Kathy Cooper

From:	ecomment@pa.gov
Sent:	Monday, July 27, 2020 3:28 PM
To:	Environment-Committee@pasenate.com; IRRC; environmentalcommittee@pahouse.net; regcomments@pa.gov; ntroutman@pasen.gov; timothy.collins@pasenate.com; gking@pahousegop.com
Cc:	c-jflanaga@pa.gov
Subject:	Comment received - Proposed Rulemaking: Control of VOC Emissions from Oil and Natural Gas Sources (#7-544)

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Re: eComment System

The Department of Environmental Protection has received the following comments on Proposed Rulemaking: Control of VOC Emissions from Oil and Natural Gas Sources (#7-544).

Commenter Information:

Robert Kleinberg
Columbia University; Boston University (robert@robertkleinberg.com)
104 Avon Hill Street
Cambridge, MA 02140 US

Comments entered:

From: Robert L. Kleinberg, Ph.D., Andrew E. Pomerantz, Ph.D.
Re: Proposed Rulemaking: 25 PA. CODE CHS. 121 AND 129

Control of VOC Emissions from Existing Oil and Natural Gas Sources:
Technical Deficiencies

We find the proposed regulations have, from a technical point of view, four important defects: (1) the daily production threshold specified by the regulation will allow at least 61% of natural gas emitted to the atmosphere to escape undetected, (2) the limited range of source categories will allow significant quantities of natural gas to escape to the atmosphere undetected, (3) a large proportion of the natural gas produced in Pennsylvania has little or no VOC content, making VOC a poor measurement target, and (4) regulating emissions of volatile organic compounds while regarding methane reduction as a co-benefit will discourage the development and deployment of remote sensing technologies that can reduce the cost of compliance while improving environmental outcomes. Details are provided in the attached comment, and one-page summary.

3254

Date: 27 July 2020

To: Commonwealth of Pennsylvania
Environmental Quality Board
Harrisburg, Pennsylvania

From: Robert L. Kleinberg, Ph.D.
Andrew E. Pomerantz, Ph.D.

Re: Proposed Rulemaking
25 PA. CODE CHS. 121 AND 129
Control of VOC Emissions from Oil and Natural Gas Sources
Pa.B. Doc. No. 20-684. Filed for public inspection May 22, 2020, 9:00 a.m.

Ref: https://www.pacodeandbulletin.gov/Home/volume?vol=50&issue=21 pages 2633-2664
https://www.pacodeandbulletin.gov/Display/pabull?file=/secure/pabulletin/data/vol50/50-21/684.html

Submitted to http://www.ahs.dep.pa.gov/eComment

Control of VOC Emissions from Existing Oil and Natural Gas Sources: Technical Deficiencies

Qualifications of Commenters

Dr. Robert L. Kleinberg retired in 2018 after a forty year career in the oil and gas industry, having worked at both an operating company – Exxon – and at an oilfield services company – Schlumberger. He invented apparatus and methods to make oil and gas exploration and production safer and more efficient. His professional record is reflected in more than 120 scientific and technical publications and 41 U.S. patents. He has been elected to the National Academy of Engineering.

Dr. Andrew E. Pomerantz is an Energy Transition Technology Advisor at Schlumberger. He joined the company in 2005, and his roles have included technical and management positions developing new methods to characterize oil and gas reservoirs and to reduce the GHG footprint of oil and gas development. He has authored 100 peer-reviewed technical papers and 25 granted U.S. patents. He currently serves as an Associate Editor for scientific and professional journals including *Energy & Fuels*, published by the American Chemical Society.

Introduction

The Environmental Quality Board (EQB) has proposed various changes to the Pennsylvania Code. Regulation of volatile organic compound (VOC) emissions is extended to existing wells that produce more than 15 barrels of oil equivalent per day (boe/d) [25 Pa. Code 129.127(a)(1)] with a gas-oil ratio of greater than 300 standard cubic feet of gas per barrel of oil [25 Pa. Code 129.127(b)(1)(ii)]. For a gas well, 15 boe/d = 90 Mcf/d, where Mcf designates 1000 standard cubic feet and 1 boe = 6.003 Mcf[1]. Methane emissions are not explicitly regulated but are assumed to be reduced as a co-benefit of VOC regulation.

We find the proposed regulations have, from a technical point of view, four important defects: (1) the daily production threshold specified by the regulation will allow at least 61% of natural gas emitted to the atmosphere to escape undetected, (2) the limited range of source categories will allow significant quantities of natural gas to escape to the atmosphere undetected, (3) a large proportion of the natural gas produced in Pennsylvania has little or no VOC content, making VOC a poor measurement target, and (4) regulating emissions of volatile organic compounds while regarding methane reduction as a co-benefit will discourage the development and deployment of new sensor technologies that promise to reduce the cost of compliance while improving environmental outcomes.

Following the technical discussion, we present an economic analysis of various leak detection and repair scenarios.

The daily production threshold specified by the regulation will allow at least 61% of natural gas emitted to the atmosphere to escape undetected

According to the commentary accompanying the proposed rulemaking (page 2637):

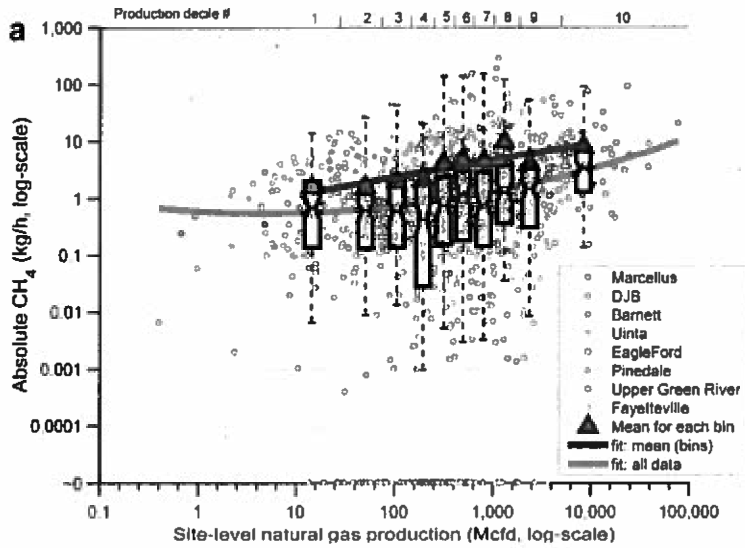
> The Department is aware of approximately 89,320 unconventional and conventional oil and natural gas wells, of which the Department estimates that 8,403 unconventional and 71,229 conventional wells are currently in production. These facilities also include approximately 435 midstream compressor stations, 120 transmission compressor stations and 10 natural gas processing facilities in this Commonwealth whose owners and operators may be subject to the proposed VOC emission reduction measures, work practice standards, and reporting and recordkeeping requirements. . . . Of the 71,229 conventional wells reporting production, only 303 are above the 15 barrels of oil equivalent per day production threshold as reported in the Department's 2017 oil and natural gas production database and will have fugitive emissions component requirements.

While it might be imagined that emission rates are proportional to production, evidence shows that the relationship between lost gas and beneficially produced gas is weak. Figure 1 shows methane emission rates from production sites plotted against average production rates.[2]

---

[1] BP, "Approximate conversion factors", Statistical Review of World Energy, 2019. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-approximate-conversion-factors.pdf

[2] M. Omara et al., Methane Emissions from Natural Gas Production Sites in the United States: Data Synthesis and National Estimate, Environ. Sci. Technol. 2018, 52, 12915–12925 https://pubs.acs.org/doi/abs/10.1021/acs.est.8b03535



Data for Pennsylvania are available in table format[3]

Production (Mcf/d)	< 10	10 - 100	100 – 1000	> 1000
Contribution to PA's methane emissions from this sector (%)	38	23	4	34

Omara et al. estimate that Pennsylvania wells producing less than 100 Mcf/d are responsible for 61% of total methane emissions, while wells producing more than 100 Mcf/d are responsible for 38% of total emissions. Natural gas in western Pennsylvania is predominantly methane[4] and in eastern Pennsylvania it is essentially pure methane (see below). Therefore, the distribution of methane emissions is expected to be similar to the distribution of natural gas emissions. Thus, one must conclude that the proposed regulation is likely to be inadequate to address the needs outlined in the commentary to the rulemaking.

The limited range of source categories will allow significant quantities of natural gas to escape to the atmosphere undetected

There are five source categories that are affected by the proposed regulation: storage vessels; natural gas-driven pneumatic controllers; natural gas-driven diaphragm pumps; reciprocating and centrifugal compressors; and fugitive emissions components.

---

[3] M. Omara et al., Methane Emissions from Natural Gas Production Sites in the United States: Data Synthesis and National Estimate, Supporting Information, Tables S10, S11.
https://pubs.acs.org/doi/suppl/10.1021/acs.est.8b03535/suppl_file/es8b03535_si_001.pdf

[4] Burruss, R.C., and Ryder, R.T., 2014, Composition of natural gas and crude oil produced from 14 wells in the Lower Silurian "Clinton" Sandstone and Medina Group Sandstones, northeastern Ohio and northwestern Pennsylvania, U.S. Geological Survey Professional Paper 1708, 38 p., http://dx.doi.org/10.3133/pp1708G.6

There are at least three other important sources of natural gas emissions. The first is unlit and inefficient flares. It has been found in the Permian Basin that 93% of gas sent to flares is uncombusted, thereby venting methane and VOC to the atmosphere.[5] Another recent study found that 10% of flares in the Permian Basin are unlit or malfunctioning,[6] meaning nearly all of the VOC and methane directed to those flares is vented to the atmosphere. The greenhouse gas impact of flares is affected by both feed gas composition and flare efficiency.[7] This problem is intermittent and therefore likely to be undetected by occasional surveys undertaken with Method 21 or optical gas imaging.

A second major source of natural gas leaks is gas gathering pipelines, which account for 30% of natural gas emissions in the Permian Basin of southeast New Mexico.[8]

A third source of gas leaks are abandoned wells, which are estimated to account for 5-8% of all anthropogenic methane emissions from Pennsylvania.[9] Concerted state or federal campaigns to plug these wells could yield significant environmental and economic benefits.[10]

A large proportion of the natural gas produced in Pennsylvania has little or no VOC content, making VOC a poor measurement target

A large proportion of Pennsylvania's natural gas resources are almost completely devoid of volatile organic compounds. A prominent example is the Marcellus shale of northeastern Pennsylvania. In 2018, Susquehanna, Bradford, Tioga, Wyoming, Lycoming, and Sullivan counties produced 3.4 trillion cubic feet of gas, 54% of the Pennsylvania total of 6.3 trillion cubic feet.[11] In fact those six counties accounted for 9% of total U.S. dry gas production. The natural gas of northeastern Pennsylvania has very low VOC content. In Bradford County, in the heart of this region, VOC content of field gas averages less than 0.1%.[12] In other words, there is 1000 times

---

[5] GaffneyCline, Tackling Flaring: Learnings from Leading Permian Operators, June 2020 https://www.gaffneycline.com/sites/g/files/cozyhq681/files/2020-06/Tackling%20Flaring_Final.pdf

[6] https://www.bloomberg.com/news/articles/2020-04-30/when-the-flames-go-out-the-permian-s-methane-problem-worsens

[7] Kleinberg, RL., (2019). Greenhouse Gas Footprint of Oilfield Flares Accounting for Realistic Flare Gas Composition and Distribution of Flare Efficiencies. https://www.essoar.org/doi/10.1002/essoar.10501340.1

[8] Hart Energy, E&P Operator Solutions: Methane Measurement Understanding the Big Picture, 28 May 2020 https://www.hartenergy.com/exclusives/methane-measurement-understanding-big-picture-187448

[9] M. Kang, et al., 2016. Identification and characterization of high methane-emitting abandoned oil and gas wells. Proceedings of the National Academy of Sciences 113 (48) 13636-13641. https://doi.org/10.1073/pnas.1605913113

[10] D. Raimi, N. Nerurkar, J. Bordoff, Green Stimulus for Oil and Gas Workers: Considering a Major Federal Effort to Plug Orphaned and Abandoned Wells, Center on Global Energy Policy, July 2020. https://energypolicy.columbia.edu/sites/default/files/file-uploads/OrphanWells_CGEP-Report_071620.pdf

[11] PADEP, 2018. DEP Office of Oil and Gas Management, Oil & Gas Well Production Report, January - December 2018 http://www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?%2fOil_Gas%2fOil_Gas_Well_Production

[12] NYSDEC, 2011. New York State Department of Environmental Conservation. Revised Draft Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for

more methane than VOC in Bradford County fugitive gas. Pennsylvania also produces about 10 billion cubic feet of coal bed methane annually. The VOC content of coal bed methane is negligible[13,14]. Because most natural gas in Pennsylvania contains little VOC, a Pennsylvania regulation limiting VOC emissions is unlikely to be effective for limiting natural gas emissions.

Regulating emissions of volatile organic compounds while regarding methane reduction as a co-benefit will discourage the development and deployment of new sensor technologies that promise to reduce the cost of compliance while improving environmental outcomes

There are only two oilfield leak detection technologies currently approved by the U.S. Environmental Protection Agency, Method 21 and optical gas imaging. Both, as commonly implemented, are sensitive to both methane and VOC.[15] However, there is broad agreement, ranging from the Environmental Defense Fund[16] to the Independent Petroleum Association of America[17], that presently employed technology is inefficient and sometimes ineffective. New sensor technologies are currently being developed and tested to detect natural gas emissions. Many of the most promising of these techniques are sensitive to methane but insensitive to VOC. Regulation of both methane and VOC will not change the present situation and will allow Pennsylvania companies to use the best reasonably available control technology for emission detection and control that may arise in the future.

One of the two approved gas leak detection methods is Method 21,[18] in which a probe samples the air at the surfaces of pipe fittings, valves, and other components. The second approved method is optical gas imaging (OGI), an Alternative Work Practice.[19] OGI images gas plumes, enabling leak detection more efficiently and more effectively than Method 21 sniffer probes. Optical gas imagers utilize broadband infrared (IR) spectroscopy, which is suitable for short range

---

Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs. NYSDEC September 7, 2011. Table 5.30.
http://www.dec.ny.gov/data/dmn/rdsgeisfull0911.pdf

[13] Kim, A.G., 1973. "The Composition of Coalbed Gas", U.S. Bureau of Mines Report of Investigations 7762.

[14] Ripepi, N., et al., 2017. "Determining Coalbed Methane Production and Composition from Individual Stacked Coal Seams in a Multi-Zone Completed Gas Well", Energies 10, 1533. doi:10.3390/en10101533

[15] R.L. Kleinberg, A.E. Pomerantz, "Re: Docket ID No. EPA-HQ-OAR-2017-0757; EPA's 'Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Reconsideration; Proposed Rule'; 84 FR 50244 (24 September 2019)", 25 November 2019.
https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0757-2195

[16] Environmental Defense Fund, Pathways for Alternative Compliance: A Framework to Advance Innovation, Environmental Protection, and Prosperity, April 2019
https://www.edf.org/sites/default/files/documents/EDFAlternativeComplianceReport_0.pdf

[17] Independent Petroleum Association of America, Re: Environmental Protection Agency's Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Reconsideration at 83 Federal Register 52056 (October 15, 2018) – Supplemental Comments, 17 June 2019. Docket ID No. EPA-HQ-OAR-2017-0483
https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0483-2232

[18] 40 CFR 60 Appendix A-7

[19] 73 FR 78199-78219

(distance ≈ 4 meter) inspection[20]. Most commonly, OGI instruments used in the oil and gas industry (e.g. FLIR GF320)[21] are sensitive to wavelengths in the mid-IR band between 3.2 μm and 3.4 μm. In this band, OGI is sensitive to both methane and VOC (such as propane), see Figure 1.

Thus, given presently approved methods as commonly implemented, relying solely on a VOC emission rule is equivalent to relying on a methane emission rule, so long as those methods are used to inspect all infrastructure, regardless of the VOC content of natural gas produced in the region.

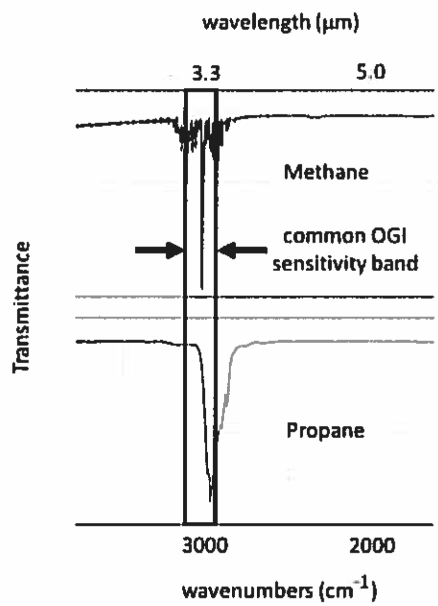


Figure 1. Infrared transmittance spectra of methane (top) and propane (bottom).[22] Optical gas imagers are typically sensitive to wavelengths between 3.2 μm and 3.4 μm (black box), thereby imaging both methane and VOC.

However novel technologies to detect fugitive emissions are being developed by innovators and field tested by a broad coalition of operators, industry trade groups, and environmental advocates. Advanced technologies can be usefully deployed to reduce, perhaps dramatically, the cost of compliance with natural gas leak detection and repair (LDAR) rules[23,24]. These technologies potentially include surveillance of oil and gas infrastructure by sensors deployed on

[20] A.R. Brandt, Assessment of LDAR technology options, ONE Future Methane & Climate Strategies Event, 15 May 2018. http://onefuture.us/wp-content/uploads/2018/05/Stanford_Brandt_LDAR_2018.pdf

[21] FLIR, Infrared Camera for Methane and VOC Detection, https://www.flir.com/products/gf320/

[22] NIST, 2019. NIST Chemistry WebBook, National Institute of Standards and Technology. https://webbook.nist.gov Accessed 8 September 2019.

[23] American Petroleum Institute, EPA-HQ-OAR-2017-0483-0801 https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0483-0801

[24] Independent Petroleum Association of America, EPA-HQ-OAR-2017-0483-1006 https://www.regulations.gov/document?D=EPA-HQ-OAR-2017-0483-1006

drones, helicopters, fixed-wing aircraft, and/or earth-orbiting satellites[25,26,27]. For many emerging technologies, speciation of fugitive emissions is inherent to the physical principles that underly the detection technique.

The principle that underlies many emerging technologies is the absorption of infrared radiation, commonly referred to as IR spectroscopy. Methane and VOC are both strong absorbers of infrared radiation. Indeed, their strong infrared absorption is the reason that these compounds are potent greenhouse gases.

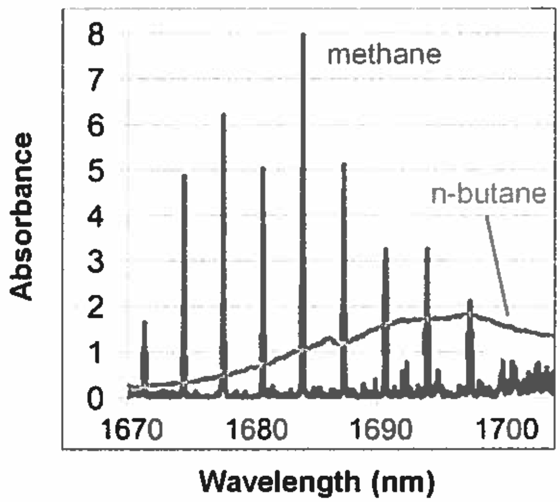


Figure 2. Methane absorbs infrared radiation in a series of narrow features, while n-butane, a typical VOC, absorbs infrared radiation in a single, wide feature.[28]

While both methane and VOC absorb infrared radiation, the ways in which they absorb infrared radiation are different; hence the ability to detect them with infrared radiation is different. The IR spectra of small molecules such as methane consist of a series of narrow spectral features, while the IR spectra of larger molecules such as VOC consist of a single broad spectral feature. As shown Figure 2, methane absorbs infrared radiation strongly at particular wavelengths but only weakly at nearby wavelengths, while n-butane (a typical component of VOC) absorbs infrared radiation at all wavelengths in a relatively broad wavelength range.

Differences in the width of the spectral features impacts how methane and VOC are detected. Some emerging methane detection technologies utilize near infrared (also called shortwave infrared) spectroscopy, with detected wavelengths around 1650 nm. The IR spectrometer is

---

25 Ball Aerospace, Methane Monitor http://www.ball.com/aerospace/Aerospace/media/Aerospace/Downloads/D3242-Methane-Monitor_0518.pdf?ext=.pdf

26 Bridger Photonics, Gas Mapping LIDAR, https://www.bridgerphotonics.com/gas-mapping-lidar/

27 GHGSat, Global Emissions Monitoring, https://www.ghgsat.com/

28 Mitsumoto, Laser Spectroscopic Multi-component Hydrocarbon Analyzer, Yokogawa Technical Report English Edition 56(2) (2013), https://web-material3.yokogawa.com/rd-te-r05602-008.pdf

mounted on a drone, helicopter, airplane, or satellite.[29,30] Measuring emissions using an IR remote sensor requires correcting for many factors than can influence the amount of infrared radiation detected, including the strength of the infrared source (either the sun or a laser); the reflectivity of the surface that reflects the infrared radiation to the spectrometer; and scattering from dust, water, or other airborne particulates.

Using differential absorption spectroscopy, wavelength modulation spectroscopy, or similar techniques, corrections are performed by measuring the difference in infrared radiation detected at two wavelengths: one wavelength is absorbed by the gas, and the other wavelength is not absorbed by the gas. This procedure requires the two wavelengths to be close together, so the interfering factors are held constant and can be subtracted out. This requirement is met for methane, as a result of its narrow spectral features; but not for VOC, as a result of its broad spectral features. Due to this limitation, the most promising IR spectrometers deployed in remote sensing applications can reliably detect fugitive methane emissions but cannot reliably detect fugitive VOC emissions.

We have shown that the low VOC content of much of the natural gas produced in Pennsylvania, combined with the poor sensitivity of advanced leak detection methods to VOC, is likely to make aerial or satellite detection of VOC impractical. On the contrary, advanced technology is very well adapted to methane detection. By signaling that reduction of methane emissions is not a priority of the Commonwealth of Pennsylvania, thereby discouraging the development, improvement, and deployment of the best reasonably available control technologies for methane, the Commonwealth may well condemn regulated entities to the continued use of costly, tedious, and sub-optimal techniques for natural gas leak detection.

Economic Analysis of Various Leak Detection and Repair Scenarios

The economics of methane reduction must be considered. As shown in Figure 1, the average marginal well emits approximately 0.5 Mcf/d of methane. Even if LDAR applied to marginal wells were to capture all of that emitted methane and add it to the sales line, the financial benefit to the producer of LDAR would be approximately $400/well/yr at today's prices. Given that EQB estimates LDAR will cost approximately $4,000/well/yr, it appears unlikely that mandating traditional LDAR on marginal wells will be economically justifiable.

However, there exists a middle ground between the extremes of allowing most of the industry's emissions to continue by exempting marginal wells from regulation and placing a financial burden on producers by mandating uneconomic LDAR for marginal wells. Numerous new LDAR technologies are being developed by a diverse set of innovators. Academic studies have indicated that the new technologies can improve performance and reduce cost relative to

---

[29] Tandy, Methane Monitor: The First Full Year of Campaigns and Lessons Learned, A43P-3361, American Geophysical Union Annual Meeting, December 2018. [Ball Aerospace]

[30] Jacob, Satellite observations of atmospheric methane and their value for quantifying methane emissions, Atmospheric Chemistry & Physics, 16, 14371–14396, 2016. www.atmos-chem-phys.net/16/14371/2016/ doi:10.5194/acp-16-14371-2016

traditional LDAR technologies such as optical gas imaging.[31,32,33] These new technologies take advantage of the observation that most of the industry's emissions, in Pennsylvania and elsewhere, come from a small number of "super-emitting" facilities, including marginal wells.[34] The new technologies focus on identifying the super-emitters in ways unachievable using traditional technology, allowing the new technologies to achieve large emissions reduction at low cost. In one example, Rashid et al.[35] found an optimal routing solution for the aerial surveillance of 119,000 Pennsylvania oil and gas wells utilizing an airborne platform with a sensitivity of 1 kg/hr. They estimate the cost of inspection to be only $100/well, while the effectiveness of inspection is approximately the same as from optical gas imaging.[36]

LDAR performed on marginal wells in Pennsylvania using these emerging technologies is likely to reduce a substantial fraction of emissions from this important source category at no net cost to the average producer, because the cost of the LDAR measurement is comparable to the additional revenue arising from selling the saved gas. We therefore suggest that allowing emerging technologies to be used to monitor emissions from marginal wells achieves a middle ground and represents a win-win for the producers and for the environment.

Recommendation

A process should be created that encourages the development and use of new technologies that reduce the cost of compliance of regulated entities while reducing the quantities of methane and VOC emitted within the Commonwealth. These technologies might include remote sensing and permanent sensor technologies. An example of how to encourage technical innovation is to replace the requirement that LDAR surveys be performed using prescribed technology with a requirement that LDAR surveys can be performed using any technology that has been demonstrated to achieve equivalent reductions in aggregate emissions. A specific procedure for conducting that demonstration has been developed by a group of operators, regulators, academics, solution providers, consultants, and non-profit groups from Canada and the U.S.[37]

---

[31] T.A. Fox, A review of close-range and screening technologies for mitigating fugitive methane emissions in upstream oil and gas, Environmental Research Letters, 2019. https://doi.org/10.1088/1748-9326/ab0cc3
Erratum: https://iopscience.iop.org/article/10.1088/1748-9326/ab20f1

[32] T.A. Fox, A methane emissions reduction equivalence framework for alternative leak detection and repair programs, Elementa, 2019. https://doi.org/10.1525/elementa.369

[33] A.P. Ravikumar, Single-blind inter-comparison of methane detection technologies – results from the Stanford/EDF Mobile Monitoring Challenge, Elementa, 2019, https://doi.org/10.1525/elementa.373

[34] M. Omara et al., Methane Emissions from Natural Gas Production Sites in the United States: Data Synthesis and National Estimate, Environ. Sci. Technol. 2018, 52, 12915–12925
https://pubs.acs.org/doi/abs/10.1021/acs.est.8b03535

[35] K. Rashid et al., Optimized inspection of upstream oil and gas methane emissions using airborne LiDAR surveillance, Applied Energy 275 (2020) 115327
https://doi.org/10.1016/j.apenergy.2020.115327

[36] US EPA, Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources, Background Technical Support Document for the Final New Source Performance Standards 40 CFR Part 60, subpart OOOOa, May 2016

[37] T.A. Fox, et al.,, 2019. A methane emissions reduction equivalence framework for alternative leak detection and repair programs. Elementa 7(1), 30. https://www.elementascience.org/articles/10.1525/elementa.369/

This regulation has been implemented successfully in the Canadian Province of Alberta, and a similar regulation in Pennsylvania would likely be successful as well.

Respectfully submitted,

Robert L. Kleinberg, Ph.D.
Columbia University Center on Global Energy Policy
Boston University Institute for Sustainable Energy
Member of the National Academy of Engineering
robert@robertkleinberg.com

Andrew E. Pomerantz, Ph.D.
Energy Transition Technology Advisor, Schlumberger
apomerantz@slb.com

The opinions expressed herein are those of the authors, and do not necessarily represent the views of the institutions with which they are affiliated.

Date: 27 July 2020 One Page Summary

From: Robert L. Kleinberg, Ph.D.
Andrew E. Pomerantz, Ph.D.

Re: Proposed Rulemaking: 25 PA. CODE CHS. 121 AND 129

Control of VOC Emissions from Existing Oil and Natural Gas Sources: Technical Deficiencies

We find the proposed regulations have, from a technical point of view, four important defects: (1) the daily production threshold specified by the regulation will allow at least 61% of natural gas emitted to the atmosphere to escape undetected, (2) the limited range of source categories will allow significant quantities of natural gas to escape to the atmosphere undetected, (3) a large proportion of the natural gas produced in Pennsylvania has little or no VOC content, making VOC a poor measurement target, and (4) regulating emissions of volatile organic compounds while regarding methane reduction as a co-benefit will discourage the development and deployment of remote sensing technologies that can reduce the cost of compliance while improving environmental outcomes.

Remote sensing technologies, which we show are inherently sensitive to methane and inherently insensitive to VOC, can improve performance and reduce cost relative to Method 21 or optical gas imaging. These technologies take advantage of the observation that most of the industry's emissions, in Pennsylvania and elsewhere, come from a small number of "super-emitting" facilities, including marginal wells. For example, an optimal routing solution was found for the aerial surveillance of 119,000 Pennsylvania oil and gas wells utilizing an airborne platform with a sensitivity of 1 kg/hr. The estimated cost of inspection is $100/well, while the effectiveness of inspection is approximately the same as if optical gas imaging were implemented at all wells.

A process should be created that encourages the development and use of new technologies that reduce the cost of compliance of regulated entities while reducing the quantities of methane and VOC emitted within the Commonwealth. These technologies might include remote sensing and permanent sensor technologies. An example of how to encourage technical innovation is to replace the requirement that surveys be performed using prescribed technology with a requirement that surveys can be performed using any technology that has been demonstrated to achieve equivalent reductions in aggregate emissions. A specific procedure for conducting that demonstration has been developed by a group of operators, regulators, academics, solution providers, consultants, and non-profit groups from Canada and the U.S. This regulation has been implemented successfully in the Canadian Province of Alberta, and a similar regulation in Pennsylvania would likely be successful as well.