FACT SHEET AND ANALYSIS

# Fixing the Leaks: What Would it Cost to Clean Up Natural Gas Leaks?

**About the Authors:**

The study was designed, carried out, and written by **Carbon Limits,** a Norwegian consulting company with long standing experience in climate change policies and emission reduction project identification and development. It works in close collaboration with industries, government, and public bodies to reduce greenhouse gas emissions, particularly in the oil and gas sector.

The study was commissioned by the **Clean Air Task Force**, a non-profit group that works to help safeguard against the worst impacts of climate change by catalyzing the rapid global development and deployment of low carbon energy and other climate-protecting technologies through research and analysis, public advocacy leadership, and partnership with the private sector.

*This fact sheet was prepared by Clean Air Task Force, based on the results of the study performed by Carbon Limits.*

Methane is a potent climate pollutant: it is the second most important greenhouse gas behind $CO_2$ and, pound-for-pound, it is dozens of times more potent than $CO_2$. The oil and gas industry is the biggest emitter of methane in the US, and leaks from components like connectors and valves account for nearly 30% of these emissions. These leaks warm the climate at least as much as all of the power plant $CO_2$ from New England, New York, and New Jersey. These figures are based on EPA estimates of leaks from oil and gas facilities, and numerous independent studies have shown that EPA's figures are significantly too low.

A new study commissioned by Clean Air Task Force shows that finding and fixing these leaks is a cost-effective way to reduce methane pollution.

## Study Design

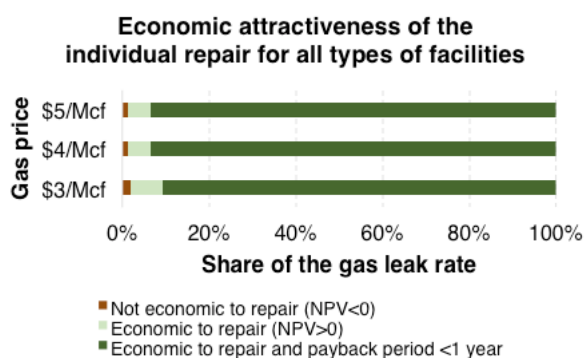
The study is based on *actual leak data from over 4,000 leak detection and repair (LDAR) inspections of oil and gas facilities,* such as well sites, gas compressor stations, and gas processing plants. The data was compiled by two firms that inspect oil and gas facilities for leaks and other excess emissions on behalf of the industry, and it was provided to the study authors.

The inspectors used infrared (IR) cameras to identify over 58,000 individual components that were leaking or venting gas. Nearly 40,000 of these were *leaks* from static components (connectors, valves, regulators, and other non-moving parts);[1] this study focused on static leaks in particular because of a lack of previously available empirical data on the cost-effectiveness of using IR cameras to find and repair leaks.

The inspection firms provided facility inspection costs and, for every leak they found, data such as the size of the leak[2] and how much it would cost to repair. With this data, our study was able to directly calculate the costs and benefits of programs that inspect oil and gas facilities for leaks and fix the leaks that are found.

## Main Results

**Because fixing leaks saves gas that would otherwise be wasted, it allows companies to sell more gas. Once the company identifies the leaks, repairing almost every leak pays for itself.** Even if gas prices were as low as $3 per thousand cubic feet, over 90% of the gas leaking from these facilities is from leaks that can be fixed with a payback period of less than one year.




**Accounting for the cost of surveys and repairs, and the value of gas conserved by repairs, frequent LDAR surveys of all types of facilities are a cost-effective way to reduce air pollution from oil and gas facilities.** We calculated the cost effectiveness of reducing leaks – the cost per ton of avoided pollution, a common metric for air pollution control measures. Natural gas is mainly methane, but it also contains smog-forming volatile organic compounds (VOC). Our study calculated the abatement cost per ton for both methane and VOC.

LDAR surveys performed quarterly would abate methane at a net cost of less than $280 per metric ton ($11/ton $CO_2$e using a global warming potential of 25) for all types of facilities. Monthly surveys of well sites and gas plants have methane abatement costs of around $800 to $900 per metric ton. This is less than the most recent estimates of the damage caused by methane emissions – EPA economists calculate that a metric ton of methane emissions causes $970 of damage to society.[3] The methodology for these calculations certainly *underestimates* the costs of damage from greenhouse gases.[4] So monthly inspections at wells and gas plants would be worth the net cost. As discussed below, our study was designed to be conservative, so these are actually *overestimates* of the abatement cost of leak detection. Clearly, surveys as frequent as every month are justified, even when only considering the avoided methane emissions.

VOC abatement costs are also reasonable: for monthly inspections net costs are below $3,500 per ton of avoided VOC emissions. This compares well with the cost-effectiveness of

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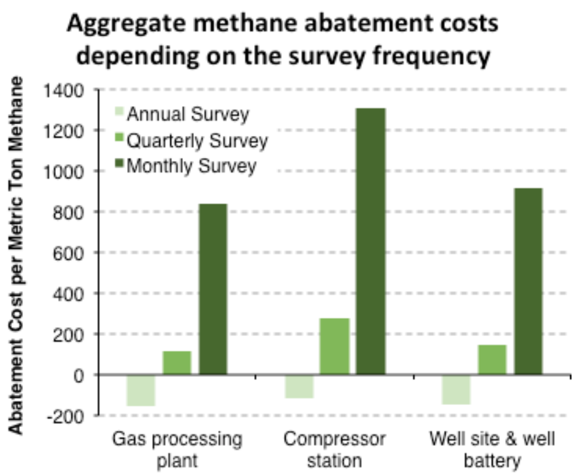
[1] The remainder of emissions sources included from compressor seals, tanks, and venting sources such as pneumatic equipment.

[2] Inspectors used a second device, a high-flow sampler, to measure how much gas was leaking. For some leaks, they estimated the leak rate with the IR camera.

[3] This value is the calculated damage from methane emitted in 2015 using a 3% discount rate, the same parameters (and using the same methodology) used by the White House Office of Management and Budget to calculate the social cost of carbon dioxide. See: Marten, A.L., and Newbold, S.C. "Estimating the social cost of non-$CO_2$ GHG emissions: Methane and nitrous oxide." *Energy Policy* **51** (2012): 957, available at: http://tinyurl.com/kdbbf4z.

[4] See for example: http://costofcarbon.org/reports.

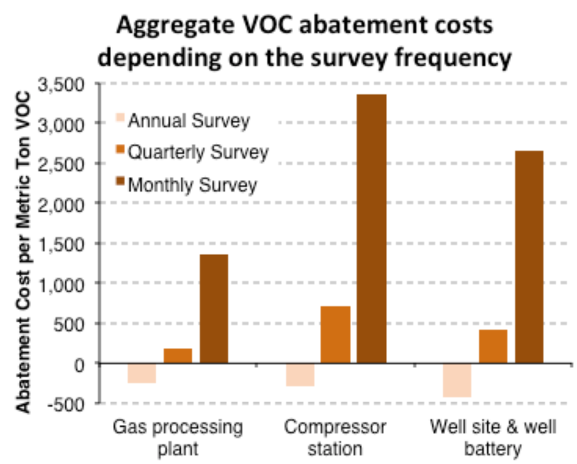
measures that reduce VOC emissions from other industries and estimates of the societal cost of VOC emissions.




**IR camera LDAR surveys identify cost-effective opportunities to reduce emissions from oil and gas facilities beyond leaks from components.** IR cameras allow inspectors to quickly, efficiently, and effectively survey all the equipment at a site. Inspectors measured emissions not just from leaks, but excess emissions from other equipment, such as compressor seals and pneumatic controllers, which are also quite substantial.

To explore the benefits and costs of mitigating other sources beyond leaks, we used the measured data on emissions from compressor rod seals in our database. Our study found that it would be economic (i.e., profitable to facility owners) to replace the seals on 13% of the compressors at gas processing plants and on 19% of the compressors at compressor stations. However, while the subset of compressors seals that are economical to replace is low, these compressors emit methane disproportionately. 70% of the emissions from compressor seals at processing plants comes from this subset of compressors; at compressor stations, the figure is 73%.

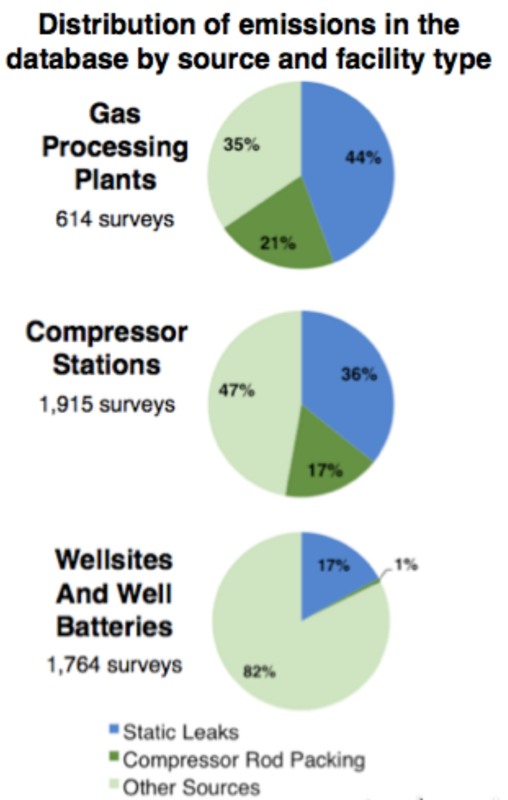
Replacing these compressor seals would significantly increase pollution reductions resulting from IR camera LDAR inspections. For example, fixing the leaks the surveys identified at gas processing plants would reduce emissions of methane from gas processing plant an average of 23 tons per year. If economic (profitable) compressor maintenance were also performed, methane reductions would rise 27% to 29 tons per year. For compressor stations, including compressor maintenance would reduce emissions by 25%.




Data limitations prevented the study authors from examining the economics of measures to reduce emissions from other sources, like tanks or pneumatic valve controllers. However, the example of emissions reductions from replacement of compressor rod seals shows that inspecting facilities in this way can reduce emissions – and provide economic value from conserved gas – beyond the identification of leaks from static components.

## Policy Relevance

Depending on the frequency of surveys, LDAR programs can substantially reduce emissions from oil and natural gas facilities. The state of Colorado estimated that monthly inspections would reduce emissions by 80% in the state's analysis for recently passed regulations requiring inspections of oil and gas facilities. A recent study from Canada reports that leak emissions have been reduced 75% as a result of inspection requirements – a mix of quarterly and annual inspection for various equipment types.[5]




Just a small fraction of oil and gas facilities in the US are required to undergo regular leak detection inspections. Nationwide, only gas processing plants built since 1984 are required to find and fix leaks, and most need not check for leaks from equipment that handles processed natural gas (which is still mostly methane, but contains a smaller portion of VOC). At the state level, Colorado has recently adopted regulations that require operators of wells and gathering compressor stations – both new and existing – to find and fix leaks. Pennsylvania and Wyoming require (or effectively require) owners of new wells to inspect for leaks annually. To our knowledge, no state requires leak inspections of compressor stations for the long distance transmissions pipelines that carry gas from production areas to market.

As described below the Colorado rulemaking was based on estimations of LDAR costs that are higher than this study shows. Statewide, Colorado estimated that their LDAR rules will cost industry (net) about 18.5 million dollars. Even at last year's relatively low gas prices, Colorado gas production was worth over 6 *billion* dollars.[6] By this calculation, LDAR for production facilities would cost the industry less than three tenths of one percent of gas industry revenues. And, as discussed below, Colorado *over*estimated LDAR costs in their analysis. Clearly, these rules do not impose an undue burden on industry.

The lack of leak inspection requirements for the vast majority of oil and gas facilities shows the clear need for effective Federal rules.

## Robustness of this Study

This study has been designed to be conservative in a number of ways. For example, the study authors assumed that, in addition to the *external* cost of hiring a contractor to inspect a facility, the facility operator must also pay *internal* costs to administer contracts; handle paperwork; etc. For the analysis results discussed here, the authors assumed that those internal costs are 50% of the external costs – a substantial mark-up.

The data in this study were largely from inspection surveys in Canada performed in compliance with provincial rules. Since these rules have been in place for some years, the inspections were mostly *repeat surveys.* Since leak detection and repair programs reduce leaks, identified leaks during repeat surveys may be lower than the current level of leaks at most facilities in the US, where

[5] Clearstone Engineering Ltd., "Draft Technical Report: Update of Fugitive Equipment Emission Factors," (2013). Available at: http://tinyurl.com/m6trgxo.

[6] At last year's average Henry Hub price, Colorado gas production was worth $6.7 billion.

there is no mandate to find and fix leaks. As a result, *the surveys underestimate the baseline level of leaks and therefore underestimate the potential emissions reductions that leak detection and repair will achieve in the US*. For this reason, this study overestimates the abatement costs to find and fix leaks.

The study describes a number of other assumptions and design aspects that make the study quite conservative.

# Comparing this Study with Previous Work

There have been a number of estimates of the cost effectiveness of finding and fixing leaks, prepared for example to support regulatory actions. By and large, previous studies have calculated the cost-effectiveness of LDAR programs using "model plants" – lists of different component types, using data for each type of component such as average leak rate rates, leak frequency, leak repair cost, etc., compiled from a number of sources. Generally, the data used in a model plant calculation comes from studies which measured leaks at smaller numbers of facilities than the thousands of surveys (and tens of thousands of leaks) that comprise the database used in our study. Furthermore, our study is a much more direct calculation of cost-effectiveness. Finally, most previous estimates are based on more costly methods of leak detection than using IR cameras.

The Colorado Department of Public Health and Environment (CDPHE) and two gas producers have recently produced estimates of the cost-effectiveness of leak detection and repair that are more directly comparable to our study. These analyses were prepared as part of the recent rulemaking process in Colorado.

CDPHE proposed a tiered rule with LDAR required at different frequencies for facilities of different size. They estimated that for compressor stations, annual LDAR inspections would cost $458 per metric ton of VOC reduction,[7] and quarterly LDAR would cost $1,815 / metric ton VOC. For well facilities, they estimated that annual LDAR would cost $469 – 526 per metric ton of VOC abatement (depending on the location of the well facility); quarterly LDAR would cost $1,123 – 1,397 / metric ton; and monthly LDAR would cost $2,463 – 3,033 / metric ton. Our results, which are more direct and empirical, are lower than CDPHE's calculations (with the exception of the monthly well facility figures, which are very similar. Given the conservative assumptions of our study, this shows that CDPHE's estimates of costs were too high.

This is borne out by data submitted by a Colorado oil and gas producer who was a party to that rulemaking process. Encana submitted data they collected over several years of performing leak inspections at their wellpads in Wyoming. They found that monthly LDAR only costs $251 per metric ton of abated VOC, while Noble Energy calculated that their LDAR costs are below $230 per ton of VOC abatement[8] – almost a factor of ten lower than our conservative estimate. While this illustrates that our figures are conservative (overestimates), it also probably exemplifies the ability of oil and gas production firms to reduce the costs of inspection surveys, once they are carrying them out regularly and incentivized to find ways to control costs.

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[7] See tables 33 and 35 in "Cost-Benefit Analysis for Proposed Revisions to Colorado Air Quality Control Commission Regulation Number 3 (5 CCR 1001-5) and Regulation Number 7 (5 CCR 1001-9)," available at: http://bit.ly/1fDrArf. CDPHE and gas producers reported abatement costs per short ton of VOC abated; we have converted those to cost per metric ton.
[8] See "Encana Presentation" and "Noble Energy Inc. & Anadarko Petroleum Corp. Rebuttal Exhibit A," available at ftp://ft.dphe.state.co.us/apc/aqcc/.