Comment Letter re: Proposed Rule – Greenhouse Gas Reporting Rule: Revisions and Confidentiality Determinations for Petroleum and Natural Gas Systems

Introduction

Bridger Photonics, Inc. ("Bridger") appreciates the opportunity to provide comments on the Environmental Protection Agency (EPA) Proposed Rule – Greenhouse Gas Reporting Rule: Revisions and Confidentiality Determinations for Petroleum and Natural Gas Systems (88 FR 50282) ("Proposed Rule"). Bridger is a technical and market leader in the detection, localization, and quantification of methane emissions. Bridger developed its aerial light detection and ranging (LiDAR) technology, Gas Mapping LiDAR™ (GML), with support from the US Department of Energy's Advanced Research Projects Agency – Energy (ARPA-E). GML technology was then commercialized in 2019 as a data product offering, which has been rapidly and broadly adopted by the oil and gas industry in North America over the past four years. Bridger serves the entire natural gas value chain, providing operators with methane emissions measurements that have an unparalleled combination of sensitivity, spatial coverage, localization precision, and quantification accuracy.

Bridger's experience optimizing GML technology to fit the needs of the oil and gas industry combined with our experience statistically evaluating methane emission measurements uniquely situates us to provide feedback on how the EPA can improve the Proposed Rule to best serve the public and industry. In this comment letter, we make recommendations to increase the accuracy of methane emissions reporting while reducing reporting complexity. Furthermore, we urge the EPA to remove incentives to use less-effective emissions monitoring technology. Bridger provides 5 specific recommendations:

1. Remove incentives to use less-effective emissions monitoring technology.
2. Fund the development of regional measurement-based methane emissions inventories and use findings to strategize and track emissions reductions.
3. Allow operators to demonstrate low emissions at their reporting facilities by developing facility-level measurement-based methane emissions inventories.
4. Create a pathway to approve and update methods for developing measurement-based methane emissions inventories.
5. Allow operators to use direct measurements to report gathering pipeline emissions.

Recommendation 1: Remove incentives to use less-effective emissions monitoring technology.

The Proposed Rule preamble indicates that significant emissions come from sources not currently accounted for in subpart W and the Proposed Rule works to address this problem by adding the "other large release event" source to reporting. This source is intended to cover a variety of unexpected abnormal process conditions and equipment failures. To determine the presence of other large release events, operators must consider any credible information.[1] Notably, this includes detections from advanced methane sensing technologies whether these technologies are used by operators on a voluntary basis or as part of regulatory compliance under proposed OOOOb/c.

[1] 88 FR 50300

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Research has shown that advanced methane sensing technology detects remarkably greater volumes of emissions compared to default emissions screening approaches like OGI or EPA M21.[2] As a result, using high-performance advanced methane sensing technology is likely to increase the identification of other large release events and correspondingly increase the total volume of methane reported by operators. The pending IRA waste methane emissions charge will mean greater fines for greater volumes of emissions reported under subpart W in cases where target methane intensity thresholds are exceeded.[3] Therefore, the proposed other large release event reporting requirement causes the unintended consequence of incentivizing operators to use less-effective emissions monitoring technologies when this reporting requirement is coupled to the waste methane emissions charge.

The fact that operators could find more emissions or fewer emissions depending on their technology deployment while remaining in compliance with subpart W highlights that the Proposed Rule enforces a nonsystematic approach to evaluating other large release event emissions and will result in inaccurate and biased inventory records.

The need to accurately account for emissions that might qualify as other large release events is made clear by looking at their important contribution to total emissions. For example, an extensive equipment-level measured emission rate distribution for Permian Basin production sites (Figure 1) shows that approximately 37% of total emissions above 3 kg/hr measured have a rate over 100 kg/h (2.2% of total detected emissions by number).[4,11] Of course, this point of reference only considers the 100 kg/h methane reporting threshold and does not even consider the 250 metric ton CO_2e threshold. However, expecting to account for this extensive set of emissions using an ad hoc mixture of technologies and accounting approaches is ill-advised.

Trying to determine if a release is over 250 metric tons CO_2e and/or evaluate if it is already accounted for in subpart W is a daunting and impractical task. For example, high emission rate events may already be accounted for in emission factors which are time-averaged values for emission types that might be episodic. Detection of a high emission rate episodic event might lead an operator to believe that this emission is an other large release event, whereas in reality it may be already accounted for by emission factors or engineering calculations. Furthermore, the proposed equipment leak population emission factors from Rutherford et al. include "super emitters".[5] This raises the question of whether individually reported other large release events do not cause double counting for emissions already accounted for in these population emission factor. This discussion of pitfalls for reporting other large release events is non-exhaustive—we advocate for the EPA to consider an improved approach. The 250 metric tons CO_2e threshold is, in general, much more problematic than the 100 kg/h methane threshold on its own because extensive analysis may be required to determine affected emission events.

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[2] "Equipment leak detection and quantification at 67 oil and gas sites in the Western United States". https://doi.org/10.1525/elementa.368, "Where the Methane Is—Insights from Novel Airborne LiDAR Measurements Combined with Ground Survey Data". https://doi.org/10.1021/acs.est.1c01572

[3] Inflation Reduction Act Methane Emissions Charge: In Brief. Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R47206

[4] We note that a large number of these detections may be due emission mechanisms like unlit flares, separator blow through to production tanks, and improperly seated thief hatches. While the proposed rule does have additional provisions to account for these emissions sources, these additional provisions are subject to considerable potential for user error and have not been validated for accuracy. Some detections may also be due to emissions that may be well accounted for such as blowdowns or other maintenance events.

[5] 88 FR 50351

Instead of attempting to ensure that subpart W reporting is accurate by relying on a patchwork of unproven methodologies to capture more emissions events, we urge the EPA to follow the example set by Colorado's Greenhouse Gas Intensity Verification rule.[6] This rule scales bottom-up model reported emissions to make sure they match the measured methane emissions for the state. The rule was developed with broad stakeholder collaboration that included the Colorado Department of Public Health and Environment, academics, operators, API, and nongovernmental organizations. The central point of reference for this rule will be a robust measurement campaign to characterize methane emissions across the regulatory jurisdiction. Although the initial program only applies to production sites, Colorado plans to extend the measurement program to additional industry segments (e.g., gathering and boosting). Colorado expects to continue evaluating emissions on an annual basis and will retain flexibility in the analysis approach to make sure that the most current science is reflected in measurements. They will also provide operators with the option to use approved measurement-informed approaches to show reduced emissions for their infrastructure. Colorado's GHG emissions verification rule is well aligned with the intent of the IRA and better aligned than proposed subpart W revisions as they currently stand.

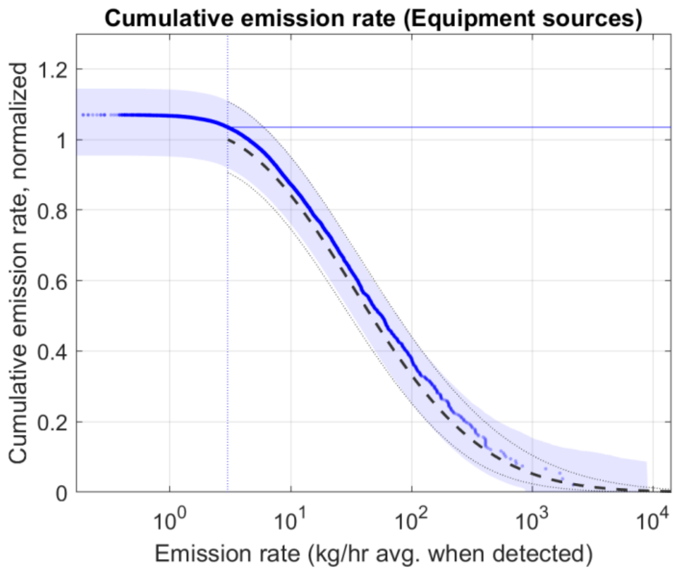

Figure 1. Equipment-level cumulative emission rate distribution from Gas Mapping LiDAR measurements at Permian Basin production facilities. In-depth discussion of this dataset is provided in the referenced publication.[11]

If the EPA implements Colorado's regulatory approach, and there are considerable discrepancies between regional methane emissions inventories and the standard subpart W bottom-up model for emissions, we encourage the EPA to improve the bottom-up model accordingly. However, we urge the EPA to do so in in a way that:

(a) Does not disincentive the use advanced monitoring technology, which can help us understand and effectively mitigate emissions (the goal of EPA air regulations in the first place);
(b) Is systematic, consistent, and yields comparable results between operators;
(c) Provides a pathway to improve the reporting data/methodologies so that reported emissions are relevant following changes in operations and infrastructure; and

[6] https://cdphe.colorado.gov/press-release/colorado-adopts-first-of-its-kind-measures-to-verify-greenhouse-gas-emissions-from

(d) Is validated against or developed from regional measurement-based methane emissions inventories.

One way to improve the representativeness of the subpart W bottom-up model would be by developing improved equipment-level emission factors. This avoids the need to rely on a large set of onsite observations to determine if abnormal process conditions exist such as stuck separator dump valves, improperly seated thief hatches, flare pilot flame malfunctions, or additional abnormal process conditions that might otherwise be considered an other large release event.

The Proposed Rule technical support document argues that including large releases within emissions factors would incorrectly skew the emissions factor for normal operations. However, with a sufficient sample size, even the detection of a single, extremely large release does not cause large fluctuation in average emissions values. For example, removing the largest emission rate detected in the set of equipment-level detections in Figure 1 changes the total detected emission rate by only 2% (and this effect could be suppressed by using a functional form of the underlying distribution). In fact, as previously noted, the EPA already proposed to include super emitters in equipment leak population emission factors.

While most abnormal process conditions could be accounted for using appropriate equipment emissions factors, it may be reasonable to require individual reporting of well blowouts and explosions because they are significant events, and they should be easy to identify. Notably, well release incidents are already reportable under certain state rules. A 4,000 metric ton CO_2e reporting threshold for well blowouts and explosions would capture even the smallest well blowout event described in Proposed Rule technical support document.

We urge the EPA to remove the incentive for operators to select less-effective emissions monitoring approaches by making sure source-level emissions accounting methodologies are systematic and without the potential for bias due to the type of monitoring technology that is deployed.

Recommendation 2: Fund the development of regional measurement-based methane emissions inventories and use findings to strategize and track emissions reductions.

The IRA charged the EPA to "revise the requirements of subpart W to ensure that reporting under subpart W (and corresponding waste emissions charges under CAA section 136) is based on empirical data, [and] accurately reflects the total CH_4 emissions (and waste emissions) from the applicable facilities…"[7] However, the proposed revisions will not make subpart W reporting an accurate reflection of methane emissions. For example, the approach for detecting other large release events is unmethodical and will cause operators to report this source category with an unreliable level of accuracy and consistency.

The best way to ensure methane emissions reported under subpart W are accurate is to base reporting on methane emissions inventories that are founded on direct measurements (we advocate for the EPA to follow Colorado's approach, see Recommendation 1). Developing inventories with equipment-level resolution would further allow the EPA to identify and reconcile discrepancies between the subpart W bottom-up model and the measured magnitude of emissions. Not only does this approach critically enable the nation to determine and eliminate true emissions drivers, but it also provides an avenue to accurately benchmark emissions and track reductions as inventories are updated with new data.

During the last several years, methods to use aerial measurements to generate source-resolved methane emissions inventories became mature. The EPA's assertion that snapshot technologies are not sensitive

[7] 88 FR 50284

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enough or suitable for annualized emissions is patently false.[8] To Bridger's knowledge, a satisfactory explanation of this assertion was not provided in either the preamble or the technical support document. While technologies relying on sunlight (e.g. solar infrared hyperspectral imaging) may lack sufficient detection sensitivity, LiDAR technologies are capable of widespread deployment with detection sensitivities near or below 1 kg/hr. In fact, methane emissions inventories based on LiDAR measurements have already been used benchmark oil and gas emissions in Canadian provinces[9] and Canada is using this work to guide national emissions reduction efforts. The US can retain its leadership in methane action by developing rules that embrace a similar scientific approach to emissions measurement and reduction.

Because emissions profiles change between different oil and gas regions (Figure 2), it is essential to develop separate inventories for different subpart W reporting jurisdictions. Meanwhile, the methods for developing methane emissions inventories at the regional scale can, in many cases, also be used to develop inventories for individual oil and gas operators (i.e., inventories can be developed at the subpart W reporting facility-level). In our 3rd recommendation, we urge the EPA to allow operators to report methane emissions using approved inventory development methods. By doing so, operators can reliably demonstrate that their operations cause less emissions than the regional expectation. This objective is in line with the IRA.

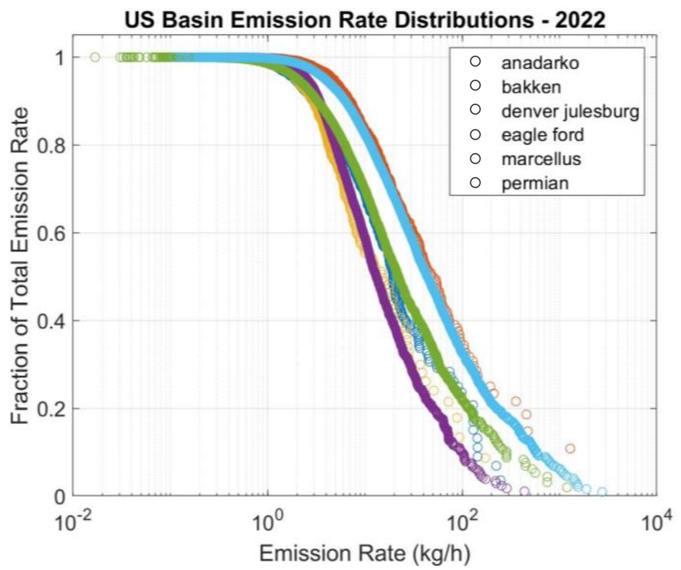

Figure 2. Cumulative emission rate distributions in major US oil and gas production basins measured by Gas Mapping LiDAR™ (colors have been removed from the legend and basins are not listed in any particular order). Note the log scale on the x-axis and that emissions profiles are dramatically different between basins.

The EPA should prioritize ongoing characterization of production basin infrastructure (e.g., production and gathering and boosting infrastructure) considering its sizeable share of total emissions.[10] Sufficient data for developing production basin methane emissions inventories is already available and will become increasingly available. Bridger has collected high-resolution data in every major US production basin. We

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[8] 88 FR 50291

[9] "Measurement-Based Methane Inventory for Upstream Oil and Gas Production in Alberta, Canada Reveals Higher Emissions and Starkly Different Sources than Official Estimates". https://doi.org/10.21203/rs.3.rs-2743912/v1, "Creating measurement-based oil and gas sector methane inventories using source-resolved aerial surveys". https://doi.org/10.1038/s43247-023-00769-7

[10] "Assessment of methane emissions from the U.S. oil and gas supply chain". doi: 10.1126/science.aar7204

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have already published comprehensive data on Permin Basin emissions rates,[11] and during the next year we will continue to publish research using Gas Mapping LiDAR measurement data. Furthermore, DOE grants to characterize emissions in numerous production basins have begun implementation.[12] More than adequate funding from the IRA Methane Emissions Reduction Program is available for use in developing methane emissions inventories throughout the US and across all segments if this funding is appropriately allocated. Information is becoming increasingly available that demonstrates measured emissions volumes from oil and gas operations differ from bottom-up models and the EPA is responsible for ensuring that subpart W reporting is accurate based on these findings.

We urge the EPA to use regional emissions inventories that are based on widespread aerial measurements to ensure overall methane emissions reporting accuracy (in a similar fashion to Colorado's GHG Emissions Intensity Verification Rule) and as a reconciliation tool for bottom-up calculations. Measurement-based inventories are the best way to ensure accurate emissions reporting and to correctly inform emissions reduction efforts. Yearly inventory updates should be performed to ensure information is up-to-date and relevant.

Recommendation 3: Allow operators to demonstrate low emissions at their reporting facilities by developing facility-level measurement-based methane emissions inventories.

If an operator wishes to demonstrate that their subpart W reporting facility emits reduced methane, they should be able to do so using state-of-the-art scientific approaches. The methods for developing regional measurement-based emissions inventories can be extended to individual reporting facilities because the fundamental principles are the same for both size scales. The EPA should allow measurement-based inventory development methods to be approved for calculating emissions both at the regional scale and at the scale of individual reporting facilities. This recommendation is in line with the IRA's mandate that "[subpart W] allows owners and operators to submit empirical emissions data, in a manner prescribed by the Administrator, to demonstrate the extent to which a [waste emissions] charge is owed.[13]

We urge the EPA to allow operators to accurately demonstrate their methane emissions volumes using approved methods for developing measurement-based emissions inventories.

Recommendation 4: Create a pathway to approve and update methods for developing measurement-based methane emissions inventories.

Methods for developing measurement-based methane emissions inventories involve both (a) frameworks for using measurement data and (b) technologies and technology deployment used to generate the measurement data. Robust frameworks to determine methane emissions inventories using direct measurement data already exist.[9] These frameworks rely on widespread aerial measurement by technologies with well-characterized performance such as Bridger's GML technology.[9,14] Subpart W should provide a pathway to approve frameworks for determining emissions inventories and it should also provide a pathway to approve suitable technologies to be used within approved frameworks. Precedent for these approval pathways comes from the alternative test method provisions in OOOOb/c proposed rules.

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[11] "Extension of Methane Emission Rate Distribution for Permian Basin Oil and Gas Production Infrastructure by Aerial LiDAR". https://doi.org/10.1021/acs.est.3c00229

[12] Project Selections for FOA 2616: Innovation Methane Measurement, Monitoring and Mitigation Technologies (IM4 Technologies), Area of Interest 3. https://www.energy.gov/fecm/project-selections-foa-2616-innovative-methane-measurement-monitoring-and-mitigation

[13] 88 FR 50285

[14] "Robust probabilities of detection and quantification uncertainty for aerial methane detection: Examples for three airborne technologies". https://doi.org/10.1016/j.rse.2023.113499

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This approval formalism would allow advances in technology and framework methodology to be taken advantage of for improved emissions reporting by allowing new methods to be submitted and approved.

Approved emissions inventory development frameworks should leverage both new data and prior knowledge of emission using standard Bayesian estimation. With current levels of measurement technology deployment, we recommend that the EPA allow data from five years before a given inventory assessment to be used so that enough information is available when the rule goes into effect. As greater volumes of fresh data become available, the EPA should iteratively limit the age of data to be used.

Any data brought into an approved inventory framework should correspond to a representative sample of infrastructure as demonstrated by quantitative evaluation. Sampling should correctly represent different equipment classes, production types and volumes, site types, site ages, and operating companies (in the case of regional inventories). Furthermore, approved frameworks should:

- Include protocols to eliminate systematic errors by accounting for intraday variation in emissions and seasonal changes.
- Include protocols to scale measurements from limited sample sets to the complete population of infrastructure in the region and to annualize emissions.
- Include protocols to integrate data appropriately considering measurement technology sensitivity and quantification uncertainty.
- Include protocols to characterize uncertainty due spatial variation of emissions and variation in emissions over time.

For a technology (and its deployment approach) to be approved for emissions inventory measurements, it should meet the following performance criteria:

- It must have sensitive emissions detection to ensure significant emissions sources are not unaccounted for. (The less sensitive the technology, the more exterior data elements must be incorporated in the inventory, which opens the door to additional sources of error). A sensitivity requirement of ~2 kg/h with > 90% probability of detection is recommended based on existing work.[9]
- The technology must have refined detection sensitivity models to determine missed emission events.
- The technology must provide accurate quantification of aggregate emissions.
- The technology must have refined error models to reduce measurement bias and correctly report instrument quantification uncertainty.
- The technology must be resilient towards systematic sources of error such as incomplete spatial coverage and diminished sensitivity under conditions of low ambient light.
- The application of a technology and its deployment within a framework must be validated for repeatability and consistency through replicate inventory assessments.

The following discussion illustrates how Gas Mapping LiDAR technology achieves the necessary technology/technology deployment performance metrics:

Detection Sensitivity. Bridger's GML technology is capable of detecting methane emissions to below 1 kg/h with 90% probability of detecting emissions. Independent third-party studies find GML to be ~30x more sensitive than the nearest alternative commercial airborne (i.e. scalable) solution.[14] Furthermore, Bridger's detection sensitivity model determines detection sensitivity performance on a site-by-site (or better) basis, allowing undetected emissions to be accurately estimated based on site-specific detection probabilities for a given emission rate and the count of emissions detected at that rate.

Quantification Accuracy. To achieve an accurate aggregate emissions inventory, the systematic error in quantifying emission rates must be low. The primary sources contributing to quantification bias are instrument bias, processing bias, and wind speed bias. Bridger's internal calibration and flight-testing procedures applied to each GML sensor remove quantification bias to <10%. Bridger uses established low-bias wind sources (e.g. NOAA's HRRR), supplemented by gas plume shape characteristics, to remove wind-based quantification bias. Bridger's aggregate quantification uncertainty (including all bias sources) for a single sensor has been rigorously confirmed to be below 10% by independent third parties when NOAA's HRRR wind source is used.[15] Bridger's quantification uncertainty model is used to further remove bias from aggregate measurements and to characterize instrument quantification confidence intervals.

Resilience Towards Systematic Errors. Bridger's GML technology uses a birds-eye aerial vantage point to prevent systematically missed sources (which could otherwise occur for sources elevated off the ground, like combustion stacks or tanks). Bridger also audits the spatial coverage of its scanning lasers. Because GML uses laser light rather than sunlight as its light source, GML has the deployment flexibility to sample at any time of day and remove uncertainty from intraday emissions variation.

Equipment Attribution. The correct attribution of emission sources to equipment in an inventory critically enables strategic and intelligent reduction strategies. Poor spatial resolution and lack of accurate equipment inventories can lead to systematic errors in emission source attribution. Bridger's machine learning algorithms to automatically detect and label equipment. Bridger combines this capability with high spatial resolution gas imagery to confidently attribute emission sources. This allows statistical filtering of the emissions inventory data.

Inventory Assessment Validation. Bridger validates the deployment of GML technology within inventory development frameworks to ensure inventory assessments are consistent and reproducible. Replicate scans of infrastructure sample sets at different points in time and under different environmental conditions (but without operator intervention between scans) are used to determine the variance in calculated total emissions between scans and evaluate if the variance aligns with the expected uncertainty. In addition, scans spaced over longer time periods are used to assess the impact of seasonal emissions variation.

As the EPA develops the final rule, Bridger will continue to inform the EPA on suitable requirements for approving inventory assessment frameworks and measurement technologies.

We urge the EPA to provide an approval pathway for frameworks and technologies to be used to develop regional and facility-level measurement-based methane emissions inventories for subpart W reporting. This would provide confidence and transparency for reporting and open the door for emissions assessment methods to be continually improved.

Recommendation 5: Allow operators to use direct measurements to report gathering pipeline emissions.

The Proposed Rule relies entirely on emissions factors for reporting gathering line emission and lacks the option to use direct measurements to demonstrate reduced emissions. These leaker emission factors come

[15] "Single-blind determination of methane detection limits and quantification accuracy using aircraft-based LiDAR". https://doi.org/10.1525/elementa.2022.00080

from a limited dataset, may not be representative,[16] and are not company specific. We urge the EPA to give operators the option to use monitoring and measurement surveys to report these emission instead, as is generally allowed for other equipment leaks in the Proposed Rule. The EPA should harmonize gathering pipelines emissions reporting with other EPA and PHMSA provisions by allowing operators to use OOOOb compliant advanced technology, subpart W compliant monitoring and measurement methods, and suitable technologies used for proposed PHMSA gas pipeline leak screening requirements as the basis for emissions reporting.[17,18] Doing so would be inline with the IRA intention of allowing operators to submit empirical data to demonstrate their methane emissions.

We urge the EPA to allow operators to submit direct measurement data to demonstrate methane emissions from their natural gas gathering lines.

Acknowledgements

Bridger gratefully acknowledges the collaboration of operators, industry trade groups, NGOs, technology solutions, and academic institutions that collectively helped guide the comments in this letter. Bridger also gratefully acknowledges the considerable efforts and dedication of EPA staff engaged in this rulemaking.

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[16] "Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin". https://doi.org/10.1021/acs.estlett.2c00380.

[17] https://www.bridgerphotonics.com/sites/default/files/inline-files/230815_Bridger_Photonics_Comment_Letter_PHMSA_Gas_Pipeline_LDAR_NPRM.pdf

[18] 88 FR 31890

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