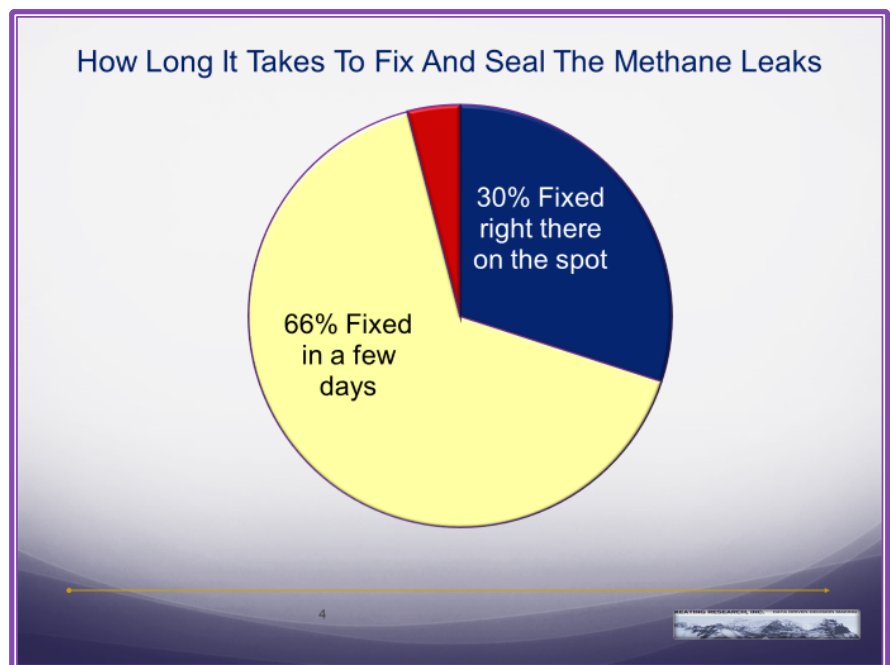
Seal on a tank hatch. Debris caused the seal to leak

Hatch. The cause would be wear and tear.

Numeric devices. Loose packing.

The hatches on the storage tanks and the cause is over pressure of the storage tanks.

Well head the casing tubing is leaking because of its age.





Threading connections, high low controllers the thief patch seal, T-12 and liquid levels.

Flange, where to parts fit together and the seal of the flange will leak.

Pipe connection leak and the clamp was loose.

Leaks on a vapor line. Because of bad fittings.

Colorado's oil and gas companies are finding leaks across all types of equipment at the site, with the most leaks in the storage tanks, 8-of-10 representatives say that they are finding *a lot* or *some* leaks in the storage tanks.

Methane leaks are also typically found in systems other than gas wells and compressors, 6-of-10 representatives say that they are finding *a lot* or *some* leaks in the other systems or structures.

The methane leaks in the other systems or structures are primarily found in the *piping, threaded connections* or the *regulators*.

Representatives describe the following types of methane leaks they are finding on other systems or structures:

Pumps or valves or connectors.

Small connections like fittings, thermostat regulators, and pressure regulators.

Threaded connection.

Separators.

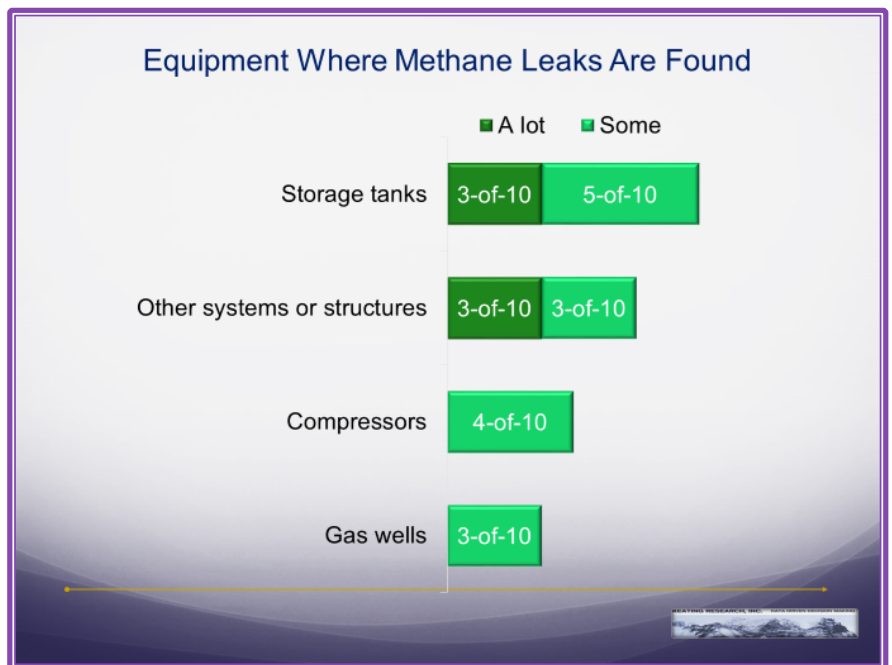
Piping and plumbing. Fitting valves and valve packing.

Pipe connections that have small leaks and they are fixed on the spot or at least a few days.

Emission control devices. Two and three phase separators and vapor recovery towers.

Storage facilities, piping, controllers.

Emission controls or vapor line piping.



Oil and gas company representatives agree that Regulation 7 significantly reduces methane emissions in Colorado.

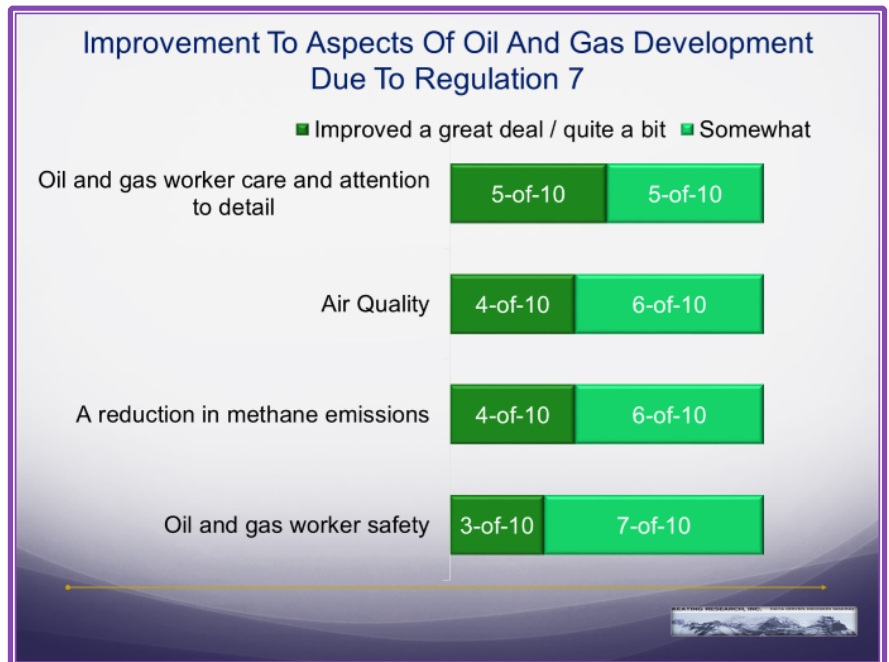
What is most encouraging is that oil and gas company representatives are taking notice that finding and fixing the thousands of methane leaks under Regulation 7 is reducing methane emissions in Colorado. Six-of-ten representatives *agree* with the statement – **Regulation 7 significantly reduces methane emissions in Colorado**, compared to 3-of-10 who *disagree*.

Four-of-ten representatives feel that Regulation 7 is improving air quality and reducing methane emissions *a great deal* or *quite a bit*, while the remaining say that these aspects are improving *somewhat*.



In addition to reducing emissions and improving air quality, oil and gas company representatives also believe that Colorado Regulation 7 improves their companies' efficiency – it improves oil and gas worker care, attention to detail, and safety.

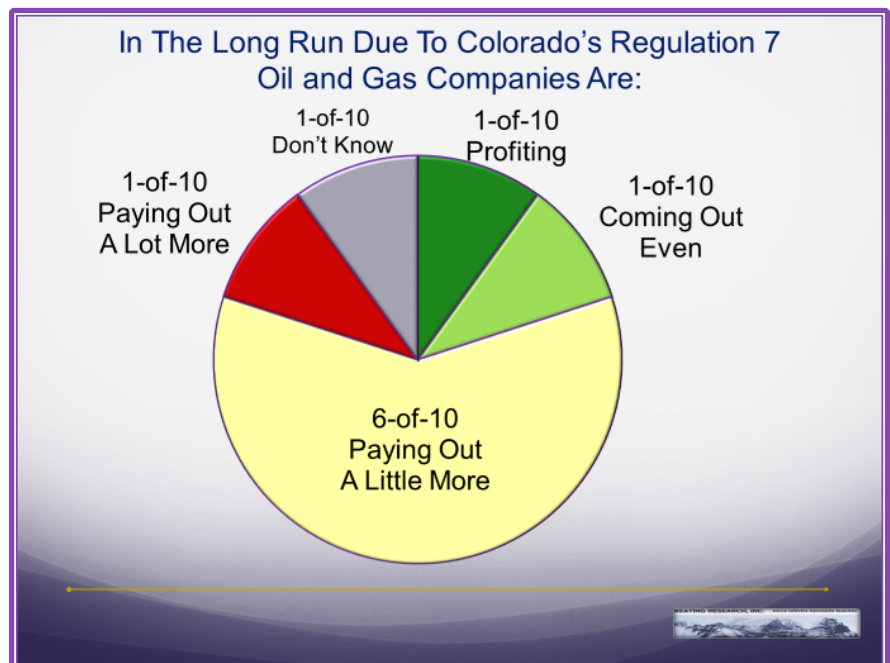
At the top of the list is oil and gas worker care and attention to detail, 5-of-10 representatives say worker care and attention to detail is improving *a great deal* or *quite a bit*, while the remaining say worker care and attention to detail is improving *somewhat*.



Eight-of-ten of oil and gas company representatives say that in the long run they are profiting, coming out even, or paying out just a little more than they are collecting in new revenue because of Colorado's Regulation 7.

Oil and gas company representatives understand that when they balance out the money they are spending to find and fix the methane leaks against the additional revenues they are receiving from the gas they are recapturing, 8-of-10 say that they are profiting, coming out even or paying out *a little* more money than they are collecting in new revenue.

Only 1-in-10 say that they are paying out *a lot* more money to find a fix the leaks than they are collecting in new revenue.

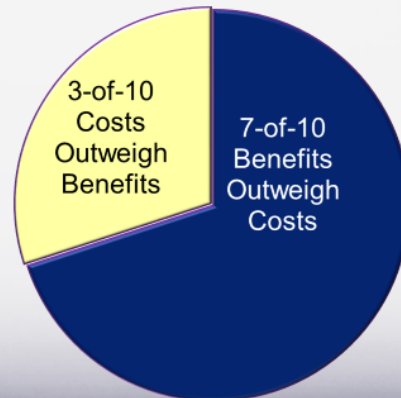




Oil and gas company representatives believe the benefits to finding and fixing the leaks under Colorado's Regulation 7 outweigh the costs.

In fact, when all of the monetary and other benefits from Regulation 7 are taken into consideration, representatives are more than twice as likely to say that the benefits outweigh the costs. A full 7-of-10 believe all of the benefits of Regulation 7 outweigh all of its costs.

Taking into account the cost to find and fix the leaks under Colorado's Regulation 7 and all of the monetary and other benefits to recapturing the methane, would you say the costs outweigh the benefits or the benefits outweigh the costs?



Chris Keating, Ph.D., President and founder of Keating Research, has worked as a public opinion pollster in Colorado for the past 21 years. Keating Research has established itself as the leading survey research firm in Colorado, having conducted hundreds of survey research projects in Colorado and Denver alone.