Rapid Vehicle-based Methane Emissions Mapping System (PoMELO)

Projecting Cost Savings in Upstream LDAR

Overview

The ability for the University of Calgary PoMELO Padmapper system to detect and map emissions on upstream oil and gas pads has been demonstrated to be robust, with minimum detection limits likely lower than most OGI systems (see single-blind testing report[1]: https://doi.org/10.7910/DVN/BUT8GA).

This suggests that the system has a high probability of obtaining regulator approval. However, how does the PoMELO Padmapper reduce costs?

The PoMELO Padmapper system is a hybrid method. The technology package, mounted on the roof of an LDAR field truck, is driven around upstream sites upon arrival. The software rapidly maps which parts of the site are emitting and which parts are not. Subsequently, emitting equipment is surveyed with a time-consuming close-range technique such as Optical Gas Imaging (OGI). Equipment that is not emitting does not need to be surveyed.

Here we describe specifically how the system reduces upstream LDAR costs and best practices for maximizing cost savings in deployment.

Overview of Upstream LDAR

To understand how the PoMELO Padmapper system reduces costs, it is helpful to examine the problem. Three main emissions sources exist on upstream pads: (i) leaks, (ii) intentional vents, and (iii) combustion emissions. In many jurisdictions, each of these classes of emissions are treated separately under regulations, yet they are interspersed on upstream pads.

Vents and leaks are most common, and the flow rates from these sources are, in general terms, quite similar. The problem here is regulatory: LDAR regulations only targets leaks, where vents are subject to very different regulations. Furthermore, vents can have temporally variable emissions rates, and in cases the emissions rates can greatly exceed most leaks.

The technical challenge here is vents and leaks are physically interspersed on upstream pads. Vents from pneumatic controllers are typically led to the exterior of separator buildings, and leaks from the equipment inside the buildings may be seeping from building vents. Casing vents from wellheads are directly adjacent to any leaks on the 'Christmas tree' or adjacent piping. Any vents on tanks is similarly adjacent to any leaks in the supply piping.

Above: *workers debate the precise source of emissions from an upstream wellhead.*

Overview of LDAR Strategies

Although alternative LDAR methods are commonly thought about in terms of platform (vehicle, drone, aircraft, satellite, etc.) – it is significantly more important to unpack the underlying strategies these methods implement to reduce emissions.

The most common method presently used to detect and tag leaks on upstream sites is close-range surveys with OGI. OGI facilitates precise identification of the exact component that is leaking and whether or not that source is a vent or leak. The main issue with OGI and other close-range techniques is the time involved in surveying every component.

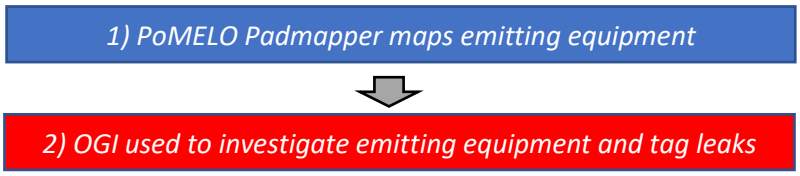
Site-level screening is an alternative LDAR strategy that uses measured total pad emissions. This can be accomplished with a vehicle-mounted sensor package, with aircraft or drones. The most common strategy is to use these measurements to prioritize OGI follow-up to the highest emitting pads. OGI crews are then called out to find and tag leaks. This strategy depends explicitly on cost-effective and accurate quantification and a well understood leak size distribution. The broad issue with site-level screening is total site emissions mix vents, leaks, and combustion emissions. A site with high emissions does not necessarily have many (or any) leaks. Furthermore, vents can be temporally variable (by design) – meaning follow-up crews can arrive to find low

emissions, when the previous site-level measurements suggested the site was anomalous. Aside from confusion around venting, site-level screening approaches suffer from challenges in managing follow-up triggers and balancing the costs of follow-up visits in the context of total program costs.

Equipment level screening is a strategy of identifying emitting equipment on a pad, accomplished with a vehicle system, drone, or aircraft. This strategy may or may not use equipment scale quantification to prioritize follow-up. The PoMELO Padmapper falls in this category – it classifies equipment as emitting or not. This is then immediately used to guide follow-up close-range surveys with OGI. While equipment level screening methods can also be misled by venting, it is not as dependent on quantification to triage follow-up. Often sites will have a significant fraction of equipment on a site that is completely clean of any methane emissions (vents or leaks).

PoMELO Padmapper Sketch

The PoMELO Padmapper is an equipment level screening technology, designed to identify which pieces of equipment are emitting on a pad to guide follow-up with an OGI camera. Similar to all other screening technologies, the PoMELO Padmapper system cannot place leak tags, OGI is necessary to place leak tags and complete the leak detection part of LDAR, but it can prevent unnecessary OGI surveys of equipment that is not emitting, saving time and money.



Above: *the workflow implemented on each pad. Both steps are completed in the same visit.*

Our strategy is to combine the rapid PoMELO Padmapper screen with follow-up OGI in one visit. This is deliberate for several reasons:

i. a major cost in LDAR is travel time. One visit significantly reduces travel time.
ii. multi-method LDAR relies on cost-effective communication and reporting. If a separate PoMELO Padmapper crew surveys ahead of an OGI crew, they must communicate specifically with the OGI crew through some detailed reporting method. It is faster, easier, more accurate, and less expensive to reduce communication by doing both the screening and OGI surveys in one visit with the same crew.
iii. one visit allows LDAR crews to resolve the source of emissions on sites immediately, taking advantage of their deep knowledge of upstream process equipment.
iv. one visit decreases the time to placing a leak tag and queueing repair. Delays from screening to follow-up surveys have an emissions penalty that needs to be offset in an alternative fugitive emissions mitigation plan.

PoMELO Padmapper Cost Savings

The main route to cost savings with PoMELO Padmapper can be distilled to one metric.

> ***The greater the number of non-emitting equipment surveyed in a day, the greater the PoMELO Padmapper program cost savings.***

The rationale here is equipment that is clean from emissions does not need to be surveyed with time-consuming OGI. Reducing extraneous OGI surveys of non-emitting equipment is the route to cost savings. We unpack the best practices to maximize this metric below.

Despite the simplicity of maximizing non-emitting equipment, we cannot ignore the costs of the PoMELO Padmapper system. Aside from the capital and minimal operational costs of the system, the rapid screen of a site takes a small amount of time onsite. Typically, this is done before a crew exits their field vehicle. The system is designed to begin surveying with no onsite setup and run continuously throughout the day. To better understand this, we can use our recent single-blind tests[1] (https://doi.org/10.7910/DVN/BUT8GA). Each pad was surveyed in approximately 4-6 minutes. Split among several equipment groups on an upstream pad (~3), this suggests approximately 2 minutes of driving is required to reliably understand whether or not an equipment group is emitting. This time may be reduced in some conditions and with experience. This time penalty is not fixed. Often a plume is immediately obvious, but several passes may help ensure a non-emitting piece of equipment is indeed clean.

In the most optimum situations, very large cost savings can be realized if all of the equipment on a site is clean – crews do not need to exit their vehicle. In particular, not using an OGI camera at all can save considerable time, OGI cameras can take ~10 minutes to be ready to use.

Optimum PoMELO Padmapper Assets: Smart Deployments

Certain assets are very well suited for PoMELO Padmapper. As cost savings are realized through maximizing the number of non-emitting equipment groups surveyed, we recommend deploying the system by design at the following types of sites:

i. Small sites with minimal venting are likely to have fewer emissions and OGI follow-up can be minimized.
ii. Sites with instrument air and emissions controls for vents will have fewer emitting equipment. Sour sites may fall in this category (and some are subject to enhanced LDAR requirements, further maximizing cost savings).
iii. Sites with good road access will maximize the number of equipment possible to survey. It is necessary to drive downwind of equipment to determine if equipment is emitting.

iv. Small sites will also increase the number of non-emitting equipment surveyed in a day as the system will be in use more of the day. For example, parking a vehicle with a PoMELO Padmapper for the day while crews survey the myriad of pipes in a large gas plant would reduce cost savings realized from the system.

Incidentally, as total sector emissions are reduced through industry-wide efforts to achieve 40-45% methane emissions reductions and sites become cleaner, the PoMELO Padmapper system will become more and more valuable.

Ancillary Benefits of PoMELO Padmapper

Although this report focuses on cost savings, the system offers ancillary benefits. First, the PoMELO Padmapper system includes a quantification engine. This engine provides equipment scale emissions quantifications, but due to the rapid speed in PoMELO Padmapper surveys, quantifications are not yet possible to use for emissions reporting. We are actively working on close-range quantification and expect updates to the underlying quantification model that will improve accuracy. Algorithm improvements will be designed to be reverse compatible and possible to run on previously collected data.

Additionally, the system automatically logs all data for auditing purposes. It is not possible to use the system without it logging detailed position and methane data. These data are important. A major issue with OGI is it is usually not possible to confirm all of a site was surveyed. The PoMELO Padmapper system provides detailed witnessing of upstream methane concentrations that are auditable and archivable.

Together, the PoMELO Padmapper facilitates defensible, practical, and reliable LDAR programs that are likely to net significant cost savings in upstream LDAR surveys.

Want to learn more?

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[1] Barchyn TE, Hugenholtz CH, 2020. University of Calgary Rapid Vehicle-based Methane Emissions Mapping System (PoMELO) Single-Blind Testing Results from the Methane Emissions Technology Evaluation Center (METEC). Harvard Dataverse. DOI: https://doi.org/10.7910/DVN/BUT8GA.