Comment Letter re: Regulations Amending the Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector);

Recommendations for Performance-Based Fugitive Emissions Inspection Requirements

Introduction

Bridger Photonics, Inc ("Bridger") appreciates the opportunity to provide recommendations for the rule proposed by Environment and Climate Change Canada (ECCC), *Regulations Amending the Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)* ("Proposed Rule"). Bridger is a technical and market leader in the detection, localization, and quantification of methane emissions. We provide our actionable Gas Mapping LiDAR™ (GML) methane emissions data to the entire natural gas value chain. Since GML technology was commercialized in 2019, it has been rapidly and broadly adopted by the oil and gas industry in the US and Canada.

Bridger's Canadian operations began with early technology testing by Alberta Upstream Petroleum Research Fund (AUPRF) prior to GML commercial release. Bridger now deploys GML across Canada in close partnership with Alberta-based Airborne Energy Solutions. Voluntary adoption of GML technology by oil and gas operators includes numerous approvals for the Alberta Energy Regulator's Alternative Fugitive Emissions Management Program (Alt-FEMP). In addition, Matthew Johnson and the research team at Carleton University's Energy and Emissions Research Lab has extensively used GML data as the foundation annual methane emissions inventories in British Columbia, Alberta, and Saskatchewan. Bridger recently bolstered Canadian operations with our first Calgary-based employee in Fall, 2023, and we look forward to continuing and growing our long-standing partnership with the Canadian oil and gas operators to whom we provide reliable, effective, and proven advanced methane detection data.

Bridger has worked closely with industry, regulators, and scientists to rigorously test and implement our methane sensing technology. We leverage this experience in our comment letter to provide recommendations for the Proposed Rule to ensure ECCC's final rule is flexible, practical, and effective. We provide the following main recommendations:

1) Base all fugitive emissions inspection requirements on technology performance instead of restricting the types of technologies that can be used so that the rule is technology-neutral and performance-based.
2) Require rigorous performance demonstration for fugitive emissions detection solutions used for compliance, including proof that solutions do not have spatial blind spots.
3) Update the screening inspection requirements to make sure operators understand what fugitive emissions inspection methods are intended and how often the sites must be screened.
4) Remove emission rate quantification as part of determining repair deadlines for detected fugitive emissions.
5) Provide suitable response guidelines for fugitive emissions detected by remote sensing technology.

Bridger's recommendations are intended to give operators access to advanced technologies for regulatory compliance, increase compliance assurance, foster technology innovation, and enable operators to strategically mitigate emissions. The body of this comment letter adds specific detail and rationale to our main recommendations and includes several additional recommendations.

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Use a Technology-Neutral, Performance-Based Fugitive Emissions Inspection Framework

We urge ECCC to allow operators to use any technology with detection performance demonstrated to be equivalent or better than optical gas imaging (OGI) or EPA Method 21 (M21) for the comprehensive inspection for fugitive emissions requirement. This includes periodic screening technology.

Rationale for Technology-Neutral Fugitive Emission Inspection Options

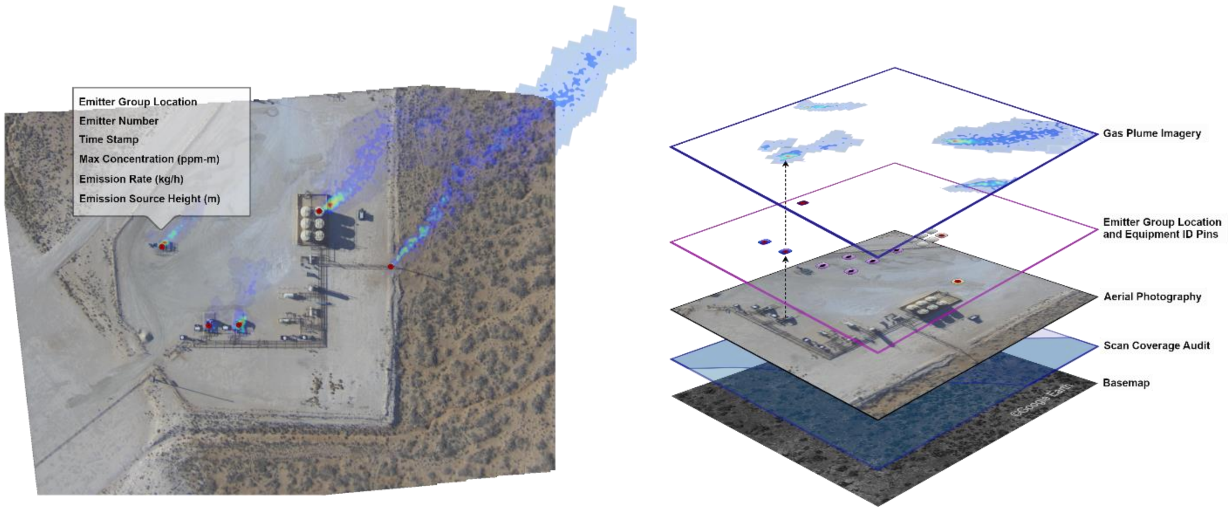
Performance-based leak detection regulatory frameworks enable operators to select leak detection technologies based on factors including their operational and geographical considerations, cost, scalability, and ability to reliably identify the greatest volume of emissions for mitigation. Although the Proposed Rule allows continuous monitoring systems (CMS) to be used in the place of OGI or M21 for the comprehensive inspection for fugitive emissions, the proposal did not allow the use of any other advanced technologies such as aerial remote sensing used for periodic screening. To provide oil and gas operators with more options, to pave the way for future technological advances, and to remove potential favoritism, the rule must be technology-neutral and performance based.

As just one example of a technology that should be allowed for comprehensive inspections, Bridger's GML technology provides the performance necessary to substitute OGI or M21 inspections on a scan-by-scan basis: (a) third-party field research by Matt Johnson at Carleton University indicates that GML detects a greater volume of emissions than OGI,[1] and (b) emissions modeling indicates that GML provides comparable performance to OGI on a scan-by-scan basis,[2,3] Conversely, Bridger is unaware of any evidence indicating that OGI or M21 detects more emissions than GML scans (median <2 kg/hr with 90% probability of detection) on a scan-by-scan basis. The rule needs to be technology-agnostic and performance-based. Considering these points of reference, we urge ECCC to allow suitable periodic screening technologies like GML in the place of OGI and M21. Expanding fugitive emissions inspection options provides many advantages:

More Efficient, More Effective, and Safer Fugitive Emissions Detection. Access to new technologies through performance-based rules allows operators to detect emissions more efficiently and effectively. Historically, operators had fewer technologies to detect gaseous emissions and they often relied on instruments like flame ionization detectors (FIDs) used according to US EPA's Method 21 (M21) protocol. M21 is laborious because the instrument interface must be scanned across the surface of equipment everywhere that fugitive emissions are suspected. More recently, optical gas imaging (OGI) cameras were commercialized, allowing operators to scan entire scenes of infrastructure within a camera view for emissions. On top of being more efficient, research suggests that OGI provides at least as effective leak detection as FID technology/M21.[4]

Since OGI became prevalent, there have been additional leak detection technology advances that ECCC should allow operators to take advantage of. For example, Bridger's laser based GML technology was developed to provide a next generation of methane detection data. Because GML is aerially deployed, up to hundreds of facilities can be scanned for emissions by a single sensor in a single day and boots on the ground only need to visit the sites where fugitive emissions are identified, thereby improving operational efficiency. When emissions are identified, operators are provided high resolution visual maps of methane emissions with the sources of emissions precisely located (Figure 1). This directs ground crews straight to any issues. GML's efficiency does not compromise efficacy: GML detected 18 times the volume of emissions that was detected by OGI at an overlapping set of sites.[1]

Using GML technology to screen for emissions increases personal safety by reducing road traffic. US NIOSH / CDC found that in 2017 (and qualitatively similar results in 2015-2016), vehicle accidents for oil and gas extraction related field operations were the leading cause of fatalities (42%).[5] Of these, the majority were on roadways to/from/between sites.



Gas plumes do not correspond to the facility shown. © Bridger Photonics, Inc.

Figure 1. Example of visual aspects of Gas Mapping LiDAR™ data. This data is delivered in GIS file formats, while additional data is commonly delivered in database formats.

Data-Driven Emissions Reductions. By opening the door to new, high-performance technologies, ECCC would create a regulatory environment that encourages operators to employ technologies that provide powerful data for emissions reduction. Advanced technology like GML can provide data that helps operators objectively assess and effectively address emissions issues. For example, GML gives operators a clear picture of their emissions through source-resolved, quantitative datasets (Figure 2). These datasets can be used to benchmark emissions, strategize mitigation efforts, and track emissions reductions. Although provincial and federal emissions regulations are broadly intended to eliminate fugitive emissions, research illustrates significant potential for emissions despite control measures.[6] By collecting comprehensive direct measurements of emissions, operators can identify and ameliorate any ongoing issues.

If advanced technology cannot be used for regulatory compliance, then it will limit operator's access to these important, quantitative datasets because operators will have to pay for this data on a purely voluntary basis. The increased fugitive emissions inspection requirements in the Proposed Rule will make the economics of emissions monitoring even more important.

A Robust Technology Marketplace. By giving operators access to any leak detection technology that meets specific performance requirements, ECCC would promote a more abundant, competitive, and freer marketspace for leak detection technology. The current proposed technology restrictions for comprehensive fugitive emissions detections could make it difficult for operators to comply with regulations due to shortages of M21 instrumentation, OGI cameras, and qualified personnel. Although the Proposed Rule allows CMS installations to be used in the place of comprehensive and screening fugitive emissions inspections, our comments illustrate that advanced periodic screening, and likely other technology, is also suitable for these inspections. Bridger advocates for the option to use both CMS and advanced periodic screening technology as a substitute for OGI/M21 so long as each periodic screening monitoring method and each CMS installation passes stringent performance demonstration.

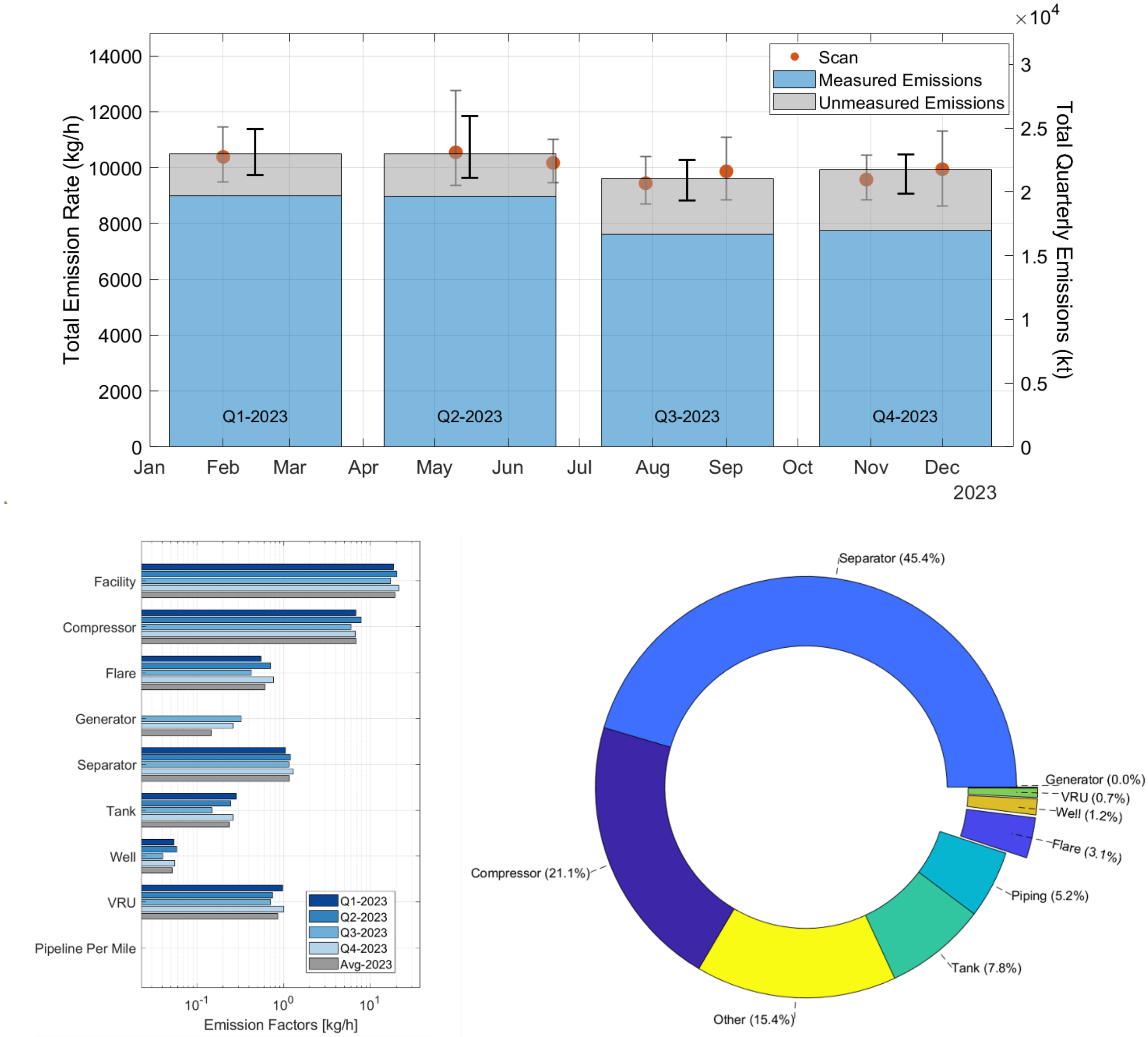


Figure 2. Example of data that Bridger generates from quarterly Gas Mapping LiDAR™ (GML) site scans. Emissions inventories can be developed to quantitatively assess performance and track the impact of emissions reduction measures (top panel). GML data has equipment-scale resolution and Brider often provided to operators with equipment attributed emissions data (lower right panel). For individual equipment types, emissions can be tracked across monitoring intervals for improved evaluation of emissions reduction actions (lower left panel). Increased data granularity can be added through casual analysis of detection events as demonstrated by Johnson et al.[6] To protect client confidentiality, the dataset shown was developed to represent emissions volumes and uncertainties seen for existing operator-scale assessments but does not include operator data.

When considering technology readiness, although CMS are no longer a brand-new technology type, there is very little public data demonstrating that they will be able to achieve the Proposed Rule performance requirements under diverse site conditions including data connectivity and meeting detection sensitivity performance requirements for each regulated piece of equipment.[7,8] Furthermore, false positive detections are problematic for many CMS,[7] which could overburden operations teams with unproductive dispatches or cause operators to increase response thresholds and miss emission events.

In the case of GML, which is a periodic screening technology, wide-scale deployment, audited spatial coverage, site-by-site detection sensitivity, and other specific performance characteristics are welldocumented.[3,9,10,11,12,13] In fact, GML's field performance may now be better understood better than OGI and M21. Automated data streams of advanced technology like GML can provide better reliability compared to handheld instrumentations for which performance is heavily influenced by the instrument user and the inspection protocol.[14] GML technology is ready to be used extensively for regulatory compliance.

Regulatory Consistency. While periodic screening advanced technologies like GML weren't written into the Proposed Rule comprehensive inspection requirements, we anticipate that ECCC intended this sort of technology to be used for the annual inspection by an auditor. Bridger cautions against allowing technologies for auditing and enforcement purposes that ECCC does not allow for other compliance purposes. Operators should have access to the same (and/or better) technology types for complying with regular inspections as might be used for the annual audit inspections.

Rationale for Specific Technology-Neutral Performance Standards

Precedent for replacing OGI inspections with advanced technology is available under the US Environmental Protection Agency (EPA) periodic screening matrices (e.g., Table 1). The quarterly periodic screening at 3 kg/h (for an interim period) and then 1 kg/h (90% probability of detection) matches the frequency for OGI scans. This indicates that this detection threshold was considered to be at least as effective as OGI scans.

Table 1. Periodic screening matrix for compressor stations, centralized production facilities with major equipment, and well sites with major equipment. Adapted from prepublication of US Code of Federal Regulations, Title 40, Part 60 Subpart OOOOb, Table 1.

Minimum Scan Frequency	**Detection Sensitivity (90% Probability of Detection)**
Quarterly	≤3 kg/hr for 730 days (≤1 kg/hr afterwards)
Bimonthly	≤2 kg/hr
Bimonthly + Annual OGI	≤10 kg/hr
Monthly	≤5 kg/hr
Monthly + Annual OGI	≤15 kg/hr

If ECCC promotes a similar performance-based framework for implementing advanced methane sensing technologies, it promotes consistency between regulatory bodies (i.e., ECCC and US EPA). This streamlines compliance for multinational operators, and it sets a clear direction for emissions reduction measures in countries that have less-mature emissions reduction programs.

Although we urge ECCC to consider a framework similar to the US EPA's, Bridger cautions that higher detection sensitivity tiers (such as 10 kg/hr) in Table 1 provide increasingly less effective emissions mitigation potential for oil and gas production regions with less heavy-tailed emission rate distributions. For example, in Figure 3, only ~52-65% of emissions measured by GML would be detected at a 10 kg/h cutoff. Even if all emissions with rates ≥10 kg/h were immediately detected and mitigated, a 75% emissions reduction would not be directly achieved based on this threshold. A significant amount of EPA's modeling was based on measurements from the Permian Basin which has a very heavy-tailed emission rate distribution.

Despite the pitfalls of utilizing fugitive emissions detection methods with insufficient detection sensitivity, it would become impractical to impose detection sensitivity requirements that are too stringent and there are diminishing returns with increasingly sensitive detection. The US EPA provided the interim

3kg/h threshold to make sure current technologies in routine deployment meet their standard. We urge ECCC to make a practical assessment of the available technologies and deployment practices necessary to achieve highly sensitive detection. Bridger is available to collaborate on these discussions.

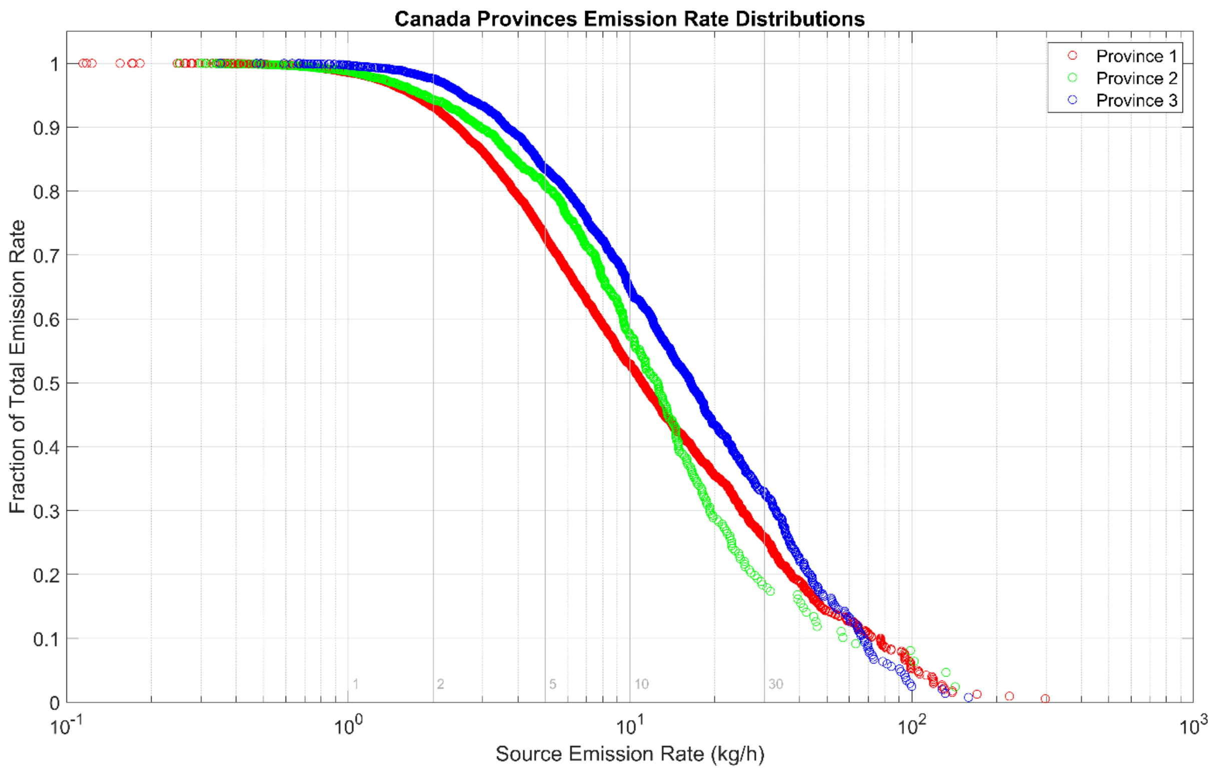


Figure 3. Oil and gas production area cumulative emission rate distributions measured by Gas Mapping LiDAR™ in Alberta, Saskatchewan, and British Columbia (in no particular order, based on 2023 measurements). These distributions illustrate what fraction of total emissions occur above a given emission rate threshold, providing critical insight to detection sensitivities needed to identify material emissions. Sampling does not fully represent infrastructure populations, but this data is expected to be qualitatively informative.

Specific Recommendations

Primary:

- Allow operators to use US EPA-approved periodic screening alternative test methods (according to US CFR Title 40, §60.5398b) for the comprehensive inspections for fugitive emissions.

Additional:

- Do not require comprehensive inspections during a quarter (for Type 1 facilities) or year (for Type 2 facilities) when a screening inspection or annual inspections has been performed using a detection method with performance comparable to what is required for comprehensive inspections.

Require Rigorous Technology Performance Demonstration for Fugitive Emissions Detection Solutions

We urge ECCC to require technologies used for fugitive emissions detection to demonstrate their detection sensitivity, localization performance, and spatial coverage with supporting information applicable to every inspection instance or to each site installation.

Rationale

Rigorous performance demonstration for periodic screening emissions detection methods and CMS installations gives industry and public stakeholders confidence that the options for fugitive emissions monitoring will deliver as promised. The performance of a fugitive emissions inspection approach or monitoring installation depends on both technology attributes and technology usage protocols. Essential performance metrics include:

- Detection sensitivity
- Spatial coverage
- Localization performance

These metrics are discussed in more detail below:

Detection Sensitivity. The ability to identify an emission of a certain size is well described by the probability of detecting an emission with a given mass flowrate. Therefore, we commend ECCC for proposing a mass flow rate detection sensitivity requirements tied to a 90% probability of detection (PoD). Requiring a PoD is essential because identification of emissions under diverse field conditions has a statistical likelihood that is not captured by minimum detection limits (MDL). A small emission size that is reliably detected in ideal or specific laboratory conditions may never actually be detected in the field. In addition, the decision to implement a 90% PoD requirement provides consistency between US EPA and ECCC regulations.

An excellent way to assess detection sensitivity probability of detection is through fully blinded controlled release testing by 3rd parties at the actual facilities where fugitive emissions detection work is performed. Testing should be performed at different facilities that have a diversity of environmental and operating conditions. During fully blinded testing, the entity scanning for fugitive emissions is not aware that a controlled release is present.

Another useful testing approach is single-blind testing. In this testing modality, the presence of a controlled release is known, but the emission rate of the release is not. Single blind testing is typically easier to implement than fully blind testing but because the detection entity is aware of testing, single-blind tests are unlikely to perfectly represent detection method field performance. Knowing the location of a controlled release opens the door for testing subjects to alter their methodologies to improve performance. In addition, testing subjects may complete testing under ideal conditions that do not match the diverse environments found during field deployment.

Bridger has completed both extensive single-blind and fully blinded controlled release testing by 3rd parties.[3,11,12] Using these controlled release measurements, Bridger developed a model that allows us to assess the detection sensitivity that is actually achieved on each site scanned for methane emissions by GML.[13] The model evaluates emission rate PoD for sites using the gas concentration noise that is recorded by the sensor in concert with wind data. By utilizing this model, variables including flight altitude, ground reflectivity, flight speed, and other parameters no longer require individual consideration. The model was assessed against the results of controlled release testing under diverse conditions to ensure that it is broadly applicable. Bridger's capacity to audit detection sensitivity allows operators to objectively demonstrate that GML deployments for fugitive emissions inspections achieves the detection sensitivity required by regulations.

Bridger recommends that ECCC defines detection sensitivity for periodic screening as the average detection sensitivity realized for an operator's set of sites that were scanned during a given inspection interval (similar to Figure 4). For example, if an operator intended to scan a collection of sites for fugitive emissions on a quarterly basis, the reported detection sensitivity would be the average value across those site scans in a quarter. This approach creates a practical detection sensitivity requirement because the intended regulatory impact is achieved while accounting for the reality of the vast parameter space impacting detection sensitivity that may cause small variations in detections sensitivity for individual sites.

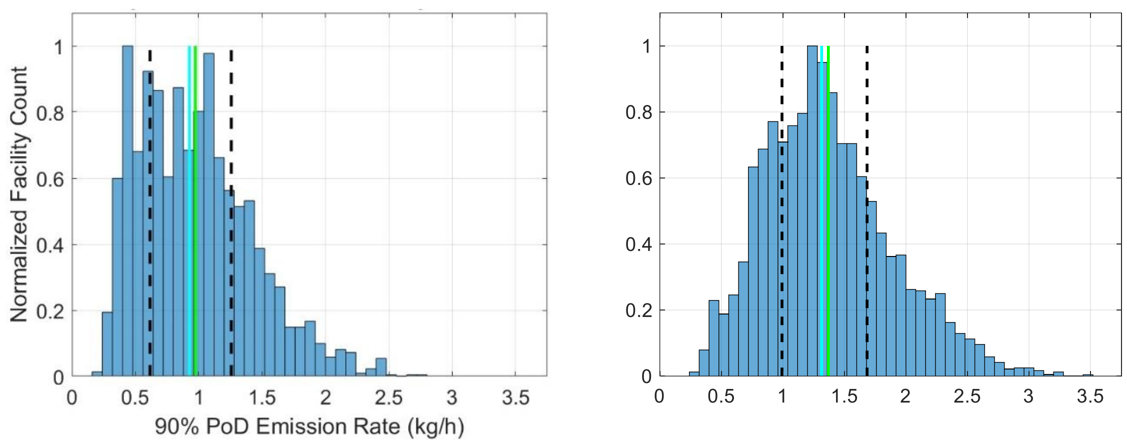


Figure 4. Histograms of site-specific detection sensitivities for collections of Gas Mapping LiDAR™ (GML) site scans. Site scans used to generate the figure on the left were acquired using more sensitive GML deployment parameters compared to the figure on the right. Detection sensitivity is defined as the mass emission rate at which 90 % probability of detection (PoD) is achieved. The green bar shows the mean (average), the light blue bar shows the median, and the dashed lines bound the inner quartile realized detection sensitivities.

Spatial Coverage. Critical to fugitive emissions detection performance is the spatial coverage of a periodic screening method or CMS installation. A high level of detection sensitivity does not equate to emission detection performance if certain emission sources are not monitored with the required detection sensitivity or systematically missed altogether.

For technologies like point sensor networks, fugitive emissions detection performance can be highly dependent on sensor spatial density and configuration.[15] Lofted emissions from tanks or flares can be missed and differing sensor configurations and numbers may be required at individual facilities. Certain wind angles and speeds may be necessary for CMS to appropriately detect, quantify, and localize emissions. These considerations highlight the need to qualify individual sensor installations as is specified in the Proposed Rule. For OGI cameras, measurement distance, differing thermal backgrounds, and visual access to elevated sources can impede detection of emissions from important sources such as opening on the tops of tanks and flare stacks.[6]

GML technology provides comprehensive and auditable spatial coverage within line of site from the air. A physical audit of ground coverage (scan coverage audit, see Figure 1) is provided based on the backscattered light to the GML sensor and range measurements coupled to encoded laser beam measurement angles. The scan coverage audit is checked to ensure that the measurement swath covered the target infrastructure.

Localization Performance. Advanced technologies identify emissions source locations with varying degrees of uncertainty. The spatial resolution and localization performance of a technology is fundamental to how operators respond to detected emission events. GML sensors have been shown to localize emission sources to < 2 m (1σ) in testing. If operators observe detection data and see that emissions are coming from a storage tank, they may be able evaluate their SCADA information to identify a cause like over pressurization without needing to visit the site. Alternatively, if the emission is coming from yard piping, they may dispatch ground crews with handheld instruments to identify specific emitting componentry and directly address the issue. If the emission is clearly from non-regulated equipment, a response may not be necessary. For technologies that cannot confidently locate emissions sources, operators may need to visit a site following every detection and comprehensively scan the infrastructure with handheld instruments to identify one or more issues that led to the detection.

We recommend that ECCC requires technologies used for fugitive emissions inspections (or CMS used in place of inspections) to demonstrate their emission source localization performance so that operators can appropriately plan and rationalize their response to detected emissions.

Specific Recommendations

Primary:

- Audit advanced leak detection methods and individual CMS installations for reliability in detecting emissions through fully-blinded testing and disqualify methods/installation without reliable performance.

Additional:

- Require advanced leak detection methods and CMS technologies to demonstrate their emission source localization performance.

Screening Inspection Requirements Should be Updated to Clearly Specify the Necessary Frequency and Inspection Approach

We urge ECCC to clarify the instances when sites must be inspected under the proposed screening inspection requirement for fugitive emissions, and what emissions detection approaches should be used.

Rationale

It is Bridger's understanding that the screening inspection for fugitive emissions is meant to provide a quick scan for fugitive emissions using readily available emissions detection technologies each month that operators access their sites but not necessarily monthly (and notably excluding periods of time when site access is impractical). This was not immediately obvious in the Proposed Rule language. We recommend that ECCC clarifies when sites must be screened, and what screening approaches are appropriate.

Based on the 1kg/h (90% PoD) detection sensitivity requirement, it makes sense that Bridger's GML could be used under sensitive deployment parameters. However, we expect that ECCC intended the screening inspection to be less stringent than the comprehensive inspection requirement which specified OGI and M21. 1 kg/h (90% PoD) is a highly stringent detection sensitivity requirement. As previously discussed, GML 1.0 detected a greater volume of emissions compared to OGI even when deployed at a detection sensitivity less sensitive than 1 kg/h (stated upstream detection sensitivity of 3.0 kg/h with 90% PoD under typical conditions, GML 2.0 provides more sensitive detection than GML 1.0).

The concept that the screening inspection is meant to be less stringent than the comprehensive inspection is reinforced by ECCC's cost modeling. The Proposed Rule requires four comprehensive inspections, one annual inspection, and multiple screening inspections for Type 1 facilities each year, yet the cost was modeled as 5 OGI or M21 inspections.

We urge ECCC to reevaluate the screening inspection to make sure to that the requirement is better aligned with the intent of rapid screening for notable emission events. We recommend that the regulation provides clear and practical guidance on cadence and technology.

Specific Recommendations

Primary:

- Change the required mass flow rate detection sensitivity for screening inspections to a more appropriate value, clearly state instances when screening inspections should be performed, and provide clear guidance on any handheld technologies and usage protocols for the screening inspection.

Additional:

- If a comprehensive inspection is performed in a month that the screening inspections would otherwise be performed, remove the requirement for a screening inspection to avoid duplicative workloads.

Repair Deadlines Should Not Be Based on Emission Rates Due to Technological Limitations

We urge ECCC not to base repair timelines on emission rate quantification in recognition of the limitations of in-situ quantification technologies and the uncertainty associated with quantifying individual emission events using remote sensing.

Rationale

The proposed repair timelines based on emission rate thresholds is impractical due to the limitations of existing quantification approaches. Achieving precise estimates of individual emission sources can sometimes be achieved using quantification methods such as high flow sampling, bagging, and flow meters. However, there are severe practical limitations to using these methods. For example, high flow sampling capacity is commonly understood to max out at ~9 kg/h methane emission rates.[16] Furthermore, each one of these in-situ measurement approaches has limitations because personnel must directly access the emission source, which is often difficult for elevated sources, sources where dangerous gasses could be present, or when the emission source is hot. Furthermore, the emission source interface must be amenable to these quantification approaches (an obvious problem for bagging and flow meters). Finally, each of these approaches is independent from default detection technologies like M21 or OGI which do not inherently quantify emission rates, meaning the quantification step is an added burden.

Remote sensing can overcome the practical limitations for quantifying emissions rates that exist for in-situ techniques. In addition, the same remote sensing technology can often be used for both fugitive emissions detection and quantification. However, remote sensing technologies are subject to significant error for individual emission rate measurements.[7,12,17] In the case of GML, the random error across aggregated sets of measurements cancel so that accurate cumulative emission rate estimates are provided, but there is significant variance for individual emission rate measurements. For example, Bell et al. report that 87.3% of measurements in an extensive controlled release study had quantification errors between -50% and +100% when using HRRR wind data.[7] If wind data is restricted to less reliable sources, single-measurement quantification error could be greater.

In light of practical limitations for in-situ emissions rate measurements and the uncertainty associated with individual remote sensing emission rate measurements, we urge ECCC not to base response timelines on quantified emission rates.

Specific Recommendations

- Remove mass flow rate thresholds as a determining factor in repair timelines for detected fugitive emissions.

Practical Response Guidelines are Needed for Emissions Detected by Remote Sensing Technology

We urge ECCC to provide an appropriate response pathway for fugitive emissions detected using remote sensing technology.

Rationale

Throughout this comment letter, we provide supporting evidence on the use case of aerial remote sensing as an effective detection method for the fugitive emissions inspection requirements in the Proposed Rule (beyond the annual inspection). As a result, we urge ECCC to provide a suitable response pathway for emissions detected during aerial remote sensing.

It is necessary to provide a time window between fugitive emissions scans and data delivery to operators. This time window allows for data transfer, QA/QC protocols (a scan should be considered null if quality metrics are not met), and data post-processing. To provide consistency with US EPA regulations, we encourage ECCC to adopt the 5-day window for data delivery following a site scan.[18] It would be impractical for any repair timelines to be triggered before operators have scan data in hand.

When a fugitive emission is detected, it is appropriate to triage scan data (refer to Figure 1) using the best available data sources. Operators may be able to conclusively identify the emission source through investigative analysis using a combination of advanced technology scan data, compressor runtime data, process control / SCADA data, maintenance activity logs, and prior inspection results. In some cases, an onsite follow-up is unnecessary and it may also be unhelpful because instruments like OGI and M21 instrumentation are not suited for investigating emission sources such as compressor engines and control devices because they are unable to clearly differentiate between normal and abnormal operation.[6] Meanwhile, these emission sources are regularly detected by advanced technologies even when normally operating. If permitted process emission are detected and conclusively identified, then no response other than recordkeeping should be necessary. For emissions identified as intermittent or nonpersistent (e.g. those coming from over-pressurization, from maintenance events, or episodic control device malfunctions) additional onsite screening is unlikely to be helpful and an investigative analysis is the appropriate response.

In the cases that onsite investigation of detected emissions is appropriate, it should only be necessary to investigate the detection event within localization uncertainty region of the advanced technology. By way of example, GML provides a localization performance ≤2 m (1σ) such that an onsite investigation would only be required throughout that spatial extent.

Specific Recommendations

Primary:

- Allow a 5-day data delivery window for remote sensing fugitive emissions inspections and initiate repair timelines only once data is delivered by the inspection entity to the end-user.

Additional:

- Allow operators to appropriately triage remote sensing detection to avoid unnecessary or unhelpful onsite investigations.
- If onsite investigations are appropriate, ECCC should allow operators to leverage the emission source localization capabilities of the remote sensing technology.

Additional Recommendations

Consider Additional Information for the Risk-Based Approach to Fugitive Emissions Inspection Requirements

We urge ECCC to ensure facility classifications for fugitive emissions inspection requirements are consistent with measured emissions profiles.

Operators have voiced concern that the risk-based facility classifications that impact fugitive emissions inspection requirements may not correspond correctly to the emissions profiles for those facilities. For example, to Bridger's knowledge, inactive facilities are subject to the same requirements as active facilities. Bridger is willing to support ECCCs analysis of emissions profiles to ensure that the risk-based approach will achieve intended results.

Allow Methane to Serve as a Surrogate for Hydrocarbon Gas for Fugitive Emissions Detection Requirements

We urge ECCC to ensure that methane-selective fugitive emissions detection technologies can be used for regulatory compliance.

The Proposed Rule is broadly based on hydrocarbon emissions reductions. Owing to the co-occurrence of methane with other alkanes and VOCs, methane is frequently considered a suitable surrogate for hydrocarbon emissions detection for oil and gas infrastructure. We urge ECCC to specify methane selective detection technology and detection sensitivity based on methane emission rate probability of detection as suitable for the fugitive emissions inspection requirements.

References

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[1] Tyner, D. R.; Johnson, M. R. Where the Methane Is—Insights from Novel Airborne LiDAR Measurements Combined with Ground Survey Data. Environ. Sci. Technol. 2021, 55 (14), 9773–9783. https://doi.org/10.1021/acs.est.1c01572.
[2] (prepublication) US Code of Federal Regulations, Title 40, Part 60 Subpart OOOOb Table 1
[3] Johnson, M. R.; Tyner, D. R.; Szekeres, A. J. Blinded Evaluation of Airborne Methane Source Detection Using Bridger Photonics LiDAR. Remote Sensing of Environment 2021, 259, 112418. https://doi.org/10.1016/j.rse.2021.112418.

[4] Pacsi, A. P.; Ferrara, T.; Schwan, K.; Tupper, P.; Lev-On, M.; Smith, R.; Ritter, K. Equipment Leak Detection and Quantification at 67 Oil and Gas Sites in the Western United States. Elementa: Science of the Anthropocene 2019, 7, 29. https://doi.org/10.1525/elementa.368.
[5] https://www.cdc.gov/niosh/topics/fog/data2017.html
[6] Johnson, M. R.; Tyner, D. R.; Conrad, B. M. Origins of Oil and Gas Sector Methane Emissions: On-Site Investigations of Aerial Measured Sources. Environ. Sci. Technol. 2023, 57 (6), 2484–2494. https://doi.org/10.1021/acs.est.2c07318.
[7] Bell, C.; Ilonze, C.; Duggan, A.; Zimmerle, D. Performance of Continuous Emission Monitoring Solutions under a Single-Blind Controlled Testing Protocol. Environ. Sci. Technol. 2023, 57 (14), 5794–5805. https://doi.org/10.1021/acs.est.2c09235.
[8] Chen, Q.; Schissel, C.; Kimura, Y.; McGaughey, G.; McDonald-Buller, E.; Allen, D. T. Assessing Detection Efficiencies for Continuous Methane Emission Monitoring Systems at Oil and Gas Production Sites. Environ. Sci. Technol. 2023, 57 (4), 1788–1796. https://doi.org/10.1021/acs.est.2c06990.
[9] Gas Mapping LiDAR is used by top Canadian operators, and it is also by 8 of 10 top Permian Basin natural gas producers as well as the largest natural gas distribution company in the US. Many 10's of thousands of miles of pipeline and facilities are scanned every year.
[10] Kunkel, W.; Thorpe, M.; Carre-Burritt, A.; Aivazian, G.; Snow, N.; Harris, J.; Mueller, T.; Roos, P. Extension of Methane Emission Rate Distribution for Permian Basin Oil and Gas Production Infrastructure by Aerial LiDAR; preprint; Environmental Monitoring, 2023. https://doi.org/10.31223/X5BS9V.
[11] Bell, C.; Rutherford, J.; Brandt, A.; Sherwin, E.; Vaughn, T.; Zimmerle, D. Single-Blind Determination of Methane Detection Limits and Quantification Accuracy Using Aircraft-Based LiDAR. Elementa: Science of the Anthropocene 2022, 10 (1), 00080. https://doi.org/10.1525/elementa.2022.00080.
[12] Conrad, B. M.; Tyner, D. R.; Johnson, M. R. Robust Probabilities of Detection and Quantification Uncertainty for Aerial Methane Detection: Examples for Three Airborne Technologies. Remote Sensing of Environment 2023, 288, 113499. https://doi.org/10.1016/j.rse.2023.113499.
[13] Thorpe, M.; Krietinger, A.; Altamura, D.; Dudiak, C.; Conrad, B.; Tyner, D.; Johnson, M.; Brasseur, J.; Roos, P.; Kunkel, W.; Carre-Burritt, A.; Abate, J.; Price, T.; Yaralian, D.; Kennedy, B.; Newton, E.; Rodriguez, E.; Ibrahim Elfar, O.; Zimmerle, D. Deployment-Invariant Probability of Detection Characterization for Aerial LiDAR Methane Detection; preprint; Environmental Monitoring, 2024. https://doi.org/10.31223/X5R96M.
[14] Zimmerle, D.; Vaughn, T.; Bell, C.; Bennett, K.; Deshmukh, P.; Thoma, E. Detection Limits of Optical Gas Imaging for Natural Gas Leak Detection in Realistic Controlled Conditions. Environ. Sci. Technol. 2020, 54 (18), 11506–11514. https://doi.org/10.1021/acs.est.0c01285.
[15] Chen, Q.; Schissel, C.; Kimura, Y.; McGaughey, G.; McDonald-Buller, E.; Allen, D. T. Assessing Detection Efficiencies for Continuous Methane Emission Monitoring Systems at Oil and Gas Production Sites. Environ. Sci. Technol. 2023, 57 (4), 1788–1796. https://doi.org/10.1021/acs.est.2c06990.
[16] US Federal Register, Vol. 88, No. 146 Page 50359
[17] Caico, C.; Fragu, L.; Gonzalez, L.; Juéry, C.; Kangas, P.; Lawson, C.; Negroni, J.; Roberts, P.; Smithers, B.; Tupper, P.; Vaskinen, K.. An Evaluation of an Optical Gas Imaging System for the Quantification of Fugitive Hydrocarbon Emissions; 2/17; Concawe.
[18] (prepublication) US Code of Federal Regulations, Title 40, §60.5398b(b)(5)(i)