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Neil Kornze
Director, U.S. Bureau of Land Management
1849 C Street NW, Room 5665
Washington, DC 20240

Attn: RIN 1004-AE14

Re: Comments of Environmental Defense Fund on BLM's Proposed Rule on Waste Prevention, Production Subject to Royalties, and Resource Conservation

The Environmental Defense Fund ("EDF") appreciates the opportunity to comment on the Bureau of Land Management's ("BLM") February 8, 2016 proposed rule regarding Waste Prevention, Production Subject to Royalties, and Resource Conservation ("Proposed Rule").[1] EDF is a national non-profit, non-partisan organization that represents over 750,000 members nationwide and is dedicated to protecting human health and the environment by effectively applying science, economics, and the law.

Rigorous BLM standards are urgently needed to minimize waste of natural gas produced on the nation's federal and tribal lands. Every year, oil and gas facilities on federal and tribal lands waste massive quantities of natural gas through venting, equipment leaks, and flaring—much of which could be avoided or substantially reduced through proven, highly cost-effective best practices and technologies. These losses represent a tragic misuse of a precious natural resource owned by the public, deprive taxpayers and governments of vital royalty revenues, and pose significant threats to climate and public health. Under our nation's mineral leasing and land management laws, BLM has a clear statutory responsibility to ensure that oil and gas operators on federal and tribal lands operate at the highest standards to minimize waste and protect climate and air resources.

In these comments, we describe the clear need for BLM to take strong and effective action to reduce waste and minimize methane emissions on federal and tribal lands; outline BLM's manifest statutory responsibility to carry out the measures described in the proposed rule; support major elements of BLM's proposed standards on waste prevention; and recommend that BLM improve and strengthen the proposed standards in key areas. Our principal recommendations include:

[1] Proposed Rule: Waste Prevention, Production Subject to Royalties, and Resource Conservation, 81 Fed. Reg. 6616 (February 8, 2016).

Equipment Leaks:

- Require more frequent, instrument-based leak detection and repair ("LDAR"), including at well sites that produce less than 15 barrels of oil equivalent ("BOED") per day. BLM could optimize the frequency of monitoring requirements by adopting a tiered approach along the lines of the state of Colorado.
- Strengthen LDAR provisions by requiring monitoring of intermittent-bleed pneumatic controllers and by eliminating frequency adjustments based on the number of leaking components.

Flaring:

- Strengthen the flaring requirements by adopting a flaring limit of 1,200 Mcf per month for all wells and analyze additional achievable reductions based on establishing a per-well flaring limit rather than the proposed limit averaged across a lease.
- Align the definition of 'development well' for purposes of the proposed flaring requirements with EPA's definition.
- Rigorously apply the economic test that would permit an existing well to exceed the flaring limit.
- Eliminate the two-year renewable exemption from the flaring limit for existing wells.

Liquids Unloading:

- Finalize rigorous standards to limit venting during liquids unloading.

Pneumatic Controllers:

- Where feasible, require operators to use zero emitting pneumatics technologies or route bleed gas to a process or control device.
- Remove the exception allowing continued use of high-emitting pneumatic controllers at a facility with an estimated remaining productive life of no more than three years.
- Ensure intermittent controllers are likewise subject to waste minimization standards, including evaluating opportunities to replace these devices with zero-emitting alternatives.

Storage Tanks:

- Prohibit venting from access points during normal storage tank operations, require certification of compliance, and specify that control devices used to meet the BLM requirement have at least a 98% destruction efficiency

Our detailed comments provide additional support for these recommendations. All prior written and oral testimony and submissions to the Agency in this matter, including all citations and attachments, as well as all of the documents cited to in these comments are hereby incorporated by reference as part of the administrative record in this BLM action, Docket ID No. RIN 1004-AE14.

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I. OIL AND GAS ACTIVITIES ON FEDERAL AND TRIBAL LANDS ARE A SIGNIFICANT SOURCE OF UNNECESSARY WASTE AND AIR POLLUTION

The U.S. oil and gas sector discharges significant quantities of natural gas to the atmosphere in the form of vents and equipment leaks. According to EPA's latest Greenhouse Gas Inventory, oil and gas facilities are the nation's largest source of methane (the primary constituent of natural gas)—accounting for 9.8 million metric tons of methane emissions in 2014, or approximately thirty percent of the United States' total methane emissions.[2] Moreover, the latest scientific evidence suggests that actual emissions from the sector could be substantially higher than the inventory indicates.[3]

These losses represent a substantial and irreplaceable waste of a critical natural resource. Because methane is also a potent greenhouse gas, this wasted gas likewise presents both a serious threat to the stability of our climate and an important opportunity to achieve near-term reductions in harmful climate pollution. Reducing methane emissions from the oil and gas sector would also yield significant dividends for public health in the form of reduced air pollutants that are co-emitted with methane, including ozone precursors such as VOCs and carcinogenic substances such as benzene and other hazardous air pollutants ("HAPs").[4]

a. BLM-Administered Leases Are Responsible for Significant Waste

BLM manages nearly one third of the nation's mineral estate, with domestic production from onshore oil and gas wells making up 11 percent of the nation's natural gas supply and 5 percent of its oil supply in fiscal year 2014.[5] The Office of Natural Resources Revenue ("ONRR") estimates the production value of this oil and gas exceeded $27.2 billion and generated approximately $3.1 billion in royalties.[6] Yet, between 2009 and 2014, "operators on BLM-administered leases wasted enough natural gas to serve 5.1 million homes for 1 year."[7]

BLM estimates that in 2013 alone, about 98 Bcf of natural gas was vented, flared, or leaked from oil and gas production on BLM-administered leases, "representing about 3.4 percent of the total production from BLM-administered leases in that year (2,901 Bcf)."[8] Of this amount, BLM

[2] EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014* (2016) ("2014 GHGI"), at ES-6, Table ES-2, *available at* https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Main-Text.pdf.
[3] *See* section I.b., *infra*.
[4] Pétron, *et al.*, (2014), "A new look at methane and nonmethane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin," *J. of Geophysical Research: Atmospheres*, 119 ("Petron (2014)"), at 6836, 6850, *available at* http://onlinelibrary.wiley.com/doi/10.1002/2013JD021272/pdf.
[5] 81 FR 6626, February 8, 2016.
[6] *Id.*
[7] 81 FR 6626 and ONRR, Statistical Information, http:// statistics.onrr.gov/ReportTool.aspx using Sales Year—FY2014—Federal Onshore—All States Sales Value and Revenue for Oil, NGL, and Gas products as of December 2, 2015.
[8] 81 FR 6626. *See also* BLM, Regulatory Impact Analysis for Revisions to 43 CFR 3100 (Onshore Oil and Gas

estimates that approximately 66 Bcf—enough gas to supply almost 900,000 homes each year—derived from federal and tribal mineral interests.[9] This estimate is based on a combination of EPA's then-available Greenhouse Gas Inventory data and production data reported to the Department of Interior and it is consistent with a recent inventory of federal and tribal natural gas losses commissioned by EDF and produced by the independent consulting firm ICF International.[10]

As BLM points out, "gas that is flared, vented, or leaked into the atmosphere from production on BLM-administered leases is a lost public or tribal resource that is not available for productive use."[11] This wasted gas likewise deprives taxpayers of important additional revenues that would otherwise be associated with the produced gas. Indeed, BLM estimates that "the gas presently lost from BLM-administered leases would provide an additional $49 million in royalties each year to the Federal Government, States, and tribes."[12]

b. Actual Amounts of Waste and Air Pollution on Federal and Tribal Lands Likely Exceed these Estimates

The estimates in BLM's proposal significantly understate the deleterious impacts of wasted natural gas on Federal and Tribal lands for several reasons. BLM has relied on EPA inventory estimates and recent scientific studies suggest that 'bottom-up' inventories—which estimate emissions using emissions factors and equipment counts in the field—consistently underestimate emissions. A recent series of studies in the Barnett—incorporating both top-down and bottom-up measurement—found that emissions were 90 percent greater than estimates based on the GHGI.[13] Similarly, a recent study sponsored by EDF indicates sector-wide emissions 1.5 to 2 times EPA's reported estimates.[14] BLM discusses many of these same studies and conclusions in its proposal and recognizes, "[o]verall, these studies and alternative sources of data suggest that the BLM's estimates of lost gas likely underestimate, and potentially substantially underestimate, the extent of the problem."[15]

Leasing) and 43 CFR 3600 (Onshore Oil and Gas Operations) (January 14, 2016) ("RIA"), at 111 (Appendix A-2).

[9] *Id.*

[10] *Id.*

[11] 81 FR 6627

[12] 81 FR 6627 and RIA at 3.

[13] Zavala-Araiza et al., Reconciling divergent estimates of oil and gas methane emissions, Proceedings of the National Academy of Sciences, vol. 112, no. 51, 15597–15602 (Dec. 22, 2015).

[14] Lyon, *et al.*, (2015), "Constructing a Spatially Resolved Methane Emission Inventory for the Barnett Shale Region," *Environ. Sci. Technol.*, 49, at 8147-57, *available at* http://pubs.acs.org/doi/pdf/10.1021/es506359c. *See also* Karion, et al., (2015), "Aircraft-Based Estimate of Total Methane Emissions from the Barnett Shale Region," *Environ. Sci. Technol.*, 49, at 8124-31, *available at* http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b00217.

[15] 81 FR 6632-6633 (citing numerous studies, including A. R. Brandt et al., Methane Leaks from North American Natural Gas Systems, Science, 733 (Feb. 14, 2014), http://www.sciencemag.org/content/343/ 6172/733.full.; Gabrielle Pétron et al., A new look at methane and nonmethane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin, Journal of Geophysical Research: Atmospheres, 6836 (June 3, 2014), http:// onlinelibrary.wiley.com/doi/10.1002/ 2013JD021272/pdf; David T. Allen et al., Measurements of Methane Emissions at Natural Gas Production Sites in the United States, 17768 (Oct. 2013), The Proceedings of the National Academy of Sciences of the United States of America, 17768 (Oct. 2013), http://www.pnas.org/content/110/44/17768.full.pdf; David T. Allen et al., Methane Emissions from Process Equipment at Natural Gas Production Sites in the United States: Pneumatic Controllers, 636 and 638 (Dec. 9, 2014), Environmental Science and Technology, available at

In addition, recent studies have documented a greater instances of high emitting sources on Federal and Tribal lands, including, for instance, a study described in greater detail below, which found 42% of super-emitting sites were on Federal lands, though Federal lands only constituted 29% of surveyed sites.[16]

Finally the proposal further understates the environmental impact of these emissions by relying on an outdated global warming potential ("GWP") value for methane. BLM has relied on the 100-year GWP[17] for methane—a value of 25—that appeared in the Intergovernmental Panel on Climate Change's ("IPCC") Fourth Assessment Report ("AR4") from 2007.[18] In 2013, the IPCC released its Fifth Assessment Report ("AR5"), revising upward the earlier report's 100-year GWP for fossil methane from 25 to 36,[19] yet BLM has proposed to use the lower, outdated figure from the earlier report. Had BLM instead relied on the most accurate value of 36, estimates of 100-year climate impacts of methane from oil and gas sources would have been 44% higher— 350 MMT CO_2e rather than 244 MMT. Additionally, AR5 reports a 20-year methane GWP of 87,[20] which corresponds to a total of roughly 850 MMT CO_2e from domestic oil and gas methane emissions in 2014 (approximately 287% higher than the 2014 GHGI estimate).

Both the substantial (and likely underestimated) waste of natural gas on Federal and Tribal lands and harmful environmental effects of that waste underscore the urgent need for BLM to establish standards to address this pollution.

II. UNIFORM AND CLEAR BLM RULES ARE NECESSARY TO CURB WASTE AND POLLUTION AND WILL YIELD SUBSTANTIAL BENEFITS

Uniform, rigorous BLM rules are necessary to curb waste and pollution —both because BLM's current policy is outdated and "neither the EPA nor State regulations adequately address the issue of waste gas from BLM-administered leases."[21] BLM's proposal will fill important gaps in the existing regulatory regime for oil and gas production on federal land, more effectively and efficiently minimizing unnecessary waste of natural gas.

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http://pubs.acs.org/doi/ abs/10.1021/es5040156; Zavala-Araiza et al., Reconciling divergent estimates of oil and gas methane emissions, Proceedings of the National Academy of Sciences, vol. 112, no. 51, 15597–15602 (Dec. 22, 2015).

[16] Lyon, *et al.*, (2016) "Aerial surveys of elevated hydrocarbon emissions from oil and gas production sites," Environ. Sci. Technol. (Article ASAP), Web publication April 5, 2016 ("Lyon, et al. (2016)"), available at http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00705.

[17] A compound's GWP refers to its ability (in comparison to CO_2) to trap heat from the sun in the Earth's atmosphere. CO_2 has a GWP of 1; a compound *x* with a GWP of (for example) 50 would have 50 times more heat-trapping capacity than the same quantity of CO_2.

[18] *See* RIA, at 38, n. 42; 20145 GHGI at ES-3.

[19] IPCC, *Fifth Assessment Report, Climate Change 2013- The Physical Science Basis, Chapter 8: Anthropogenic and Natural Radiative Forcing* (Sept. 2013), at 714, Table 8.7, *available at* https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf. Methane's GWP of 36 reflects the full impacts from fossil-based sources and includes impacts from methane's oxidation to carbon dioxide.

[20] *Id.*

[21] 81 Fed. Reg. at 6618.

a. BLM's Current Policy is Outdated and Inefficient

The proposed rule would replace the U.S. Geological Survey's 1979 Notice to Lessees and Operators of Onshore Federal and Indian Oil and Gas Leases ("NTL-4A")—the dated requirements for venting, flaring, and royalty obligations for operators on onshore Federal and Indian leases. NTL-4A is neither comprehensive nor efficient in its approach to waste prevention. Moreover, as a 36-year-old rule, NTL-4A does not reflect current oil and gas practices or waste minimization capabilities.

The Proposed Rule replaces a limited, inefficient rule with a streamlined, more comprehensive approach. As BLM recognizes, NTL-4A sets forth only "broad, generalized directives"[22] on the permissibility of venting and flaring, and for determining whether these and other gas losses are subject to royalty obligations. What's more, both the royalty obligations and venting and flaring allowances largely require individual determinations by the bureau,[23] which has resulted in inefficiencies as well as uncertainty for operators. Moreover, under the Notice, no royalty obligations accrue, and no other requirements are imposed for production deemed 'unavoidably lost,' which include "gas vapors which are released from storage tanks or other low-pressure production vessels," and oil and gas lost due to "line failures, equipment malfunctions, blowouts, fires," which are not the result of the lessee or operator's negligence. This definition ignores significant and preventable sources of waste.

BLM's proposal will replace this limited and inefficient program with a more comprehensive and uniform approach to minimizing waste. As opposed to requiring initial case-by-case determinations for allowing venting and flaring, the Proposed Rule streamlines the regulatory approach by eliminating venting, setting a universal limit on the rate of flaring at a well, and determining exceptions by application. The proposal finally recognizes leaks as a substantial source of waste from the oil and gas sector by addressing leaking components with monitoring, repair, and equipment requirements. And the proposal sets forth clear requirements for the use of proven, cost-effective best practices and technologies, rather than rely on royalty payments alone to provide operators with an incentive to minimize waste.

[22] 81 FR 6628.

[23] The Notice permits venting and flaring in defined emergencies during certain well tests. Otherwise, gas well gas may not be vented or flared, and oil well gas may only be vented or flared with pre-approval of an application by a Supervisor. Operators must submit either a plan to eliminate venting and flaring within one year, or "engineering, geologic, and economic data" sufficient to show that if capture were required, it would lead to premature abandonment of the well such that "a greater loss of equivalent energy than would be recovered if the venting or flaring were permitted to continue" would result. Likewise, oil and gas production is subject to royalty obligations if an Area Oil and Gas Supervisor deems it to have been 'avoidably lost.' The Notice defines 'avoidably lost' production as "the venting or flaring of produced gas without *the prior authorization* . . . *of the Supervisor* and the loss of produced oil or gas *when the Supervisor determines* that such loss occurred as a result of (1) negligence . . . (2) the failure of the lessee or operator to take all reasonable measures to prevent and/or to control the loss, or (3) the failure . . . to comply fully with the applicable lease terms and regulations." (emphasis added).

Industry advances further support updating NTL-4A. As BLM accurately notes, "NTL-4A neither reflects today's best practices and advanced technologies, nor is particularly effective in requiring their use to avoid waste."[24] NTL-4A is not a forward-looking provision—it did not attempt to harness advances in technology after its 1979 issuance. But neither does it utilize the technology of its time. It employs a mechanism whereby operators apply to vent or flare from their wells, without setting any default emission limits or equipment requirements. This approach fails to establish any baseline standards for gas conservation.

The proposed rule employs many current best practices, providing requirements for instrument-based leak detection and repair, prohibiting the use of high-bleed pneumatic controllers, specifying emission control requirements for pneumatic pumps and storage vessels, and requiring best practices to reduce waste during certain operations such as drilling, completion, refracturing, and liquids unloading. These requirements for the first time make clear the gas capture practices and devices that constitute compliance, eliminating NTL-4A's subjective, case-by-case approval mechanism and resulting in more effective minimization of waste on public lands.

b. State Rules Do Not Offer a Uniform Policy for BLM Lands

BLM's uniform approach is likewise needed because many states lack comprehensive regulatory requirements to minimize natural gas waste and methane emissions. Federal and Tribal lands span 26 states, and oil and gas operations on BLM-administered leases in these states may be subject to no requirements or to differing sets of standards. As such, these "specific state requirements, and the outcomes they produce, vary widely."[25] In almost all cases, these state requirements either do not address the critical sources of waste in BLM's proposal or apply only to a subset of sources. Moreover, state rules do not apply to BLM-administered leases on tribal lands. Rigorous BLM standards are therefore essential to address this gap and to provide a uniform approach to minimizing waste from oil and gas production on Federal and Tribal lands.

To illustrate, Wyoming, Colorado, and New Mexico—the top three states for oil and gas production on BLM-administered lands,[26] and each with contiguous areas of BLM land—have widely differing requirements for venting, flaring, and equipment leaks.

Wyoming. In Wyoming, oil and gas operations on BLM-administered lands are subject to Oil & Gas Conservation Commission (OGCC) rules on venting and flaring, as well as Department of

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[24] 81 FR 6628.
[25] 81 FR 6633.
[26] BLM, Oil & Gas Statistics, *available at* http://www.blm.gov/wo/st/en/prog/energy/oil_and_gas/statistics.html.

Environmental Quality (DEQ) permit requirements, which vary by facility location.[27] Under Wyoming regulations, only oil and gas facilities located in designated areas in the Upper Green River Basin are subject to leak detection and repair requirements and requirements to minimize venting from existing pneumatic controllers and pumps. Under OGCC rules, venting and flaring are allowed in certain emergencies, for necessary maintenance, and during test procedures up to certain Mcf/day thresholds and limited time periods.[28] Operators may request to flare in additional circumstances by submitting a detailed application.[29]

New Mexico. Conversely, New Mexico does not require oil and gas production facilities to adopt the basic best practices described in BLM's proposed rule, such as leak detection and repair and low or zero-bleed pneumatic controllers. The New Mexico Oil Conservation Division does prohibit flaring or venting from oil wells after 60 days following a well's completion, [30] but also provides broad exemptions "when the flaring or venting . . . appears reasonably necessary to protect correlative rights, prevent waste or prevent undue hardships on the applicant."[31] The New Mexico Air Quality Control Act, administered by the state Environment Department, sets emission standards at petroleum and natural gas processing facilities for some air pollutants, including particulate matter,[32] but these regulations do not provide equipment requirements or other best practices to meet the standards, and only minimize waste as a collateral effect.

Colorado. Meanwhile in Colorado, the OGCC allows venting and flaring without prior approval under similar exemptions for emergencies, maintenance, and testing,[33] but provides minimal guidance to operators on the factors affecting a request to vent or flare. For instance, the form on which a request is made does not require an explanation for the need.[34] Separately, the Colorado Department of Public Health and Environment ("CDPHE") has developed robust rules that apply to new and existing facilities state-wide and that establish an emissions limit for VOCs and other

[27] Wy. Oil and Gas Production Facilities Permitting Guidance (Sept. 2013), *available at* http://deq.wyoming.gov/media/attachments/Air%20Quality/New%20Source%20Review/Guidance%20Documents/2013-09_%20AQD_NSR_Oil-and-Gas-Production-Facilities-Chapter-6-Section-2-Permitting-Guidance.pdf (setting separate requirements for facilities in 'concentrated development areas,' in the Upper Green River Basin, in the Jonah and Pinedale Anticline development Area and Normally Pressured Land, and for other facilities not located in these areas; each of these areas encompass BLM lands).

[28] WY OGCC Ch.3, Section 39(b)

[29] WY OGCC Ch.3, Section 39(c) (requiring the reason for flaring; the estimated duration of flaring; the daily volume of gas; the daily volume and type of associated fluids, gas, or plant products; a description of the well or other facility; and a detailed gas capture plan).

[30] NMAC 19.15.18.12A.

[3131] NMAC 19.15.18.12B.

[32] 20 N.M.A.C. § 2.37 (setting emission standards for hydrogen sulfide, mercaptan, carbon monoxide, and ammonia); 20 N.M.A.C. § 2.35 (setting emission standards for sulfur).

[33] CO OGCC Rule 912.

[34] CO OGCC, Sundry Notice Form 4, *available at* https://cogcc.state.co.us/Forms/PDF_Forms/form4_05152014.pdf.

hydrocarbons, set equipment standards for significant emissions sources, and require monitoring and repair of leaks.[35] However, these rules do not apply on Tribal Lands.

As evidenced by the above discussion, these states—and others—take differing approaches to minimizing waste and addressing emissions. In certain cases, states lack requirements entirely, and, even in states with the most protective standards, state requirements do not fully address the sources and measures BLM has proposed to minimize waste. Accordingly, BLM's rules are critical to fulfill its statutory mandate and provide a uniform approach to preventing waste on Federal and Tribal Lands.

c. EPA Standards Do Not Comprehensively Address Waste and Emissions on Federal and Tribal Lands

EPA's proposed methane reduction requirements in NSPS OOOOa—which deploy many of the same technologies to reduce methane emissions from new and modified sources in the oil and gas sector—also apply on federal lands, though there are important ways in which EPA's proposed standards do not comprehensively address waste in these areas. For instance, EPA requirements do not address the existing sources in the oil and gas sector,[36] which account for the vast majority of waste from the oil and natural gas sector.[37] Moreover, there are several areas where BLM's proposed rule requires additional technologies and practices to minimize waste not reflected in the EPA proposal, including BLM's standards to minimize or eliminate venting during liquids unloading[38] and BLM's requirements for reducing flaring of associated gas. Indeed, while EPA's proposed standards are complementary and consistent with BLM's proposed approach, EPA's measures are not designed to reduce waste and only further reinforce the need for rigorous BLM program. As BLM explains, "EPA regulations are directed at air pollution reduction, not waste prevention; they focus largely on new sources; and they do not address all avenues for reducing waste (for example, they do not impose flaring limits for associated gas)."[39]

III. BLM's Proposed Approach Leverages Highly-Cost Effective Technologies and BLM has Appropriately Characterized the Benefits of the Rule.

[35] CO DPHE, Regulation 7, *available at* https://www.colorado.gov/pacific/cdphe/summary-oil-and-gas-emissions-requirements.
[36] EPA, Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. 56,593 (Sept. 18, 2015). *See also* 80 Fed. Reg. at 56,614 (describing definitions of 'modification').
[37] ICF Methane Cost Curve Report at 1-1, *available at* https://www.edf.org/energy/icf-methane-cost-curve-report (noting that facilities that existed as of 2011 will account for 90% of methane emissions from the oil and gas sector in 2018).
[38] 81 FR at 6623.

BLM's proposal relies on an extensive technical record documenting highly-cost effective technologies and practices[40] that conserve gas, minimize waste, and largely (or entirely) offset the costs of deploying these controls. ICF International analyzed many of these same controls and found that they could help reduce methane emissions by 40% for, on average, just one penny per thousand cubic feet of natural gas produced.[41] BLM estimates that the net benefits from the rule will range from $115–232 million per year, considering costs between $117–245 million per year, with the benefits of gas capture far exceeding compliance costs.[42]

BLM's analysis likewise shows that the costs of the rule are very modest, even for smaller operators.[43] Indeed, the agency concluded that average cost of complying with the rule would reduce small operators' net income by approximately 0.1%.[44] We expanded this analysis to an additional set of small businesses operating on federal and tribal lands and likewise compared compliance costs to different financial metrics, including company revenue and net cash taken from company balance sheets. As Appendices A–1 and A–2 show, total compliance costs are modest even for small companies, representing on average far less than 1 percent of annual revenue, and less than 2 percent of net cash annually.[45]

BLM's assessment of costs and benefits are rigorous and fulfill the agency's obligation to consider climate impacts when assessing the proposed rule's costs and benefits. In *Center for Biological Diversity v. National Highway Traffic Safety Administration* [hereinafter *NHTSA*], the Ninth Circuit deemed an agency's failure to consider greenhouse gas emission reductions in a cost-benefit analysis to be arbitrary and capricious.[46] Notably, the *NHTSA* court required consideration of those benefits despite disagreement over their precise monetary value.[47] Like NHTSA, BLM was required to assess the costs and benefits of a proposal that would result in reduced greenhouse gas emissions.[48] The statutory mandate that lessees "use all reasonable precautions to prevent waste of oil or gas"[49] reinforces this requirement. The terms "reasonable" and "waste" necessarily encompass the full costs of vented or flared methane, rather than merely the operator's foregone

[40] *See* RIA. *See also* EPA, Methane: Addressing Greenhouse Gases and Smog-forming VOCs from the Oil and Gas Industry, https://www3.epa.gov/airquality/oilandgas/methane.html.
[41] ICF International, Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries B-6 (March 2014) ("ICF (2014)") at 3-9, available at https://www.edf.org/energy/icfmethane-cost-curve-report.
[42] 81 FR 6625.
[43] *See* RIA at 157 ("Small businesses" were identified by confirming employee counts of 500 or fewer per the company 10-K forms.).
[44] RIA, Appendix A-7: Detail of Small Business Impacts Analysis, at 183-184.
[45] These figures reflect BLM's estimated compliance costs including semi-annual LDAR. Appendices A–1 and A–2 also show the cost-effectiveness of rule compliance including quarterly LDAR compliance costs.
[46] *See NHTSA*, 538 F.3d 1172, 1200 (9th Cir. 2008).
[47] *See id.*, 538 F.3d at 1200 ("[W]hile the record shows that there is a range of values, the value of carbon emissions reduction is certainly not zero.").
[48] *See* 81 Fed. Reg. at 6673 (discussing Executive Order 12,866).
[49] 30 U.S.C. § 225.

revenue. BLM's assessment of the rule's impacts properly included the benefits of greenhouse gas reductions.

To assess the costs and benefits of methane emission reductions, BLM utilized the social cost of methane ("SC-CH_4"),

> a metric that estimates the monetary value of impacts associated with marginal changes in methane emissions in a given year. It includes a wide range of anticipated climate impacts, such as net changes in agricultural productivity and human health, property damage from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning.[50]

With this broad analytical scope, the SC-CH_4 is a rational means of measuring the net benefit of methane emission reductions.

Moreover, BLM reasonably "defer[red] to and rel[ied] on the subject matter expertise of EPA"[51] in utilizing the same social cost numbers that EPA has developed. This decision was fully consistent with BLM's rulemaking obligations. EPA estimated the SC-CH_4 based on the rigorous, transparent modeling assumptions developed by the Office of Management and Budget ("OMB") to estimate the social cost of carbon dioxide emissions ("SC-CO_2").[52] OMB's express aim was to inform "cost-benefit analyses of regulatory actions that impact cumulative global [CO_2] emissions"[53]—the same goal that EPA had for methane. The estimates of the SC-CO_2 incorporated peer-reviewed analysis and underwent public comment.[54] Similarly, EPA used peer-reviewed analysis and accepted public comments when estimating the SC-CH_4.[55]

In addition to fulfilling any procedural requirements, BLM's decision to utilize EPA's estimates of the SC-CH_4 is scientifically sound. Methane has the same social cost regardless of where or how it is emitted, so EPA's analysis is applicable to any methane emissions reduced by BLM's rule.[56] In

[50] RIA 33 (quoting EPA, Regulatory Impact analysis of the Proposed Emission Standards for New and Modified Sources in the Oil and Natural Gas Sector, EPA-452/R-15-002, at 4-7 (Aug. 2015) [hereinafter EPA's RIA].
[51] *Id.* at 40.
[52] *See id.* at 37 (explaining that EPA utilized "SC-CH_4 estimates . . . that are consistent with the modeling assumptions underlying the SC-CO_2 estimates") (quoting EPA's RIA 4-12).
[53] Interagency Working Group on Social Cost of Carbon, *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact analysis Under Executive Order 12866*, at 2 (May 2013).
[54] *See, e.g.*, OMB, Notice of Availability and Request for Comments, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact analysis Under Executive Order 12866, 78 Fed. Reg. 70,586 (Nov. 26, 2013).
[55] *See* EPA, Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. 56,593, 56,656 (Sep. 18, 2015) (Proposed Rule). BLM expects to adopt the approach to estimating the SC-CH_4 that EPA uses in the final version of its rule. *See* RIA 40.
[56] Atmospheric methane persists long enough "to become globally well mixed throughout the entire atmosphere," meaning that its climate impacts do not vary by the source or location of the emissions. EPA, Endangerment and Cause

light of BLM's obligation to reasonably assess the greenhouse gas benefits associated with the proposed rule, and BLM's evaluation of EPA's rigorous process for estimating the SC-CH_4 and its "subject matter expertise," BLM appropriately decided to utilize EPA's estimate of the social cost of methane.

EDF has separately submitted comments to this rule's docket, supporting the soundness of methodologies that EPA has utilized to value the social cost of carbon, as well as the social cost of methane.[57]

IV. BLM HAS CLEAR AUTHORITY TO ADOPT REQUIREMENTS TO MINIMIZE WASTE, REDUCE METHANE EMISSIONS, AND UPDATE ROYALTY PROVISIONS.

BLM has clear statutory authority under the nation's mineral leasing and land management laws to adopt requirements to minimize wasted natural gas, reduce harmful air pollution, and update royalty provisions. We describe each of these independent authorities in greater detail, below, and also describe how the complementary authorities of the Environmental Protection Agency and states in no way weakens or otherwise constrains BLM's clear statutory mandates.

a. BLM Has a Clear Responsibility and Duty Under Existing Statute and Regulations to Minimize Waste of Resources

BLM has a clear statutory obligation to prevent waste of oil and gas produced on federally-leased land. The Mineral Leasing Act of 1920 ("MLA")[58] requires that BLM minimize waste of federal oil and gas through its leasing regime. Each federal oil and gas lease must:

> contain provisions for the purpose of insuring the exercise of reasonable diligence, skill, and care in the operation of said property . . . and such other provision as [Interior] may deem necessary . . . for the protection of the interest of the United States . . . and for the safeguarding of the public welfare.[59]

Additionally, the MLA places an affirmative obligation on Federal lessees to minimize waste of federal resources. Section 16 of the MLA provides:

> All leases of lands containing oil or gas, made or issued under the provisions of this chapter, *shall be subject to the condition that the lessee will*, in conducting his explorations and mining operations, *use all reasonable precautions to prevent waste*

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or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496, 66,517 (Dec. 15, 2009). As a practical matter, many of the sources of methane emissions are the same under both agencies' proposed rules.

[57] *See* Environmental Defense Fund, Institute for Policy Integrity at New York University School of Law, Natural Resources Defense Council, and Union of Concerned Scientists, Comments on BLM's Proposed Rule, Waste Prevention, Production Subject to Royalties, and Resource Conservation (April 22, 2016).

[58] 30 U.S.C. § 181 et seq.

[59] 30 U.S.C. § 187.

> of oil or gas developed in the land…Violations of the provisions of this section shall constitute grounds for the forfeiture of the lease…[60]

This provision is reflected in BLM's current regulations at 43 C.F.R. § 3161.2, which require that the lease owner or operator conduct all operations "in a manner which protects other natural resources and the environmental quality, protects life and property and results in the *maximum ultimate recovery* of oil and gas *with minimum waste* and with minimum adverse effect on the ultimate recovery of other mineral resources."[61]

These regulations fall squarely within the authority the MLA provides the Department of the Interior ("DOI") to "prescribe necessary and proper rules and regulations and to do any and all things necessary to carry out and accomplish the purposes of this chapter. . ."[62] This is a "broad grant of authority."[63]

The MLA's mandate to prevent waste is unambiguous.[64] Legislative history makes clear that one of the primary catalysts for the MLA was Congressional concern over perceived waste of federal oil and gas resources.[65] At the time of its enactment, Congress intended that the MLA:

> will go a long way toward…reserv[ing] to the Government the right to supervise, control and regulate the…[development of natural resources], and prevent monopoly and waste, and other lax methods that have grown up in the administration of our public land laws.[66]

Moreover, the Federal Land Policy and Management Act of 1976 ("FLPMA")[67] charges BLM with a broad mandate to prevent waste. Under FLPMA, BLM "*shall*, by regulation or otherwise, take any action necessary to prevent unnecessary or undue degradation of the lands and to manage those lands using the principles of multiple use and sustained yield."[68] The "sustained yield" management goal in the statute "requires BLM to control depleting uses over time, so as to ensure a high level of valuable uses in the future."[69] The agency has discretion to determine how to achieve the sustained yield goal, and may thus set standards and require controls as necessary to avoid waste and ensure sustainable development of federal resources.

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[61] 43 C.F.R. § 3161.2 (emphasis added).
[62] 30 U.S.C. § 189.
[63] *Arch Mineral Corp. v. Lujan*, 911 F.2d 408, 415 (10th Cir. 1990) (§ 189 is a "broad grant of authority"); *Getty Oil v. Clark*, 614 F.Supp. 904, 916 (D. Wyo. 1985), *aff'd sub nom. Texaco Producing, Inc.*, 84 F.2d 776 (10th Cir. 1988).
[64] *Boesche v. Udall*, 373 U.S. 472 (1963).
[65] H.R. Rep. No. 1138, 65th Cong. 3d Sess. 19.
[66] *Id*.
[67] 43 U.S.C. §1701 et seq.
[68] 43 USC §§ 1732(b) (emphasis added).
[69] *Norton v. S. Utah Wilderness Alliance*, 542 U.S. 55, 58 (2004); *see also Theodore Roosevelt Conservation P'ship v. Salazar*, 616 F.3d 497, 518 (D.C. Cir. 2010).

As we detail below, the measures set forth in the proposed rule are eminently reasonable and fit well within BLM's broad authority to ensure that lessees "use all reasonable precautions to prevent waste."[70]

b. BLM Also Has Clear Authority to Protect Air and Climate Resources on Public Lands

BLM has an independent statutory obligation to protect climate and air resources on public lands by imposing reasonable standards on operators of oil and gas facilities. Under FLPMA, BLM "*shall*, by regulation or otherwise, take any action necessary to prevent unnecessary or undue degradation of the lands."[71] BLM has interpreted the phrase "unnecessary or undue degradation" to embrace protection of air quality along with other environmental values.[72] In pursuit of this objective, BLM is authorized to issue all regulations necessary for the "management, use, and protection of the public lands, including the property located thereon."[73]

FLPMA explicitly recognizes that protection of "air and atmospheric" resources is a critical objective of BLM management of the public lands with a declaration of policy that:

> the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, *environmental, air and atmospheric,* water resource, and archeological values.[74]

Similarly, as noted above, MLA directs DOI to "regulate all surface-disturbing activities conducted pursuant to any lease" and "determine reclamation and other actions as required in the interest of conservation of surface resources."[75] In addition, MLA requires DOI to ensure each lease contains provisions "as [DOI] may deem necessary . . . for the protection of the United States . . . and for the safeguarding of the public welfare."[76] These broad requirements to protect surface resources and the public welfare easily encompass protection of public health and the environment – including air quality – from uncontrolled oil and gas emissions.

Accordingly, FLPMA and MLA taken together provide BLM with broad mandates for resource conservation and environmental protection, including protection against air pollution. Indeed, the agency has previously acted under these authorities to mitigate the deleterious environmental effects of oil and gas development on public lands.

Instruction Memorandum No. WY-2012-007 ("IM"), for example, establishes minimum standards for management of pits approved by BLM's Wyoming State Office, outlining five specific "water

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[70] 30 U.S.C. § 225.
[71] 43 U.S.C. § 1732(b) (emphasis added).

[73] 43 U.S.C. §1733.
[74] 43 U.S.C. § 1701(a)(8) (emphasis added).
[75] 30 U.S.C. § 226(g). *See also Copper Valley Machine Works, Inc. v. Andrus*, 653 F.2d 595, 600 (D.C. Cir. 1981) (interpreting the phrase "conservation of natural resources" under a separate provision of the MLA to broadly encompass environmental protection and safeguarding of all natural resources).
[76] 30 U.S.C. § 187.

quality protection measures" to be required in order to minimize the potential for approved activities to result in adverse impacts to human health or the environment.[77]

The agency has also used its authority to address environmental aspects of oil and gas development to regulate air as well as water quality. For example, BLM's Colorado State Office published its Comprehensive Air Resources Protection Protocol ("CARPP") in September 2013.[78] As authority for the CARPP, BLM Colorado cited FLPMA Section 102(a)(8), and confirmed "[t]he BLM has the authority and responsibility under [FLPMA] to manage public lands in a manner that will protect the quality of air and atmospheric values."[79] These examples demonstrate that BLM has sufficiently broad authority under both FLPMA and the MLA to regulate environmental impacts attributable to oil and gas development on public lands, including impacts to air and atmospheric quality.

That EPA also has responsibility for protecting public health and welfare against air pollution under the Clean Air Act does not relieve BLM of its independent statutory duties to minimize waste and protect "air and atmospheric" resources on public lands. Rather, limiting BLM's authority on that basis would subvert clear congressional commands. As the Supreme Court recognized in a related context where EPA's regulatory responsibilities overlapped with those of another agency, "[t]he two obligations may overlap, but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency."[80] In another case, the Supreme Court found that the Clean Air Act necessarily displaced certain elements of federal *common law* in order to preserve Congress's delineated policy.[81] By contrast, displacement of BLM's *statutory* authority would create the opposite outcome and would thwart clear congressional directives.

Moreover, BLM's proposal embodies the Supreme Court's recognition that complementary statutory mandates can be implemented in a consistent fashion. Indeed, BLM's standards are aligned with EPA proposed requirements in key respects, and for certain sources, BLM recognizes compliance with EPA standards as being sufficient for compliance with its own requirements:[82] "it is important to ensure that updated BLM requirements do not subject operators to conflicting or redundant requirements. Thus, in addition to our outreach to States, we are coordinating closely

[77] BLM, Instruction Memorandum No. WY-2012-007 (Nov. 15, 2011), available at http://www.blm.gov/pgdata/etc/medialib/blm/wy/resources/efoia/IMs/2012.Par.59729.File.dat/wy2012-007.pdf.
[78] BLM Colo. Bureau of Land Mgmt., Comprehensive Air Resource Protection Protocol (Sept. 2013), available at http://www.blm.gov/pgdata/etc/medialib/blm/co/field_offices/san_juan_public_ lands/land_use_ planning/proposed_lrmp.Par.75621.File.dat/2013-0911%20Comprehensive%20Air%20Resource %20Protection%20Plan.pdf.
[79] *Id*. at 3. Resource Management Plans issued under FLPMA in recent years have also included provisions addressing protection of air quality and reduction of air pollution. *See* Tres Rios Field Office, Approved Resource Management Plan and Record of Decision, II-63 to II-64 (Feb. 2015) (RMP requiring certain measures to reduce methane, VOC, and other emissions from oil and gas operations, including measures not required by EPA).
[80] *Massachusetts v. EPA*, 549 U.S. 497, 532 (2007).
[81] *Am. Elec. Power v. Connecticut*, 465 U.S. 410, 424 (2011).
[82] *See, e.g.*, 81 Fed. Reg. at 6,623 ("Thus, the BLM is also proposing to allow an operator to demonstrate that it is in compliance with EPA requirements for control of gas from well completions in lieu of compliance with the BLM requirements. The BLM is coordinating closely with the EPA on the agencies' proposals, and the BLM expects to ensure that our final requirements would not impose additional burdens on an operator that complies with any EPA requirements on new well completions.")

with the EPA as it works to finalize its 40 CFR part 60 subpart OOOOa rulemaking."[83] At the same time, as discussed above, BLM's proposal includes requirements to minimize waste, including through reducing liquids unloading emissions and flaring—which underscore the importance of both agency's acting to satisfy their respective congressional mandates. [84]

c. BLM Has Clear Authority to Revise its Regulations Governing Royalty-Free Production and Royalty Rates

One of the purposes of both the MLA and the Indian Mineral Leasing Act of 1938 (IMLA)[85] is to provide the public and Indian tribes with a fair financial return on the development of Federal and Tribal Lands.[86] For decades, this statutory purpose has been advanced through the collection of royalties and the regular adjustment of royalty policies applicable to oil and gas leases on Federal and Tribal Lands.

BLM's authority to oversee royalty policy for oil and gas leases on both Federal and Tribal Lands is well-established.[87] Indeed, NTL-4A itself reflects a long-standing policy of distinguishing between "unavoidable" and "avoidable" losses of gas, and ensuring that forms of resource loss that can be reasonably avoided or minimized are subject to royalty. In the Proposed Rule, the agency seeks to clarify the scope of these provisions and ensure that royalty policies are well-aligned with — and complement — the critical mandatory standards for waste minimization in the proposed Subpart 3179.[88] This proposed revision to BLM's royalty policies is consistent with the MLA, judicial precedent, and the Federal government's own long-standing interpretation and construction of the MLA via NTL-4A.

V. BLM HAS PROPERLY PROPOSED TO APPLY THESE STANDARDS TO LEASES SUBJECT TO ITS JURISDICTION

EDF strongly supports the broad application of rigorous standards for waste minimization and emission reductions to oil and gas facilities extracting from the federal and tribal mineral estates.

[83] *Id.* at 6,618.

[84] Some commenters have erroneously suggested BLM's proposal is somehow infirm because of alleged conflicts with state laws. Those arguments are flawed and ignore BLM's clear mandate to minimize waste and reduce air pollution on federal lands. Moreover, though we believe the district court erred in enjoining BLM's proposed Hydraulic Fracturing Rule, the reasoning in that case—which is based on different federal statutes that address underground injection—is wholly inapplicable here. *See* Order on Motions for Preliminary Injunction, *Wyoming v. U.S. Dep't of the Interior*, 2015 U.S. Dist. LEXIS 135044, at *33 (D. Wyo. Sep. 30, 2015).

[85] Indian Mineral Leasing Act of 1938, 25 U.S.C. 396a–g.

[86] *California Co. v. Udall*, 296 F.2d 384, 388 (D.C. Cir. 1961) (the MLA was "intended to promote wise development of…natural resources and to obtain for the public a reasonable financial return on assets that 'belong' to the public"); *Kerr-McGee Corp. v. Navajo Tribe of Indians*, 731 F.2d 597, 601 n.3 (9th Cir. Ariz. 1984) ("the legislative history suggests that an important purpose of the [IMLA] was to secure for the Indians 'the greatest return from their property.'").

[87] 30 U.S.C. 226(b)(1)(A) and (c)(1); 30 U.S.C. 352 (acquired land); 25 CFR 211.41, 212.41 ("The Secretary shall not approve leases with a royalty rate less than 16-2⁄3 percent of the amount or value of production produced and sold from the lease unless a lower royalty rate is agreed to by the Indian mineral owner and is found to be in the best interest of the Indian mineral owner.").

[88] 81 Fed. Reg. 6682 (proposed 43 CFR § 3179.4)

BLM has appropriately proposed to apply the provisions of this rule to new and existing leases that are subject to its jurisdiction – including all onshore federal and Indian oil and gas leases, units, and communitization agreements.[89]

Below, we explain the clear legal basis for BLM to apply the proposed requirements to a variety of lease situations and to existing leases. We also recommend that BLM clarify the applicability of the proposed requirements to centralized gathering systems located on BLM-administered leases and rights-of-way, which could be significant sources of natural gas losses and harmful emissions.

a. BLM Has Clear Authority to Apply the Proposed Rule to Facilities Extracting From Both the Federal and Tribal Mineral Estates

First, it is clear that the MLA and FLPMA's mandates to prevent waste and protect air quality apply broadly to all areas where the federal government holds a subsurface mineral interest. The MLA states that "[d]eposits of…oil…or gas, *and lands containing such deposits* owned by the United States…shall be subject to disposition in the form and manner provided by [the MLA]."[90] Moreover, the MLA applies to "deposits" in lands that "may have been or may be disposed of under laws reserving to the United States such deposits."[91] DOI regulations that govern onshore oil and gas leases define "federal lands" to encompass "all lands and interests in lands owned by the United States which are subject to the mineral leasing laws, including mineral resources or mineral estates reserved to the United States in the conveyance of a surface or nonmineral estate."[92] Accordingly, BLM's authority under the MLA applies equally to all areas where oil and gas operators are extracting from the federal mineral estate, regardless of the ownership of surface property.

Similarly, FLPMA defines the "public lands" it governs as "any land and *interest in land* owned by the United States within the several States and administered by the Secretary of the Interior through the Bureau of Land Management."[93] This statutory language expressly refers to the Federal mineral estate, and also demonstrates that FLPMA – like the MLA – still applies to the subsurface Federal mineral estate even when surface rights were "conveyed" to private entities.[94]

BLM's own long-standing interpretation further supports its authority over split estates. As BLM described in its Onshore Oil and Gas Order Number 1, BLM must "regulate exploration, development, and abandonment on Federal leases on split estate lands *in essentially the same*

[89] 81 Fed. Reg. 6681 (proposed 43 CFR § 3179.2(a)).
[90] 30 U.S.C. 181 (emphasis added).

[92] 43 CFR 3160.0-5 (emphasis added). This language appears to reference the various public land disposal statutes (e.g. The Stock-Raising Homestead Act of 1916) that reserved the subsurface rights of land for the Federal Government while transferring the surface rights to private entities.
[93] 43 U.S.C. 1702(e) (emphasis added).
[94] *See* Casper Draft Management Plan and Environmental Impact Assessment, A-2 (describing BLM's obligation to address federal mineral interests in planning documents for FLPMA), *available at* *http://www.blm.gov/style/medialib/blm/wy/programs/planning/rmps/casper/deis/appendices.Par.69488.File.dat/appendix-a.pdf*.

manner as a lease overlain by Federal surface."[95] BLM's guidance on the rights and responsibilities of BLM, the lessee, and the private surface owner in split estate situations, specifically names the MLA and FLPMA, among other statutes, as providing the agency with authority over the subsurface mineral rights.[96]

Based on the MLA and FLPMA's statutory language, DOI's regulations of onshore oil and gas leases, and BLM's prior interpretation of its authority over split estates, the Proposed Rule's waste prevention regulations can and must be applied equally to split estate leases.

In addition, BLM's authority to regulate for the purpose of conserving the federal mineral estate is similarly well-established with respect to leases that are part of communitization agreements. The MLA clearly provides the Secretary of the Interior with broad authority to regulate leases subject to communitization agreements, stating that the Secretary is "authorized, in his discretion . . . to establish, alter, change or revoke drilling, producing, rental, minimum royalty, and royalty requirements of such leases and to make regulations with reference to such leases . . . as he may deem necessary or proper to secure the proper protection of the public interest."[97] The standard federal communitization agreements utilized by BLM also include a provision notifying all parties that the Secretary of the Interior "shall have the right of supervision over all fee and State mineral operations within the communitized area to the extent necessary to monitor production and measurement, and assure that no avoidable loss of hydrocarbons occurs in which the United States has an interest pursuant to applicable oil and gas regulations of the Department of the Interior relating to such production and measurement."[98]

BLM has also appropriately proposed to apply the standards in the proposed rule to leases on tribal lands that are subject to its jurisdiction,[99] pursuant to BLM's responsibility to manage oil and gas leasing on tribal lands for the benefit of the tribes.[100] Under the Indian Mineral Leasing Act (IMLA), Indian tribes may – with the Secretary's approval – lease tribal lands for mining purposes.[101] The IMLA states that "All operations under any oil, gas, or other mineral lease issued pursuant to the terms of sections 396a to 396g of this title or any other Act affecting restricted Indian lands shall be subject to the rules and regulations promulgated by the Secretary of the Interior."[102] Moreover, BLM's regulations for oil and gas leases under Part 3160, as well as other BLM oil and gas regulations, have long applied to leases on Tribal Lands.[103] BLM's proposal to

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[95] 72 Fed. Reg. 10308 (March 7, 2007) ("Onshore Oil and Gas Order Number 1") (citing a 1988 DOI Office of the Solicitor memorandum entitled "Legal Responsibilities of BLM for Oil and Gas Leasing and Operations on Split Estate Lands").

[96] BLM, SPLIT ESTATE: RIGHTS, RESPONSIBILITIES, AND OPPORTUNITIES (2007) at 2, *available at* http://www.blm.gov/style/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/bmps.Par.57486.File.dat/SplitEstate07.pdf.

[97] 30 U.S.C. § 226(m).

[98] BLM, Federal Communitization Agreement at Paragraph 12, *available at http://www.blm.gov/style/medialib/blm/co/field_offices/royal_gorge_field/oil_and_gas.Par.92388.File.dat/Federal%20CA%20template%20-%20Updated%20per%20WO%202015-124.pdf.*

[99] 81 Fed. Reg. at 6681 ("§ 3179.2 Scope.").

[100] *See Woods Petroleum Corp. v. Department of Interior,* 47 F.3d 1032, 1038 (10th Cir. 1995).

[101] 25 U.S.C. 396a ("Leases of unallotted lands for mining purposes; duration of leases").

[102] 25 U.S.C. 396d.

[103] *See* 25 CFR § 211.4.

apply the proposed rule equally to Federal and Tribal lands accords with this well-established legal framework. Further, it assures that production on tribal lands will take place in a way that minimizes waste of tribal resources, increases royalties for tribal governments, and protects air quality and public health in tribal communities.

b. BLM Has Clear Authority Under Existing Statute and Regulations to Apply the Proposed Rule to Existing BLM-Managed Leases and Rights-of-Way

Existing oil and gas facilities on Federal and Tribal lands are governed by leases and rights-of-way (ROW) between the government and lessee oil and gas companies. BLM has also issued regulations governing the leasing process and ROW, stipulating basic terms and conditions for those instruments. These lease terms and regulations demonstrate BLM's ample authority to require the implementation of the Proposed Rule's waste mitigation measures at facilities subject to existing leases and ROW.

BLM oil and gas leases include specific terms providing that leases are subject to subsequent requirements. After 1936, the granting clause of all oil and natural gas leases set forth that lessees are subject to orders and regulations "now and hereafter promulgated."[104] In more recent versions of the standard lease, this granting clause clarifies that lessees are subject to newly-promulgated requirements when they are "not inconsistent with lease rights granted or with specific provisions of the lease."[105] Moreover, Section 6 of the modern lease form includes environmental provisions requiring lessees to minimize adverse impacts to "land, air, and water," and specifically notifying the lessee that the United States may require "reasonable measures" including "modification to siting or design of facilities" to ensure adequate environmental protection.[106]

These clauses allow BLM to issue orders for compliance with environmental provisions or resource recovery mandates in future regulations, onshore orders, and notices to lessees.

BLM regulations include similar language to lease Section 6 and likewise clarify when post-lease BLM requirements are "consistent with lease rights granted" and therefore authorized under the granting clause of the lease. Specifically, these regulations provide that:

> [a] lessee shall have the right to use . . . the leased lands . . . subject to . . . such reasonable measures as may be required by the authorized officer to minimize

[104] General Land Office Circular 1386 (May 7, 1936). *See also Coastal Oil & Gas Corp. et al.*, 108 IBLA 62 (1989) (the intent of the "now and hereafter promulgated" language "is to incorporate future regulations, even though inconsistent with those in effect at the time of lease execution, and even though to do so creates additional obligations or burdens for the lessee.").
[105] Form 3100-11, at 1.
[106] *Id*., Section 6 ("Lessee must conduct operations in a manner that minimizes adverse impacts to the land, air, and water, to cultural, biological, visual, and other resources, and to other land uses or users. Lessee shall take reasonable measures deemed necessary by lessor to accomplish the intent of this section. To the extent consistent with lease rights granted, such measures may include but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures.").

> adverse impacts to other resource values, land uses or users not addressed in the lease stipulations at the time operations are proposed.[107]

The BLM regulations go on to clarify when such "reasonable measures" are authorized under the granting clause and Section 6 of the lease:

> At a minimum, measures shall be deemed consistent with lease rights granted provided that they do not: require relocation of proposed operations by more than 200 meters; require that operations be sited off the leasehold; or prohibit new surface disturbing operations for a period in excess of 60 days in any lease year.[108]

Indeed, BLM's own analysis of its authority to regulate oil and gas facilities, contained in a 2007 Information Bulletin, confirms that federal leases issued during the thirty years in which these regulations have been effective are subject to waste minimization requirements and environmental protections that BLM may subsequently adopt by regulation.[109] The Information Bulletin clarifies that "the Secretary's authority to administer oil and gas leases and mitigate impacts associated with their development is not dependent upon the age or date of lease issuance."[110]

In addition, BLM regulations specifically obligate operators to conduct operations in a way that protects mineral resources and environmental quality, and directs operators to comply with orders, regulations, and other requirements issued to protect these values:

> The operator shall conduct operations in a manner which protects the mineral resources, other natural resources, and environmental quality. In that respect, the operator shall comply with the pertinent orders of the authorized officers and other standards and procedures as set forth in the applicable laws, regulations, lease terms and conditions, and the approved drilling plan or subsequent operations plan.[111]

BLM regulations governing federal ROW also put lessees on notice that reasonable environmental regulations may be imposed following the grant of the ROW. These regulations set forth mandatory terms and conditions for federal ROW under the MLA, including the requirement that grantees "comply with all existing and subsequently enacted, issued, or amended Federal laws and regulations…"[112] Further, the regulations expressly retain the right of the United States to modify the terms and conditions of existing ROW to protect public health and the environment. Specifically, the regulations provide that BLM may "*change the terms and conditions* of your [ROW] grant . . . as a result of changes in legislation, regulation, *or as otherwise necessary to protect public health or the environment.*"[113]

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[107] 43 C.F.R. §3101.1-2 (emphasis added).

[109] *See* Information Bulletin No. 2007-119 (Sept. 25, 2007).
[110] BLM, Legal Authority for Environmental Protection Relating to Oil and Gas Operations (Attachment), available at http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/ib_attachments/2007.Par.95724.File.dat/IB2007-119_att1.pdf.
[111] 43 C.F.R. 3162.5-1.
[112] 43 C.F.R. § 2885.11(b)(1) (emphasis added).
[113] 43 C.F.R. § 2885.13(e) (emphasis added).

The Proposed Rule's waste mitigation measures fit well within provisions in existing oil and gas leases and BLM regulations governing leases and ROW. In particular, as described above, all of the mwaste itigation measures are authorized by the broad grants of authority in the MLA and FLPMA and would therefore fit within the lease granting clause's reference to subsequently promulgated orders and regulations. In addition, the Proposed Rule's methane mitigation measures are consistent with Section 6 of the standard lease, which requires lessees to minimize impacts on air. Furthermore, these measures will not require relocation of proposed operations, nor delay operations for over 60 days per year. Accordingly, these measures are consistent with lease rights as defined by the BLM regulations under 43 C.F.R. 3101.1-2. In addition, as applied to oil and gas facilities on federal ROW, these measures are public health and environmental protections for which the United States has unequivocally retained the right to alter the terms and conditions of existing ROW.

c. BLM Should Clarify that the Proposed Requirements Apply to All Types of Facilities, including Centralized Gathering Facilities Located on Leases and should Extend Requirements to Rights of Way

BLM has proposed to apply the royalty and waste prevention requirements to "onshore wells, tanks, compressors and other facilities located on leases, federally approved units or communitized areas."[114] In so doing BLM has proposed individual equipment standards or limits for continuous-bleed pneumatic controllers, pneumatic pumps, crude oil and condensate storage vessels, equipment leaks, oil development wells, liquids unloading activities and well completion activities. These standards and limits apply to each type of covered equipment (e.g., a pneumatic device) or activity (liquids unloading).

BLM does not propose to extend the requirements to rights-of-way.[115] This is based on BLM's assessment that the likely largest source of emissions on rights-of-way are compressors, and that compressors on rights-of-way are not significant emission sources.[116] As we discuss below, however, EPA has significantly increased its estimate of emissions from the gathering and boosting sector in response to recent studies reporting that gathering infrastructure is both far more extensive and emits far more natural gas than previously understood. This information underscores the need to address emissions from centralized gathering facilities on both leases and rights-of-way.

<u>Centralized Gathering Facilities on Leases</u>

We urge BLM to clarify and ensure that its proposed requirements apply to centralized gathering facilities located on leases. By its terms, the proposal applies to individual equipment and activities located on leases, units and communitized areas, regardless of whether such equipment is connected

[114] Proposed 43 C.F.R. §§ 3178, 3179 et seq.
[115] 81 FR 6662.
[116] Id.

with or located at any particular type of facility.[117] It is critical that BLM apply the requirements in this way given recent scientific studies demonstrating that centralized gathering facilities are significant sources of waste and pollution and that historical inventories underestimate emissions from such facilities:

- Mitchell (2015). A February 2015 study by Colorado State University examined methane emissions from 114 randomly selected gathering facilities in multiple states.[118] Researchers observed venting from liquids storage tanks at approximately 20 percent of sampled gathering facilities, with emission rates at these facilities four times higher on average than rates observed at other facilities.[119]

- Marchese (2015). Using the measurement data from the 2015 Mithell paper and activity data for different types of gathering and boosting facilities, Marchese et al., estimated national emissions for gathering and boosting facilities. This estimate resulted in a much higher per-facility emission factor than implied in the GHGI. Specifically, Marchese estimated gathering and boosting facilities emitted 42.4 MMT CO2e in 2012 rather than the GHG inventory of 5.7.[120]

Centralized Gathering Facilities on Rights-of-Way

We also urge BLM to extend its proposal to oil and gas equipment and facilities, including centralized gathering facilities, located on rights-of-way. As noted above BLM excludes facilities on rights-of-way from the proposal based on its assumption that compressors are the primary source of emissions on rights-of-way and that emissions from compressors are small. However, ICF's federal and tribal lands inventory estimated that gathering and boosting infrastructure was responsible for a total of 7.2 Bcf of whole gas emissions in 2013 – equivalent to approximately 26% of all natural gas losses from natural gas production on federal and tribal lands.[121] In addition, the Mitchell and Marchese studies, and EPA's revised inventory, underscore the need to extend the BLM proposal to all types of equipment and facilities located on rights-of-way.

Recent studies demonstrate that there are numerous sources of emissions at centralized gathering facilities other than compressors, and that this extensive equipment contributes significant waste

[117] The one exception to this is centralized gathering facilities owned by a pipeline company and which are not operated, leased or under the direct control of the lease, unit or communitized area operator. 81 FR 6669. BLM has specifically exempted these types of facilities from LDAR.

[118] Mitchell, A.L., *et al.*, (2015), "Measurements of Methane Emissions from Natural Gas Gathering Facilities and Processing Plants: Measurement Results," *Environ. Sci. Technol.*, **49**, at 3219-3227 ("Mitchell (2015)"), *available at* http://pubs.acs.org/doi/abs/10.1021/es5052809.

[119] Mitchell (2015) at 3219.

[120] EPA, Inventory of U.S. GHG Emissions and Sinks 1990-2014: Revision to Gathering and Boosting Station Emissions, at 6, available at https://www3.epa.gov/climatechange/ghgemissions/usinventoryreport/Final_Revision_GB_Station%20Emissions_2016-04-14.pdf; See also Marchese, et al., *Methane Emissions from United States Natural Gas Gathering and Processing*, Environ. Sci. Technol., 2015, 49 (17), pp 10718-10727 at p.10725, available at http://pubs.acs.org/doi/abs/10.1021/acs.est.5b02275.

[121]

and air pollution. Of the facilities sampled by Mitchell, six consisted of sites that included dehydration and treatment equipment but did not contain on-site compression nor storage vessels.[122] These six facilities recorded throughput as high as 650 million standard cubic feet per day (MMSCF/d).[123] The emission rates from these six facilities averaged 0.65 percent of throughput (with a maximum emission rate of over 2 percent),%).[124] This is comparable to or higher than the emission rates for many of the gathering compressor stations examined in the study.[125] Moreover, the average emissions rate from these six facilities was 11.7 kg/hr – slightly higher than the average emission rate for the (larger) number of gathering compressor stations measured, which was 11.3 kg/hr.[126]

EPA recently revised its Greenhouse Gas Inventory to more accurately reflect emissions from gathering and boosting sources such as centralized gathering facilities. Specifically, EPA increased its estimate of the number of gathering and boosting stations and emissions associated with those stations.[127] Pursuant to this latest inventory, EPA estimates there were 4,639 gathering and boosting stations in the U.S., rather than the 16 EPA estimated in prior inventories.[128] Relying on updated emission factors for these facilities, and the updated count, EPA estimates gathering and boosting stations emitted 43 MMT CO2-e in 2013 (nearly a quarter of all methane emissions from natural gas systems).[129]

In light of this additional information, and the agency's manifest legal authority, we urge BLM to revisit its conclusion that there are not significant emissions sources on rights of way and to extend its proposed commonsense requirements to minimize waste in these areas.

VI. SPECIFIC RECOMMENDATIONS

BLM has proposed requirements for many key sources of wasted natural gas and harmful air pollution on Federal and Tribal Lands. Many of these requirements are consistent with standards EPA has proposed in NSPS OOOOa and, for those sources, we urge BLM to strengthen its approach in the same ways we recommended in that proceeding.[130] Here, we provide additional information on leaks, given the slight differences in BLM's proposed approach and the critical

[122] *See* Mitchell (2015), Supporting Information at S7 Table S1 (indicating facilities 110-115 were classified as either dehydration only (D) or dehydration/treatment (D/T)).
[123] *Id.* at S12, Table S2 (Facilities 110-115).
[124] *Id.* at S27, Table S7 (Facilities 110-115). These emissions include both fugitive leaks and equipment venting. See S21, Table S6 (Facilities 110-115). Infrared camera inspection of these facilities indicates that at four of the six sites, the emissions included leaks.
[125] *Id.* at S27, Table S7.
[126] *Id.* (comparing average rate for Facilities 110-115 to average emission rate for Facilities 1-34).
[127] EPA Greenhouse Gas Inventory Report: 1990-2014 (April 2016), 3-68, available at https://www3.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2016-Chapter-3-Energy.pdf.
[128] EPA, Inventory of U.S. GHG Emissions and Sinks 1990-2014: Revision to Gathering and Boosting Station Emissions at 6.
[129] Id.
[130] Joint Environmental Comments on EPA's proposed Emission Standards for New and Modified Sources ("methane NSPS"), 80 Fed. Reg. 56,593 (Sept. 18, 2015), and Supplemental Comments of Environmental Defense Fund on EPA's Proposed Rule, 80 Fed. Reg. 56593.

importance of minimizing waste and reducing emissions from those sources. We likewise provide recommendations on additional sources not covered by EPA's rule—including flaring, storage tanks, and liquids unloading activities—as well as recommendations for strengthening provisions related to pneumatic controllers and pumps. Finally, we discuss BLM's proposed variance mechanism and recommended adjustments to ensure that it is applied in a rigorous fashion.

a. Equipment Leaks

Equipment leaks are one of the most significant sources of waste and methane emissions from the oil and gas sector, and readily available technologies exist to find and fix these leaks. Rigorous leak detection and repair standards are therefore an indispensable element of a comprehensive program to reduce waste and to address methane emissions from the oil and gas sector. We support several features of BLM's proposed leak detection and repair (LDAR) requirements, and also urge the agency to strengthen the proposal in critical respects. In particular, we urge BLM to:

- Finalize requirements for frequent, instrument-based LDAR for all fugitive emission components at oil and gas facilities on BLM leases, including well sites that produce less than 15 barrels of oil equivalent per day;
- Strengthen the definition of fugitive emissions component to include all potential sources of unanticipated emissions, such as malfunctioning intermittent pneumatic controllers;
- Optimize the frequency of monitoring requirements by adopting a tiered approach along the lines of the state of Colorado;
- Remove provisions allowing for frequency adjustments based on the number of leaking components;
- Provide additional detail on the factors BLM will consider when approving advanced, alternative technologies to ensure these technologies secure equal or greater waste minimization and environmental performance.

Below, we provide evidence that equipment leaks are a significant source of emissions on federal lands and note readily available, and highly-cost effective technologies that can help address these emissions. We then provide additional detail on each of these recommendations.

i. Equipment Leaks are a Significant Source of Emissions from Leases on Federal Lands

According to BLM's estimates, leaks are a significant source of gas vented from Federal and Indian leases, with "up to 4.35 Bcf of natural gas [] lost in 2013 as a result of leaks or other fugitive emissions at operations on BLM-administered leases."[131] This estimate represents 20 percent of all vented natural gas from oil and gas operations on Federal and Indian lands. [132] This estimate likely underestimates emissions from this source as it is based on inventories and emission factors that do

[131] *See* 81 FR 6620, February 8, 2016 and RIA at 3 and 19.
[132] RIA at 19-20.

not fully incorporate the most recent science. In fact, ICF found gas lost as a result of leaks and other fugitive emissions on federal and tribal lands were much higher, accounting for 27.5 Bcf.[133]

As detailed in our comments on EPA's proposed NSPS subpart OOOOa standards, recent scientific research—conducted across various geographies and value chain segments, and with diverse methodologies— confirms that leaks are a significant source of emissions and suggests that current inventories likely underestimate the magnitude of this wasted gas. In particular:

- **Barnett Shale Field Campaign.** A recent series of studies in the Barnett—incorporating both top-down and bottom-up measurement—found that emissions were 90 percent greater than estimates based on the GHGI.[134] The studies partially attributed these large emissions to high emission sites not reflected in inventories, which focus on average emission factors. One study in particular found that a small number of sources are responsible for a disproportionate amount of emissions, noting specifically that "sites with high proportional loss rates have excess emissions resulting from abnormal or otherwise avoidable operating conditions, such as improperly functioning equipment."[135]

- **Allen *et al* (2013).** A study conducted by an independent team of scientists at the University of Texas found that emissions from equipment leaks were 38 percent higher than estimated in EPA's GHG Inventory.[136] Importantly, this study examined the same components included in those inventories, such as valves and connectors. Even without observing other significant fugitive emission sources that have also been overlooked by national inventories, such as thief hatches on storage tanks or improperly functioning separator dump valves, this study found that those inventories underestimated leaks.

We strongly support BLM's conclusion that these and other studies "suggest that the BLM's estimates of lost gas likely underestimate, and potentially substantially underestimate, the extent of the problem."[137]

Indeed, a study documenting helicopter surveys of fugitive emissions from over 8,000 well sites in seven basins nationwide further supports this finding.[138] That study focused only on very high emitting sources, given the helicopter survey detection limit which ranged from 35–105 metric tons per year of methane (for comparison, EPA estimated its model facility in NSPS OOOOa would

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[133] ICF, Onshore Petroleum and Natural Gas Operations on Federal and Tribal Lands in the United States: Analysis of Emissions and Abatement Opportunities, September 16, 2015 at 8.

[134] Zavala-Araiza et al., Reconciling divergent estimates of oil and gas methane emissions, Proceedings of the National Academy of Sciences, vol. 112, no. 51, 15597–15602 (Dec. 22, 2015) ("Barnett Synthesis").

[135] Zavala-Araiza, *et al.*, (2015) "Toward a Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites," *Environ. Sci. Technol.*, 49, at 8167−8174 ("Zavala-Araiza (2015)"), *available at* http://pubs.acs.org/doi/pdfplus/10.1021/acs.est.5b00133.

[136] Allen, D.T., *et al.*, (2013) "Measurements of methane emissions at natural gas production sites in the United States," *Proc. Natl. Acad.*, 110, ("Allen (2013)"), *available at* http://www.pnas.org/content/110/44/17768.full.

[137] 81 FR 6632-6633

[138] Lyon, *et al*., (2016) "Aerial surveys of elevated hydrocarbon emissions from oil and gas production sites," *Environ. Sci. Technol.* (Article ASAP), *Web publication April 5, 2016* ("Lyon, et al. (2016)"), *available at* http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00705

emits approximately 4.5 metric tons of methane per year). The paper reported that emissions exceeding the high detection limits were found at 327 sites, of which approximately 50 were sites producing less than 15 barrels of oil equivalent per day. 92 percent of the emission sources identified were associated with tanks, including some tanks with control devices that were not functioning properly and so could be expected to be addressed through a leak detection and repair program.

While the study did not characterize the individually smaller but collectively significant leaks that fell below the detection limit, it nonetheless confirms that high-emitting leaks occur at a significant number of production sites and that total emissions from such leaks are very likely underestimated in official inventories. Further, the basins with the highest prevalence of super-emitters likewise have the greatest percentages of wells on federal and tribal lands, including the Bakken (14 percent) and the Uintah (7 percent), as displayed in the table below. In fact, although only 29 percent of the total well pads surveyed (and only 24 percent of the total wells on the surveyed pads) were on federal and tribal lands, 42 percent of the sites found to be leaking were on these lands. Additionally, 38 percent of the total leaks identified were on BLM lands. The disproportionately high super-emitting sites and number of emissions sources on BLM lands relative to the non-BLM sites surveyed indicates that regulations to reduce these emissions, such as LDAR, would have a significant impact on BLM-administered leases.

Table 1: Aerial Survey Study Percentage of Emitting Sites and Sources by Basin[139]

	% of sites with detected emissions	% of detected sources from tanks
Bakken	14%	94%
Barnett	3%	96%
Eagle Ford	5%	96%
Fayetteville	4%	100%
Marcellus	1%	94%
Powder River	1%	83%
Uintah	7%	81%
Total	4%	92%

Several characteristics of these super-emitters—documented in the helicopter survey study and elsewhere—underscore the importance of a rigorous, comprehensive leak detection and repair program:

- **Super-Emitters Not Included in Inventories**. There is considerable evidence that emissions from equipment leaks are heterogeneously distributed—with a small percentage of sources accounting for a large portion of emissions—[140] and that existing inventories do

[139] *Id*. Adapted from Table 1. Infrared Camera Survey Results by Basin and Strata.
[140] *See, e.g.*, Allen, D.T., *et al.*, "Measurements of methane emissions at natural gas production sites in the United States," *Proc. Natl. Acad.*, 110 (44) pp. 17768–17773 ("Allen (2013)"), *available at* http://www.pnas.org/content/110/44/17768.full; ERG and Sage Environmental Consulting, LP, "City of Fort Worth Natural Gas Air Quality Study, Final Report" ("Fort Worth Study") (July 13, 2011), *available at*

not accurately reflect the presence of these "super-emitters."[141] The concentration of emissions within a relatively small proportion of sources has been observed both among groups of components within a site and among groups of entire facilities.[142]

- **Equipment Leaks are Unpredictable**. Recent studies have assessed whether well characteristics and configurations can predict super-emitters, concluding that they are only weakly related,[143] and that these emissions are largely stochastic.

- **Super-Emitters Shift in Time and Space**. Abnormal operating conditions, such as improperly functioning equipment, can occur at different points in time across facilities.[144] While it is true that at any one time roughly 90% of emissions come from 10% of sites, these sites shift over time and space—meaning that, at a future time, a different 10% of sources could be responsible for the majority of emissions.[145]

The heterogeneous, unpredictable, and ever-shifting nature of equipment leaks all suggest that frequent leak detection and repair is essential to help identify and remediate leaks. Below, we recommend several ways in which BLM's proposal should be strengthened to better reflect these scientific findings.

ii. Readily Available and Cost Effective Solutions Exist to Address this Pollution

In our comments on EPA's proposed New Source Performance Standards (NSPS) for methane from oil and gas facilities, we highlighted currently-available technologies that enable rigorous leak

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http://fortworthtexas.gov/gaswells/default.aspx?id=87074 (finding that the highest 20 percent of emitting sites account for 60–80 percent of total emissions from all sites; the lowest 50 percent of sites account for only 3–10 percent of total emissions); Zavala-Araiza (2015), *available at* http://pubs.acs.org/doi/abs/10.1021/acs.est.5b00133 (finding that "functional super-emitter" sites represented approximately 15% of sites within each of several different "cohorts" based on production, but accounted for approximately 58 to 80% of emissions within each production cohort); Barnett Synthesis, at 15600 (finding that "at any one time, 2% of facilities in the Barnett region are responsible for 90% of emissions, and 10% are responsible for 90% of emissions.").

[141] Barnett Synthesis at 15599.

[142] *See* EPA, "Oil and Natural Gas Sector Leaks: Report for Oil and Natural Gas Sector Leaks" (2014), *available at* http://www3.epa.gov/airquality/oilandgas/2014papers/20140415leaks.pdf.

[143] Lyon, *et al*., (2016) "Aerial surveys of elevated hydrocarbon emissions from oil and gas production sites," *Environ. Sci. Technol.* (Article ASAP), *Web publication April 5, 2016, available at* http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00705. *See also* Brantley, H.L., *et. al.*, "Assessment of methane emissions from oil and gas production pads using mobile measurements," Environmental Science & Technology, 48(24), pp.14508-14515, *available at* http://pubs.acs.org/doi/abs/10.1021/es503070q (assessing where well characteristics can predict emissions, concluding that they are weakly related and that emissions are largely stochastic); Zavala-Araiza et al. (2015) ("The large number of facilities in the Barnett region cause highemitters to always be present, and these high-emitters seem to be spatially and temporally dynamic. . . .To reduce those emissions requires operators to quickly find and fix problems that are always present at the basin scale but that appear to occur at only a subset of sites at any one time, and move from place to place over time.").

[144] Zavala-Araiza (2015) at 15600.

[145] *Id*.

detection and that are continuously improving in terms of efficacy and cost,[146] including some of the cost-saving advantages of optical gas imaging ("OGI") systems. OGI-based LDAR programs are a central feature of many leading state standards and an effective tool deployed by many leading operators.[147]

Both EPA and BLM based their cost estimates on a report by Carbon Limits that concluded that third-party contractors' average fee to inspect a well site was $600.[148] We have compiled additional information suggesting the agencies' cost estimates are conservative and likely overstate costs:

- Rebellion. In its comments at the EPA public hearing on the proposed NSPS in Dallas, TX, Rebellion Photonics noted that its services are available for $250 per site.[149] Rebellion noted that this cost is "turn-key," including data management services.

- Colorado. Colorado's economic analysis of its LDAR requirements assumed an hourly contractor rate of $134 (reflecting a 30% premium).[150] Assuming a per-site survey time of four hours, this hourly rate yields a total per-site survey cost of $536.[151]

- ICF. ICF developed a complex model to investigate the distribution of LDAR cost profiles at well sites. The results of the model indicate that the cost for LDAR using third-party contractors ranges between $491–793 per facility, depending on facility size.[152]

- EDF also contacted a number of third-party service providers and equipment rental firms, which provided costs that support the reasonableness of EPA's determination. In particular, a FLIR presentation includes information from survey providers suggesting well-pad rates ranging from $300-$800.[153]

- Noble and Anadarko submitted comments in response to the Colorado LDAR rule, stating that "the leak detection and repair requirements using instrument-based monitoring is a

[146] Joint Environmental Comments on EPA's proposed Emission Standards for New and Modified Sources ("methane NSPS"), 80 Fed. Reg. 56,593 (Sept. 18, 2015) at 28-31.
[147] State programs and operator experience with OGI-based LDAR are described in section IV.b.v of these comments.
[148] Background Technical Support Document, Proposed 40 CFR Part 60 subpart OOOOa, August 2015, page 72, *available at* https://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2010-0505-5021.
[149] Rebellion Photonics comments at the EPA hearing in Dallas, TX on September 23, 2015.
[150] Colorado Air Pollution Control Division, Final Economic Impact Analysis for Regulation Number 7, at 18. Colorado assumed slight longer surveys, approximately 6.1 hours, yielding third party survey costs of approximately $817.
[151] CDPHE Cost Benefit Analysis for Proposed Revisions to AQCC Regulations No. 3 and 7.Table 14: Instrument Based Tank Inspections Based on Proposed Tiering.
[152] ICF Leak Detection and Repair Cost-Effectiveness Analysis, December 4, 2015. Figures reflect survey and equipment costs per facility.
[153] FLIR, OGI Service Provider Survey, March 2016, at 2-3 (Attachment 2). The presentation notes additional charges for travel but also notes potential discounts for multiple well surveys.

reasonable and cost effective way to reduce fugitive emissions at well production sites."[154] Additionally, the companies compiled a cost analysis for LDAR under the Colorado rule and found that, "Based on company-specific historic data and certain estimated values, Noble anticipates that LDAR monitoring at well production facilities would cost between approximately $260 and $430 per inspection…"[155]

- According to a presentation delivered by Jonah Energy at the WCCA 2015 Spring Meeting, total LDAR program costs were about $99 per inspection in the first year, decreasing to about $29 per inspection in the 5th year.[156]

As evidenced by the information above, equipment leaks are a significant source of emissions on BLM-administered leases. Further, these fugitive emissions are likely significantly underestimated in current inventories due to the disproportionately high contribution of emissions from super-emitters. Indeed, a recent study which utilized helicopter flyovers to survey super-emitting facilities found that the percentage of such sites on BLM lands is notably higher than the percentage of total sites surveyed on BLM lands. In addition, the range of information from states, third parties, and service providers indicates that LDAR can be employed to detect these leaks effectively and cost-efficiently.

iii. BLM Should Ensure LDAR Applies Comprehensively to Equipment and Components that Contribute to Equipment Leaks

We support BLM's proposal to require LDAR for a variety of potentially leaking components and in particular, support the agency's proposal to include LDAR requirements for separators, thief hatches, and other potential emissions associated with storage tanks. As the helicopter study and other studies[157] underscore, these are important emissions sources and critical to include in a rigorous LDAR program.

In addition, we urge BLM to strengthen the scope of its proposal to include monitoring

[154] Prehearing statement of Noble Energy, Inc. and Anadarko Petroleum Corporation in the matter of proposed revisions to Regulation Number 3, 6, and 7, *available at* ftp://ft.dphe.state.co.us/apc/aqcc/Oil%20&%20Gas%20021914-022314/PREHEARING%20STATEMENTS,%20EXHIBITS%20&%20ALTERNATIVE%20PROPOSALS/Noble%20Energy%20Inc%20&%20Anadarko%20Petroleum%20Corporation%20(Noble%20&%20Anadarko)/Noble%20and%20Anadarko%20PHS.pdf.

[155] Rebuttal Statement of Noble Energy, Inc. and Anadarko Petroleum Corporation in the matter of proposed revisions to Regulation Number 3, 6 and 7; Page 7, *available at* ftp://ft.dphe.state.co.us/apc/aqcc/Oil%20&%20Gas%20021914-022314/REBUTTAL%20STATEMENTS,%20EXHIBITS%20&%20ALT%20PROPOSAL%20REVISIONS/Noble%20Energy%20Inc%20&%20Anadarko%20Petroleum%20Corporation/NOBLE_APC%20-%20REB.pdf

[156] WCCA Spring Meeting, Jonah Energy Presentation, May 8, 2015 delivered by Paul Ulrich.

[157] *E.g.*, Mitchell, A.L., *et al.*, (2015), "Measurements of Methane Emissions from Natural Gas Gathering Facilities and Processing Plants: Measurement Results," *Environ. Sci. Technol.*, 49, at 3219-3227 ("Mitchell (2015)"), *available at* http://pubs.acs.org/doi/abs/10.1021/es5052809. (Researchers found substantial venting from liquids storage tanks at approximately 20 percent of sampled gathering facilities, with emission rates at these facilities four times higher on average than rates observed at other facilities. At some sites with substantial emissions, the authors found that company representatives, upon learning of the emissions, made adjustments resulting in immediate reductions in emissions.)

requirements for intermittent bleed pneumatic devices. As BLM notes, half (or more) of pneumatic controllers at gas well sites and gathering/compressor sites are intermittent bleed.[158] Recent studies have shown that these devices can function improperly and produce significant emissions, and an LDAR program could effectively identify and eliminate this pollution.
In particular:

- **Allen *et al* (2015).** As part of the Phase II UT study, an expert review of the controllers with highest emissions rates concluded that some of the high emissions were caused by repairable issues, and "many of the devices in the high emitting group were behaving in a manner inconsistent with the manufacturer's design."[159] For example, some devices not designed to bleed continuously (e.g., intermittent bleed devices) had continuous emissions, which according to the study authors, "could be the result of a defect in the system, such as a crack or hole in the end-device's (control valve's) diaphragm actuator, or a defect in the controller itself, such as fouling or wear."[160] Analysis of the study data indicates that average emissions from malfunctioning intermittent devices were almost 40 times higher than average emissions form normally operating intermittent pneumatics.

- **City of Fort Worth Study.** The Fort Worth Study examined emissions from 489 intermittent-bleed pneumatic controllers, using IR cameras, Method 21, and a HiFlow sampler for quantification. The study found that many of these controllers were emitting constantly and at very high rates, even though the devices were being used to operate separator dump valves and were not designed to emit in between actuations. Average emission rates for the controllers in the Fort Worth Study were at a rate approaching the average emissions of a high-bleed pneumatic controller. According to the study authors, these emissions were frequently due to supposedly improperly functioning or failed controllers.[161]

- **British Columbia Study.** The Prasino study of pneumatic controller emissions in British Columbia also noted the potential for maintenance issues leading to abnormally high bleed rates.[162] Although the researchers did not identify a cause for these unexpectedly high emission rates, the results are consistent with the observation that maintenance and operational issues can lead to high emissions.

- **The Carbon Limits Study.** The Carbon Limits Report confirms these findings and

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[158] Based on API and ANGA survey data, 49 percent of controllers at gas well sites are intermittent bleed and 61 percent of controllers at gathering/compressor sites are intermittent bleed. *See* RIA Table 11 at 210.
[159] Allen (2015) at 633–640.
[160] *Id* at 639.
[161] *Id*. at 3-99 to 3-100. ("Under normal operation a pneumatic valve controller is designed to release a small amount of natural gas to the atmosphere during each unloading event. Due to contaminants in the natural gas stream, however, these controllers eventually fail (often within six months of installation) and begin leaking natural gas continually.")
[162] The Prasino Group, *Determining bleed rates for pneumatic devices in British Columbia; Final Report*, (Dec. 18, 2013), at 19, *available at* http://www2.gov.bc.ca/assets/gov/environment/climate-change/stakeholder-support/reporting-regulation/pneumatic-devices/prasino_pneumatic_ghg_ef_final_report.pdf. ("Certain controllers can have abnormally high bleed rates due to operations and maintenance; however, these bleed rates are representative of real world conditions and therefore were included in the analysis.").

> concludes that LDAR programs may help to identify other improperly functioning devices like pneumatic controllers.[163]

The same methods used for leak detection at valves, connectors, and other leaking components and equipment at oil and gas facilities can be used to spot significant operational issues at pneumatic controllers. This is particularly true of intermittent-bleed controllers, where an OGI survey revealing continuous emissions from an intermittent controller can alert operators to the problem. Moreover, if a comprehensive LDAR program is already being implemented at a facility, the marginal cost of extending that program to intermittent-bleed pneumatic controllers would likely be very modest, especially if an operator uses an OGI camera or similar technology to detect leaks. Accordingly, we strongly urge BLM to finalize an LDAR program that addresses all potential sources of leaks and inadvertent venting, including intermittent-bleed controllers.

iv. BLM Should Finalize LDAR Requirements for Wells that Produce Less Than 15 Barrels of Oil Equivalent

BLM has correctly proposed not to exempt facilities from the LDAR requirements based on their levels of production. Published research shows that low producing wells can be responsible for substantial waste and emissions. Zavala-Araiza, et al. performed an analysis illustrating how the probability of a production site being among the highest emitting sites does not increase uniformly with production volume.[164] Consequently, requiring LDAR only at sites above certain production levels would exempt sites with low production but potentially high fugitive emissions.[165] The analysis performed by Zavala-Araiza, et al. identified significant emission reduction opportunities for the lower production cohorts.

Data from the helicopter study (Lyon, et al. (2016)) also demonstrates that both high- and lower-producing sites can be associated with high-emitting events. In particular, 51 of 351 sites with high emissions produced less than 15 BOE/d. These studies demonstrate that even low producing sites can be associated with high emissions and should be included in LDAR requirements.

Although critics of LDAR requirements have sometimes asserted that exemptions for low-producing wells are necessary to protect small operators, the data indicate that LDAR costs are very modest even for very small companies. In recent supplemental comments to EPA on the proposed methane NSPS, we submitted an analysis demonstrating that average LDAR represent—even for very small companies—far less than 1% of annual revenue.[166] This aligns with the conclusion presented in the BLM small business analysis which found that, for all measures in its proposed rule "average reduction in profit margin for small companies will be just a fraction of one percentage point, which is not a large enough impact to be considered significant."[167]

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[163] Carbon Limits (2014), at 12.
[164] Zavala-Araiza (2015), *supra* note 49, at 8167−8174.
[165] *See id*.
[166] See Appendix A, Table A-4
[167] RIA at 166-167.

Our analysis, outlined and presented in Appendix A, utilizes information from the BLM RIA[168] for LDAR compliance costs in order to analyze the cost of LDAR for smaller producers.[169] We identified certain exploration and production companies that meet the definition of a small business,[170] building from a list compiled for BLM's proposed rulemaking.[171] For these corporations, we analyzed available financial data from available SEC filings and production, well, and drilling HPDI data from DI Desktop for the years 2012-2015. We then used company-level data on new and existing wells[172] to calculate semi-annual and quarterly LDAR compliance costs and to compare these costs to companies' reported annual revenue.

Tables A-3 and A-4 in Appendix A illustrate annual compliance costs for semi-annual and quarterly LDAR as a percentage of annual company net cash from operating activities and of annual company revenue, respectively. The analysis includes cost comparisons both for new sources (based on average new wells drilled between 2012-2105) and for the entire population of existing wells that a company owns. For all new and existing sources, the overall weighted averages for those costs range from 0.02% to 1.33% of annual net cash and 0.01% to 0.47% of total revenue. For new sources, average weighted compliance costs are less than 0.2% annual net cash and 0.1% of revenues in both 2020 and 2025. Additionally, these LDAR compliance costs as a percentage of revenue are likely overstated for these companies, as the costs per facility from the BLM RIA were applied to the entire landscape of wells owned by a company, whether or not those wells were on BLM lands.

v. BLM Should Strengthen the Frequency of LDAR in the Final Rule

BLM is proposing to require all operators to conduct baseline semi-annual surveys with frequency adjustments.[173] BLM has declined to propose more frequent baseline monitoring citing a 2015 Carbon Limits study that shows net *costs* to the operator for quarterly or more regular surveys.[174] The agency, however, acknowledges other research that shows LDAR programs with quarterly inspection requirements result in cost *savings* to the operator[175] and notes other sources that document lower compliance costs:

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[168] RIA at 113.

[169] March 31, 2016 Supplemental Comments of Environmental Defense Fund on EPA's Proposed Rule, Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. 56593 (Sept. 18, 2015).

[170] "Small businesses" were identified by confirming employee counts of 500 or fewer per the company 10-K forms.

[171] RIA Appendix A-7: Detail of Small Business Impacts Analysis, at 183-184.

[172] HPDI data for 2012-2015 from DI Desktop, by operator.

[173] 81 FR 6648, February 8, 2016.

[174] 81 FR 6648, February 8, 2016 ("Increasing survey frequency allows more leaks to be found, but also increases costs. Accordingly, the BLM aims to establish an approach to survey frequency that reduces the most waste at the lowest cost. The Carbon Limits study analyzed the impact of survey frequency by analyzing over 400 annual surveys. [2015, Carbon Limits, *Improving Utilization of Associated Gas in US Tight Oil Fields*] This study found that annual or semi-annual (twice-yearly) surveys generally resulted in net benefits to the operator—the benefits of leaks avoided exceeded the costs of the surveys—whereas quarterly or more regular surveys imposed net costs on the operator—the costs of the frequent surveys outweighed the benefits of leaks avoided. This study supports starting with a frequency of annual or semiannual surveys.")

[175] RIA at 109.

> [W]e recognize that if we used per-facility or per-inspection cost data from other sources then that the result would show lower compliance costs. For example, if we used the Carbon Limits cost estimate of $35 per well inspection (7% discount rate), then the total cost of the rule's LDAR requirement would be estimated as $2.6 million per year.[176]

BLM also notes some instances where it found equipment costs that were much lower than what EPA used for the proposed methane NSPS. [177] As we noted above, we believe these lower compliance costs are well supported by additional available information, and urge BLM to adopt cost-estimates that better reflect this information. In addition, BLM relied on EPA's estimate of emissions from a hypothetical "model facility," which are biased low because they reflect more simplistic facilities than are commonly found in the field and fail to account for significant emissions from sources like tanks and separators.[178]

Even so, BLM's RIA concludes that quarterly LDAR monitoring results in annual net benefits for all years evaluated (2017-2026).[179] Correcting the above-described deficiencies would only further support the highly cost-effective nature of quarterly LDAR. Information from states requiring quarterly LDAR, industry experience, and independent assessment underscores this conclusion:

- <u>States.</u> Currently, five major oil and natural gas producing states require quarterly monitoring at oil and gas facilities—Colorado, Ohio, Pennsylvania, Wyoming and Utah.[180] California has also proposed LDAR standards at new and existing sources statewide that, if adopted, would require quarterly LDAR using OGI instruments. In addition, four air districts in Southern California already have existing inspection and maintenance requirements aimed at detecting non-methane hydrocarbon leaks, each requiring quarterly inspections as a baseline.[181] Colorado's rule demonstrated the cost-effectiveness of quarterly inspections: for

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[176] *Id.*

[177] *See, e.g.,* 81 FR 6645 ("The BLM has also received information from external service providers indicating that costs can be substantially lower than these [cost estimates used for infrared camera equipment, maintenance and external service provider costs], and we request comment on this point.") and RIA at 103 ("While the EPA references costs of $10,800 per device, the BLM identified portable detectors that cost as low as $1,000 [referencing Honeywell PhD6].")

[178] See pp. 43-47 of our NSPS comments (EPA determined cost-effectiveness based on a model facility that is far smaller (and lower-emitting) than many new well pads currently being developed. This problem is compounded by EPA's use of GRI data from 1996 to develop average site-level component and emissions profiles, both of which are lower than recent studies suggest and fail to account for large super-emitters. Additionally, in developing a model facility, EPA's methodology fails to exclude the facilities the agency has proposed to exempt, which results in an estimate that is further biased on the low end (TSD 2015 at 47).)

[179] RIA at 110 and Table 33 at 113.

[180] NSPS OOOOa comments at 54-55. (<u>Colorado</u>'s rule includes tiered frequency requirements based on the potential to emit VOCs, including inspection frequencies ranging from one time at the smallest facilities to monthly at the largest facilities; mid-sized facilities are required to undertake inspections on a quarterly basis. <u>Wyoming</u> requires quarterly instrument-based inspections at all well sites in its Upper Green River Basin with the potential to emit four tons of volatile organic compounds from fugitive components. <u>Ohio</u> requires quarterly inspections for leaks at unconventional well sites. <u>Pennsylvania</u> requires quarterly inspections of all onshore gas processing plants and compressor stations in the gathering and boosting sector. <u>Utah</u> requires quarterly inspections at well sites and storage tank batteries.)

[181] San Joaquin Valley Air Pollution Control District R. 4409 (2005); South Coast Air Quality Management District R. 1173 (1989); Santa Barbara County Air Pollution Control District R. 331 (1991); Ventura County Air Pollution Control District R.74.10 (1989).

well site inspections, the cost was $831/metric ton of methane.[182] And a recent case study confirmed Colorado's rule is effective and that its benefits outweigh its costs.[183]

- Industry. Jonah Energy—an operator in the Upper Green River Basin in Wyoming— has expressed its support of at least quarterly instrument-based inspections,[184] noting that it already complies with the proposal because "each month, Jonah Energy conducts infrared camera surveys using a forward-looking infrared camera ("FLIR") camera at each of our production facility locations."[185] According to Jonah, "[b]ased on a market value of natural gas of $4/MMBtu, the estimated gas savings from the repair of leaks identified exceeded the labor and material cost of repairing the identified leaks" while also significantly reducing pollution.[186] Jonah has reported that this highly cost-effective quarterly LDAR program has reduced fugitive VOC emissions from its facilities by over 75%, indicating that methane and other hydrocarbon losses have also been reduced by a similar proportion.[187] Jonah's experience that gas savings from repairs often exceed the cost of performing repairs to identified leaks is also borne out by the Carbon Limits report[188] and analysis carried out by Colorado.[189] There is mounting industry-supplied evidence that frequent LDAR is cost-effective.[190]

- ICF. As noted in our supplemental comments to the EPA, ICF developed a complex model to investigate the distribution of LDAR cost profiles at well sites. The results of the model indicate that the cost for LDAR using third-party contractors ranges between $491–793 per facility, depending on facility size.[191] Further, the analysis found that quarterly LDAR is

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182 CAPCD Cost-Benefit, at 28, Table 34. Cost effectiveness for well sites is calculated as net annual leak inspection and repair costs in Table 30 (adjusted from $3.5/Mcf to $4/Mcf of gas savings) divided by methane reductions in Table 35 (converted from short tons to metric tons and assuming methane is 86.1% of CH4/ethane).

183 Keating Research Inc., The Colorado Case Study On Methane Emissions: Conversations With The Oil And Gas Industry (April 10, 2016), *available at* http://static1.squarespace.com/static/558c5da5e4b0df58d72989de/t/57110da386db43c4be349dd8/1460735396217/Methane+Study.pdf.

184 Jonah Energy stated: "We support the [recent Wyoming rule for existing sources in the UGRB], as proposed, with some minor suggested changes [to the proposed tank requirements] outlined below." Ex. 1, Comments submitted to Mr. Steven A. Dietrich from Jonah Energy LLC on Proposed Regulation WAQSR, Chapter 8, Nonattainment Area Regulations, Section 6, Upper Green River Basin Permit by Rule for Existing Sources (April 13, 2015).

185 *Id*.

186 Ex. 2, Comments submitted to Mr. Steven A. Dietrich from Jonah Energy LLC on Proposed Regulation WAQSR, Chapter 8, Nonattainment Area Regulations, Section 6, Upper Green River Basin Existing Source Regulations (Dec. 10, 2014).

187 Jonah Energy, Presentation at WCCA Spring Meeting at 16 (May 8, 2015).

188 Carbon Limits (2014) at 16.

189 Colorado Air Pollution Control Division used an entirely different method than Carbon Limits to predict that almost 80 percent of repair costs for well facilities will be covered by the value of conserved gas. *See* CAPCD Cost-Benefit, at Table 30.

190 Several companies that engaged in the development of Colorado's regulations provided evidence that frequent LDAR is cost-effective. In particular, Noble estimated the cost-effectiveness of Colorado's tiered program at "between approximately $50/ton and $380/ton VOC removed" at well production facilities. (Rebuttal Statement of Noble Energy, Inc. and Anadarko Petroleum Corporation in the Matter of Proposed Revisions to Regulation Number 3, Parts A, B, and C, Regulation Number 6, part A, and Regulation Number 7 Before the Colorado Air Quality Control Commission, at 7).

191 ICF Leak Detection and Repair Cost-Effectiveness Analysis, December 4, 2015. Figures reflect survey and equipment costs per facility.

cost-effective at $258/metric ton of methane avoided for an average facility in the modeled distribution.[192]

vi. BLM Should Remove the Proposed Frequency Adjustment Based on Number of Leaking Components

In addition to proposing baseline, semi-annual monitoring requirements—which, as we describe above, would be less stringent than most existing state programs—BLM has further proposed to allow operators to adjust site monitoring frequency based on the number of leaking components found during a survey. In particular, the agency has proposed to allow sites to perform less-frequent annual inspections if, in two successive surveys, operators find no more than two leaks at a site.[193] Conversely, if three or more components are leaking, operators would have to monitor quarterly.[194] The agency's rationale suggests that the proposal is meant to reward operators for achieving low emissions: "The BLM has proposed three or more leaks at a site as the threshold for increasing the frequency of inspections, and two or fewer as the threshold for decreasing the frequency of inspections, as a possible way to distinguish between sites with very little loss from leaks and sites with more significant leak problems."[195]

In contrast to the LDAR frequency adjustment provisions in EPA's proposed methane NSPS– which would allow sites to adjust monitoring frequency based on the *percentage* of leaking components – BLM's proposal may result in more frequent monitoring schedules for more sources, but follows the same misguided logic. While well-designed policy incentives can enhance emissions performance, BLM's proposed frequency adjustments are – as with EPA's proposal – arbitrary, misalign incentives for operators, and are almost entirely divorced from a facility's emissions performance. Indeed, they reward facilities with potentially substantial emissions while applying more rigorous standards to sources that may be more modest polluters.

As with EPA's proposal, BLM's proposal creates perverse incentives by rewarding operators for failing to identify harmful leaks. This is not a hypothetical concern. A 2007 report by EPA found "significant widespread non-compliance with [LDAR] regulations" at petroleum refineries and other facilities.[196] EPA observed: "Experience has shown that poor monitoring rather than good performance has allowed facilities to take advantage of the less frequent monitoring provisions."[197] The report recommends that "[t]o ensure that leaks are still being identified in a timely manner and that previously unidentified leaks are not worsening over time," companies should monitor more

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[192] *Id*. Cost is $10.32/MT CO_2e for an average facility in the distribution model, using a GWP of 25 and gas price of $3/Mcf.

[193] 81 FR 6648.

[194] *Id.*

[195] *Id.*

[196] EPA, "Leak Detection and Repair: A Best Practice Guide," October 2007, at 1, *available at* http://www2.epa.gov/sites/production/files/2014-02/documents/ldarguide.pdf.

[197] *Id.* at 23.

frequently.[198] Instead, BLM should establish a rigorous baseline and reward operators for finding leaks more quickly and accurately—maximizing environmental benefits while minimizing costs.

Furthermore, the number of leaks found is not an accurate predictor of a facility's emissions performance and is an inappropriate metric for determining the frequency of LDAR. At a conceptual level, if emissions from leaking components were homogenously distributed, the number of components leaking at a facility would be a good indicator of facility-level emissions. However, there is overwhelming evidence that leak emissions follow a skewed, highly-heterogeneous distribution, with a relatively few number of sources accounting for a large portion of emissions. In such circumstances, the number of leaking components will not accurately reflect emissions and should not be used to determine the frequency of LDAR survey requirements.

We empirically examined the effects of BLM's proposed threshold using data from Allen, *et al.* (2013) and the Fort Worth Air Quality Study (2011), which include both component level emissions information and site-level data. Figures 1 and 2 below show the results of this analysis. Figure 1 shows the distribution of equipment leaks across the 150 production sites measured in the Allen, *et al.* (2013) study; sites with 2 or less leaks represented 70 percent of sites and constituted half of total methane emissions from leaks. Conversely, only 30 percent of sites had more than 2 leaks, representing only half of all emissions. In the Allen, *et al.* (2013) dataset, the site with the highest measured methane emissions from leaks had only 2 leaks but represented 18 percent of all emissions measured across all sites.[199]

Figure 2 shows the distribution of leaks detected across the 388 sites measured in the Fort Worth Air Quality Study (2011); sites with 2 or less leaks represented 60 percent of sites and constituted 12 percent of total methane emissions from leaks. EPA reported in its Leaks White Paper that the well data provided in the Fort Worth report showed: "At least one leak was detected at 283 out of the 375 well pads monitored with an OGI technology with an average of 3.2 leaks detected per well pad; The TVA detected at least one leak greater than 500 ppm at 270 of 375 well pads that were monitored with an average of 2.0 leaks detected per well pad."[200] These data indicate a significant amount of emissions can occur at sites with few measured leaks.

[198] *Ibid*.
[199] One leaking separator vent was responsible for 5 scfm methane at this site.
[200] USEPA, "White Papers on Methane and VOC Emissions: Leaks," *available at* https://www3.epa.gov/airquality/oilandgas/2014papers/20140415leaks.pdf

Figure 1: Number of Sites versus Number of Equipment Leaks

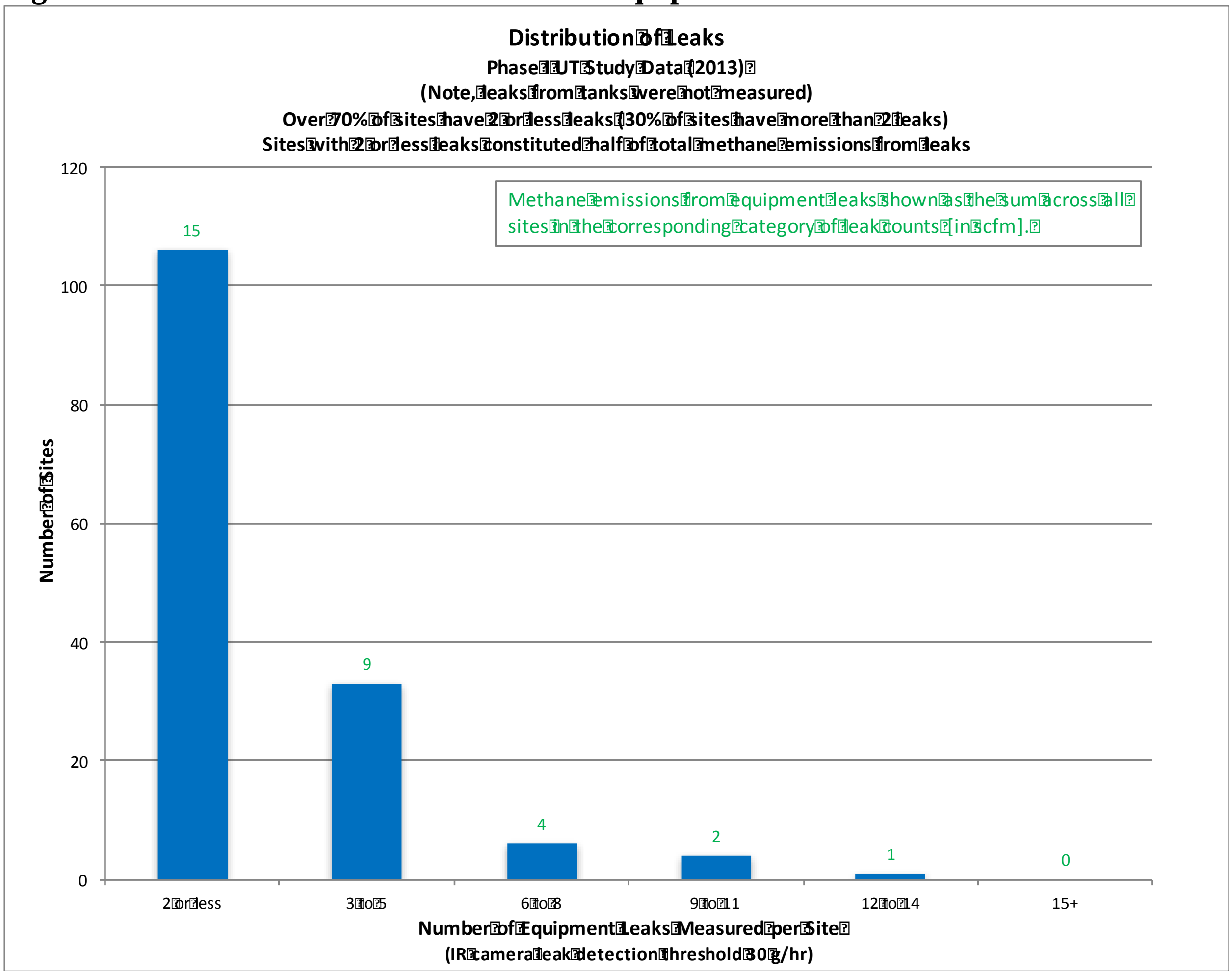
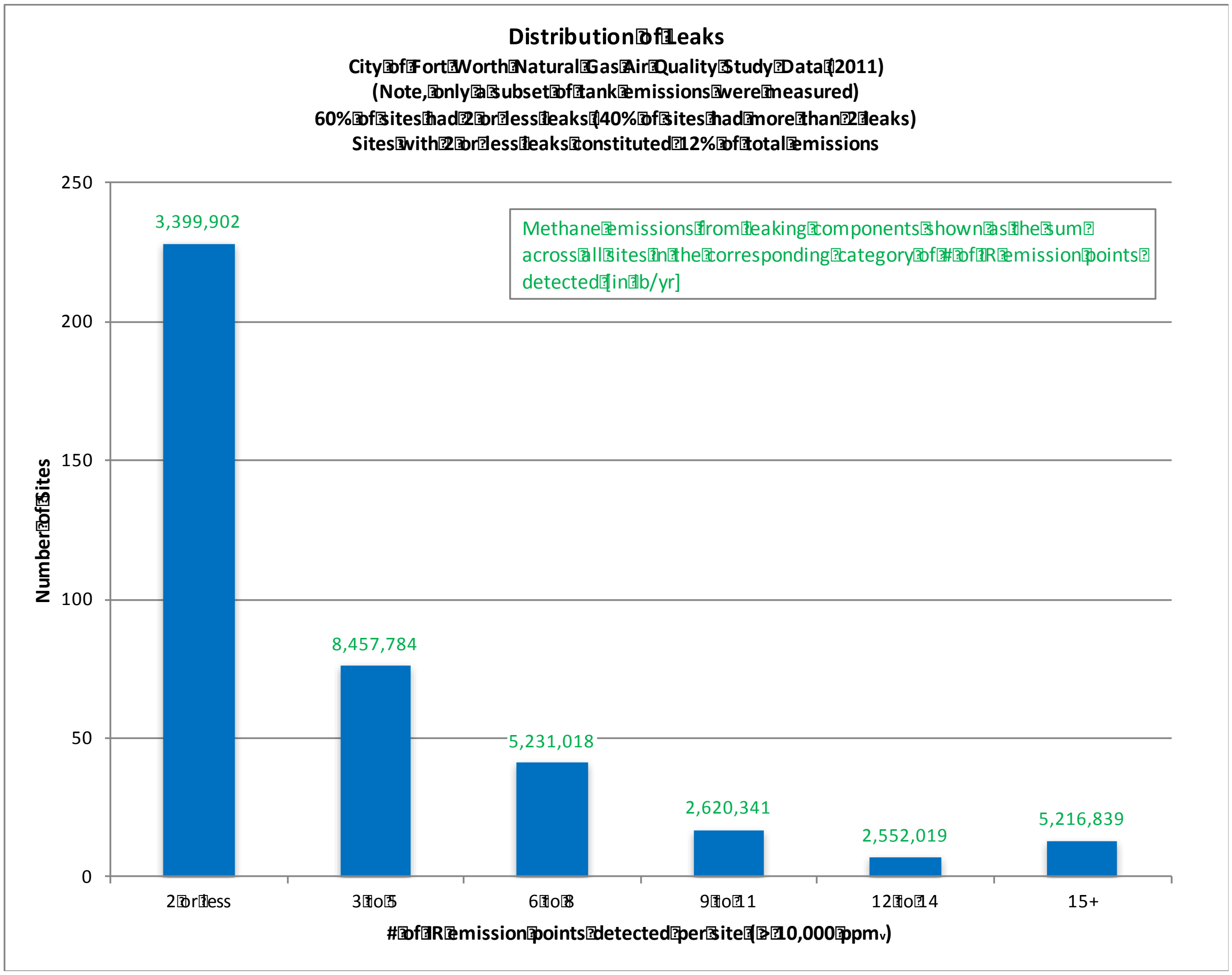


Figure 2: Number of Sites versus Number of Large Leaks



Data from operators collected as part of Colorado's LDAR program further support a fixed inspection requirement. Colorado's approach requires operators to inspect for leaks at all but the smallest sites on a fixed annual, quarterly, or monthly basis (depending on the facility's tanks emission potential).[201] Notably, Encana submitted testimony regarding its own voluntary LDAR program, which requires monthly instrument-based inspections. According to Encana, "[our] experience shows leaks continued to be detected well into the established LDAR program."[202] Encana's data shows that while the largest reductions in VOC emissions occur in the first year of an LDAR program, significant emission reductions are still being realized in subsequent years of the LDAR program – because leaks re-occur at facilities.[203] This pattern was independently confirmed in supplementary analysis carried out by Carbon Limits on leak inspection data from a number of

[201] 5 C.C.R. 1001-9, CO Reg. 7, §§ XVII.C.2.b.(ii), XVII F, (Feb. 24, 2014).
[202] Ex. 4, Rebuttal Statement of Encana Oil and Gas (USA) Inc., Before Colorado Air Quality Control Commission, Regarding Revisions to Regulation Numbers 3, 7, and 9, at 10.
[203] *Id*. at 10-11.

well production facilities and compressor stations.[204] Carbon Limits found that inspectors continued to find leaks in repeat inspections on the same facility. Additionally, Carbon Limits found that the cost-effectiveness of the leak inspections, expressed in dollars per metric ton of VOC abatement, did not significantly rise over several years after regulations were put in place requiring LDAR at facilities in Alberta.

We strongly recommend that BLM remove provisions allowing operators to reduce frequency based on the number of leaking components identified in prior surveys. Instead of these variable frequency provisions, we recommend that BLM consider tiered frequencies along the lines of the Colorado program to optimize costs.

vii. Incentivizing Innovation and Continuous Improvement in LDAR Technologies and Approaches

Although frequent OGI-based LDAR is currently a feasible and highly cost-effective approach to reducing leak emissions, advanced LDAR technologies – and protocols for using those technologies — are being swiftly developed and refined. EDF places a high priority on designing regulatory frameworks that recognize and support innovation and constant improvement in this dynamic area of waste prevention and pollution control.

Accordingly, we encouraged EPA in comments on the proposed methane NSPS – and encourage BLM here — to provide operators with flexibility to seek approval for alternative methods of complying with LDAR requirements, provided that these alternative compliance options are at least as effective in reducing waste and emissions as OGI-based LDAR. We are concerned, however, that BLM's proposed approach to providing compliance flexibility is overly vague and does not assure transparency, consistency, and rigor in approving alternatives to the default LDAR requirements.[205]

Our principal recommendations for strengthening the proposed alternative compliance provisions include:

- Eligible applicants. BLM should allow not just operators, but also technology developers and other entities, to file petitions for approval of new LDAR technologies and protocols.
- Criteria for approval. BLM should provide clear and rigorous criteria for evaluating petitions for new LDAR technologies and protocols, including:

[204] Colorado Department of Public Health and Environment, Index of /apc/aqcc/Oil & Gas 021914-022314/REBUTTAL STATEMENTS, EXHIBITS & ALT PROPOSAL REVISIONS/Conservation Group. Supplemental Testimony of David McCabe, at 734-736, *available at* ftp://ft.dphe.state.co.us/apc/aqcc/Oil%20&%20Gas%20021914-022314/REBUTTAL%20STATEMENTS,%20EXHIBITS%20&%20ALT%20PROPOSAL%20REVISIONS/Conservation%20Group/Conservation%20Groups%20-%20REB%20Exhibits.pdf.

[205] See 81 Fed. Reg. 6,686 (proposed 3179.303(b)) (providing that "The BLM may approve an alternative leak detection device, program, or method . . . if the BLM finds that the alternative would meet or exceed the effectiveness for leak detection of the approach specified in §§ 3179.302(a)(1) and 3179.303(a) of this subpart.").

  - The alternative leak detection technology and monitoring protocol have been shown by appropriate, representative data to achieve equal or greater reduction of methane emissions, as compared to the default OGI LDAR requirements in the EPA rule[206];
  - The leak detection device and protocol have been shown to produce repeatable, accurate and consistent results across a range of relevant meteorological conditions;
  - The leak detection device and protocol have a demonstrated limit of detection sufficient to support the above showings;
  - The protocol provides an appropriately detailed and reproducible method for applying the detection instrument (for example, specifying an approach to positioning fixed, continuous monitors in light of prevailing meteorological conditions and site-specific features; or specifying frequency and method of monitoring)
  - The protocol specifies the factors that trigger follow-up inspection to identify components with significant leaks and the approach to leak repair;
  - The protocol addresses these issues in sufficient detail to assure its consistent application at affected facilities and enable verification of results; and
  - All leaks detected will be tracked and follow-up actions documented to demonstrate adherence to the protocol and resulting reductions in emissions.
- Transparent and timely evaluation. BLM should provide a clear, transparent and predictable procedure for submitting and processing petitions for approval, including:
  - Identifying all supporting information that must be included with a petition for approval, including performance data, recordkeeping procedures, and other documentation;
  - Providing prompt public notice of the submission of a petition for approval, as well as actions taken on such petitions;
  - Providing a clear timeline (we recommend 180 days) for taking action on a petition;
  - Providing for appropriate conditions on approval, such as types of sites or meteorological conditions where the approved technology and protocol may be used; and
  - Providing for an explanation of any decision to grant or deny a petition.

Once a new technology or protocol is approved by BLM for one operator, we recommend that BLM allow other operators to utilize the new alternative compliance method – provided that operators

[206] Note that meeting this criterion does not require that alternative technologies can detect leaks at the same volume rates as an OGI camera at the component level. For the fixed sensor array approaches, one could make this demonstration by doing periodic OGI inspections alongside the continuous monitoring at a portfolio of sites over time while quantifying emissions when found. For OGI alternatives, one could inspect sites using the alternative technology and an OGI concurrently and then compare the results. Over time, ARPA-E and EDF field-testing, augmented by additional data developed by those seeking to market the technology and/or oil and gas companies, may demonstrate the efficacy of a variety of technology/protocol packages under a range of conditions, laying the groundwork for streamlined approval of multiple petitions.

provide adequate notice of their intention to do so, and properly document their compliance with the relevant protocols and any pertinent conditions.

In order to assure that BLM remains informed of new developments in the field of leak detection, we further recommend that the agency form and regularly consult a technical advisory committee comprised of a diverse group of technical experts from industry, non-governmental organizations, academia, and other institutions.

b. Flaring from Producing Oil Wells

i. Introduction

Flaring of associated gas at oil-producing wells is occurring at a massive scale on federal and tribal lands, constituting a significant source of waste as well as harmful emissions of carbon dioxide, nitrogen oxides, and toxic hydrocarbons from incomplete combustion. Rigorous, comprehensive standards that encourage operators to minimize flaring are urgently needed. According to BLM's analysis, about 76 billion cubic feet of gas were flared on BLM-administered leases in 2013.[207] This is amount is equivalent to the annual natural gas consumption of over one million households,[208] and, at $3 per thousand cubic feet, this volume of gas has a value of $228 million. Further, from 2009 to 2013, gas flared at oil wells on BLM administered leases increased by 292 percent.[209]

In addition to high overall flared gas volumes, wells on BLM administered leases flare high percentages of overall produced gas. In 2013, wells on BLM administered leases flared about 2.6 percent of total gas produced.[210] According to EIA data, the average US volume of flared and vented gas is consistently below 1 percent of production.[211] Further, data from an analysis by ICF that investigated methane emissions on federal and tribal lands reiterates this discrepancy, indicating that flaring rates as a percentage of gas produced are higher on BLM lands than on a national average.[212]

We agree with BLM that the current framework in NTL-4A for encouraging operators to minimize flaring, which relies on case-by-case approvals of flaring at individual leases, is not working.[213] We also appreciate BLM's desire to "strengthen its approach to reducing flaring" through a straightforward, transparent and consistent set of requirements.[214] However, we agree with other environmental and resource advocates that BLM's proposed approach is insufficiently protective

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[207] BLM Rule at 6636, *Quantities of Gas Vented or Flared*
[208] Calculated using EIA data for total residential natural gas consumer households and total residential consumption for 2013. http://www.eia.gov/naturalgas/data.cfm#consumption
[209] BLM Rule at 81 FR 6631, *Data Sources on Lost Gas: Volumes of Lost Natural Gas*
[210] BLM Rule at 81 FR 6619, *Venting and Flaring*
[211] EIA, Natural Gas Gross Withdrawals and Production. Calculated by dividing total onshore gas production by total onshore vented and flared gas for 2010-2014. https://www.eia.gov/naturalgas/data.cfm
[212] ICF Federal and Tribal Lands analysis supplemented with underlying data used in the analysis.
[213] 81 Fed. Reg. at 6619 (noting that BLM routinely approves case-by-case requests for authorization to flare under NTL-4A).
[214] *Id.*

and should be strengthened in critical respects to ensure that BLM satisfies its mandate to ensure that lessees use "all reasonable precautions to prevent waste of oil or gas."[215]

ii. Alternatives to Flaring

BLM recognizes the variety of alternatives to flaring available to operators. An operator may "capture, transport, and process" the associated gas as a means of conserving the valuable resource. Alternately, an operator may find other productive uses for the associated gas.[216]

We agree that operators have alternatives to flaring, even for those wells not connected to a pipeline. The availability of emerging onsite gas capture technologies contradicts the notion that categorical instances of flaring (such as at wildcat or delineation wells) are universally unavoidable. The range of available technologies for capture (even at smaller and more remote sites) precludes a blanket exemption to flare at certain types of facilities and demonstrates the need for tighter flaring limits and a narrowing of the proposed exceptions. As discussed in a recent study and summarized in BLM's analysis,[217] many options for onsite use or otherwise beneficial use of captured gas are currently both available and cost-effective. These options include separating out natural gas liquids ("NGL") or liquefying the natural gas ("LNG") and then trucking those liquids offsite; converting the gas into compressed natural gas ("CNG") to be used onsite or trucked offsite; and using the gas to power micro-turbines for onsite power generation or for sale back to the grid.[218] An additional option is converting the gas to liquids ("GTL"). This is different from the process of generating NGL, as it literally converts natural gas to synthetic crude oil.[219]

Additionally, the Energy & Environmental Research Center at University of North Dakota provides an extensive platform to review vendor-supplied information, economic and cost data, and technical specifications for flaring solutions and alternatives.[220] The categories of technologies include NGL recovery, power production, CNG or LNG, and other technology.
BLM recognizes the wide variety of available alternatives to flaring:

> "[O]perators have multiple avenues to reduce high levels of flaring. One is to speed up connection to pipelines, and another is to boost compression to access existing pipelines with capacity issues. BLM believes there are also other options available to avoid this waste. The economics of alternative on-site capture technologies improve as quantities of gas increase."[221]

[215] 30 U.S.C. §225.
[216] 81 FR 6619.
[217] RIA at 48.
[218] Carbon Limits, *Improving utilization of associated gas in US tight oil fields* (April 2015) (providing detailed evaluation of new and emerging gas utilization technologies).
[219] Gas to Liquids Conversion: http://www.arpa-e.energy.gov/sites/default/files/documents/files/De_Klerk_NatGas_Pres.pdf
[220] Energy & Environmental Research Center: Flaring Solutions Technology, http://www.undeerc.org/flaring_solutions/Search.aspx
[221] BLM Rule at 81 FR 6639, *Proposed Per-Well Flaring Limit*

iii. Principal recommendations

In separate comments, a large group of environmental and resource advocates ("Joint Commenters") submitted extensive technical information documenting available controls to reduce flaring and recommended strengthening those provisions in key respects. We likewise recognize the availability of flaring alternative—including technologies for onsite capture and connection to pipelines—along with the importance of rigorous flaring provisions. Accordingly, we urge BLM to strengthen the flaring provisions—consistent with key recommendations made in the Joint Commenters' submission—in the following ways:

- Adopt a flaring limit no greater than 1,200 Mcf per month. We agree with the Joint Commenters that BLM's analysis demonstrates that a flaring limit of 1,200 Mcf per month is cost effective and advances BLM's statutory duty to prevent waste. It also advances BLM's statutory duties to protect climate and air resources on public lands.[222] We believe BLM should adopt this approach for all wells on Federal and Indian lands, as imposing a hard limit on flaring will result in greater waste and air pollution reductions than the current landscape under NTL-4A where no such limit exists.

- Undertake an analysis that evaluates the potential reductions associated with a per-well flaring limit rather than one that is averaged across all wells on a lease, and propose an alternative per-well limit based on that analysis. As Joint Commenters recognize, averaging is less protective than imposing an individual well limit as in some instances it permits operators to flare large amounts at individual wells located on a lease provided other wells are flaring very small amounts. This could create an incentive for inefficient resource management and allow for unnecessary waste and air pollution.

- Revise the definition of a development well to remove the reference to profitability and instead align the definition with that used by EPA in current and proposed NSPS.

- Rigorously apply the economic test that would permit an existing well to exceed the flaring limit if it demonstrates that curtailing flaring would result in abandonment of "significant recoverable oil reserves" and "cause the operator to cease production." In particular, BLM should evaluate the economics of reducing production at the well as a way of meeting the flaring limit, as this is an appropriate and feasible way of meeting the limit and consideration of this factor may result in greater overall resource benefits than the granting of an exemption.

- Eliminate the two-year renewable exemption from the flaring limit for existing wells. As explained by Joint Commenters, this fails to take into account other available means to reduce flaring, even for wells flaring in excess of 50% over the proposed regulatory limit, not located within 50 miles from a processing plant and not connected to a gas pipeline. For example, BLM has indicated that onsite gas capture is *most* cost effective at higher flaring sites and it is perverse to provide automatic exemptions for these sites if they are not close to

[222] *See infra* Section III.b.

> processing facilities, when these technologies either would not require access to those facilities, or would be economically viable at distances over 50 miles from a processing plant. In addition, the proposed criteria for the exemption would allow unlimited flaring at unconnected well sites that are relatively close to gathering lines, so long as those sites are located the minimum distance from a processing plant and are flaring at sufficiently high rates. Lastly, the exemption may result in low-producing wells flaring natural gas in amounts that exceeds the value of the produced wells, which is not economically rational and therefore at odds with the stated purpose of this exemption.

Finally, we commissioned an analysis from ICF International (Appendix B) that evaluated the breakeven costs of installing compression at well sites that are connected to pipelines, but are nevertheless flaring due to a lack of adequate well site pressure necessary to push lower pressure gas into higher pressure pipelines. The analysis also evaluated wells not connected to pipelines and breakeven costs associated with trucking natural gas to nearby processing or sales facilities.

Among other things, ICF found that the costs adding compression to a pipeline-connected, low-pressure well in order to avoid flaring could be fully recovered even at wells producing as little as 16-46 Mcf/day (the range reflects different assumptions regarding the cost of capital and price of gas). Even at pipeline-connected wells where additional gas treatment is required, the costs of additional compression could be fully recovered at wells producing 38-107 Mcf/day. The analysis also found breakeven costs of 135-345 Mcf/day for trucking natural gas from unconnected pipelines. Importantly, though these numbers are higher, the ICF analysis notes: "the breakeven volumes for captured natural gas are not required to be captured at a single well. Rather the figure represents the volume required to be captured in total to breakeven on the investment costed in this memo." Costs therefore could be shared across multiple flaring wells with aggregate volumes reaching or exceeding the breakeven points.

We believe this analysis only further underscores the importance of strengthening BLM's flaring provisions and the availability of low-cost technologies capable of further minimizing flaring emissions.

iv. Measurement of associated gas venting and flaring

BLM requests comment on the proposed requirement that an operator measure rather than estimate the total combined flared and vented gas form a flare stack or manifold when that combined volume reaches 50 Mcf per day.[223] It is important that BLM ensure compliance with flaring limits through rigorous, verifiable measurement and monitoring — and actual measurement, using accurate flow meters, is the best means of gauging whether or not a stack or manifold complies with the flaring limit.

However, the precise threshold that triggers the measurement requirement will ultimately depend on the flaring limit that BLM finalizes. Although 50 Mcf per day may be an appropriate threshold for requiring actual measurement if the flaring limit is set at 1,800 Mcf per month, the lower limits we recommend in these comments would likely require a much lower threshold.

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[223] BLM Rule at 81 FR 6642, *Estimating or Measuring Quantities of Flared or Vented Gas*

c. Liquids Unloading

We support BLM's proposal to prohibit "purging"[224] or "uncontrolled venting" during liquids unloading activities at new wells, and to require the use of best management practices to minimize venting during liquids unloading activities at existing wells. As BLM recognizes, there are a large number of cost effective technologies and practices available to reduce waste and pollution from liquids unloading activities, which demonstrate the reasonableness of BLM's proposal. Moreover, as BLM shows, these measures are cost effective and in a number of instances result in net savings since their use both increases production and captures valuable product that can be sent to a pipeline and sold. We also support BLM's recordkeeping requirements as they will help facilitate compliance monitoring and can provide useful information to operators on the utility of implemented waste prevention measures.

Liquids unloading activities are the third largest source of vented emissions on Federal and Indian lands, according to BLM.[225] ICF, however, found that liquids unloading was the largest source of emissions on Federal and Tribal lands, accounting for over 13 BCF whole gas per year.[226] Moreover, EPA Subpart W data shows concentrated, high emissions from the San Juan Basin, which likewise has a high percentage of Federal and Tribal lands.[227]

Fortunately, as BLM recognizes, there are a number of cost effective technologies and practices that can prevent or minimize uncontrolled venting during liquids unloading activities, including, among others:[228]

- Install plunger lifts
- Install plunger lifts with smart automation
- Use artificial lift systems
- Inject surfactants
- Use small diameter velocity tubing
- Use compression
- Use flares

We strongly support BLM's approach to minimizing venting due to liquids unloading, which requires that operators eliminate such venting from new wells and minimize venting from existing wells using best management practices. For new wells, BLM reasonably concluded that all of

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[224] BLM defines purging as "blowing accumulated liquids out of a wellbore by gas pressure where the gas is vented to the atmosphere." Proposed 43 C.F.R. § 3179.204(f). For our purposes here, we refer to purging as "uncontrolled venting."

[225] RIA, Table 6, at 19.

[226] ICF Federal and Tribal wells analysis and underlying supplemental data for liquids unloading whole gas emissions from wells with and without plunger lifts on Federal and Tribal lands.

[227] 2014 Subpart W Greenhouse Gas Reported Data. San Juan basin accounts for about 11% total production emissions, but almost 20% of total unloading emissions.

[228] See EDF Response to Colorado Air Pollution Control Division Request for Input on Well Liquid Unloading FAQ Document, Oct. 21, 2014 (noting availability of "best management practices" to minimize the need for well venting during liquids unloading activities), on file with EDF.

these options would be available and that operators could effectively design wells and deploy mitigation technologies in a way that would eliminate emissions. For existing wells, BLM concluded that "it is reasonable to expect operators to use these available technologies to minimize gas losses, and we believe that failure to minimize losses of gas from liquids unloading should be deemed unavoidable waste subject to royalties."[229] BLM rightly concluded that these technologies are cost effective,[230] finding that its requirements will increase gas production and reduce venting "resulting in cost savings of about $7-8 million per year (using a 7 percent discount rate) or $7-10 million per year (using a 3% discount rate)."

To monitor compliance, BLM proposes operators maintain records documenting "the cause, date, time, duration, and estimated volume of each venting event."[231] We agree this information is necessary to ensure operators are complying fully with the requirements. In addition, this information can provide helpful data to operators to assess the relative effectiveness of various approaches to reduce waste from liquids unloading activities.

d. Pneumatic Controllers

BLM estimates that pneumatic controllers are the largest source of vented emissions on Federal and Tribal lands, accounting for 24.6% of all such waste.[232] BLM proposes to minimize waste from these sources by requiring that operators replace existing high-bleed continuous pneumatic controllers (i.e., those with a bleed rate greater than 6 scf/h) with low or no-bleed controllers within one year of the effective date of the rule.[233] BLM's proposed approach is based on proven, highly-cost effective technologies. There are, however, additional proven, low-cost technologies that can further minimize waste, and accordingly, we urge BLM to strengthen its proposal in critical respects. In particular, we recommend that BLM:

- Include standards for intermittent-bleed controllers.
- Require operators utilize zero emitting technologies such as air-driven pneumatic controllers or electric controllers, wherever feasible.
- Where the use of zero emitting technologies is not feasible, require operators route bleed gas to a process, such as a VRU or on-site fuel line. If this equipment is not available but a control device exists on site, emissions from all pneumatic controllers should be routed to a control device.
- Require periodic inspection and measurement to ensure that natural gas powered pneumatic controllers are functioning properly and venting no more than 6 scf/h of natural gas.
- Remove the exception allowing continued use of high-emitting controllers at a facility with an estimated remaining productive life of no more than three years.

i. Pneumatic Controller Emissions on Federal Lands are Significant

According BLM, continuous-bleed pneumatic controllers on Federal and Indian lands emitted over five billion cubic feet of natural gas in 2013—approximately 24 percent of the vented emissions on

[229] 81 FR 6655.
[230] *Id*.
[231] Proposed 43 C.F.R. § 3179.204(c)(2).
[232] RIA, Table 6, at 19.
[233] 81 FR 6626, 6652.

these lands.[234] ICF likewise estimated that pneumatic controllers accounted for 8.2 BCF of natural gas, or 12% of its estimate of emissions on federal and tribal lands.[235] These emissions are significant but nonetheless understate the amount of waste attributable to pneumatic controllers.

The 2015 GHG inventory, on which BLM's estimate is based undercounts the number of pneumatic controllers in service in the oil and gas industries. In addition, a number of scientific studies demonstrate that pneumatic controllers often improperly emit more, or far more, than designed to emit. Moreover, BLM's estimate omits entirely emissions from intermittent vent emissions, which can be quite significant.

Pneumatic Controller Activity Data. BLM's estimate of pneumatic controller activity data is based on EPA's 2015 GHG Inventory. In response to a substantial body of evidence that its counts of pneumatic controllers were too low,[236] EPA has just finalized a revised 2016 inventory that increases the pneumatic controllers nationwide. This update addresses some of the flaws in the 2015 GHG inventory, although more refinements may be necessary. At a minimum, EPA's revision upwards of the pneumatic controller emissions underscores the likelihood that BLM's estimate is low.

Intermittent Controllers. BLM's estimate of wasted gas attributable to controllers on federal lands does not account for intermittent vent controllers. According to data reported to EPA, these make up the majority of pneumatic controllers nationally. As shown in Table 2, the great majority of reported emissions from oil and natural gas production pneumatic controllers originate from intermittent-bleed controllers. Indeed, ICF estimated intermittent controllers were responsible for 4.9 BCF of the total 8.2 BCF (or 60%) of wasted natural gas from pneumatic devices on BLM lands annually.[237]

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[234] RIA, Table 6, at 19.
[235] ICF Federal and Tribal Lands analysis at 10 and supplemented by underlying data.
[236] For instance, EPA's reporting program, which covers only a subset of sites nationally, estimated higher emissions from pneumatic controllers than the previous version of the inventory even though the two are derived using the same emissions factors and the Inventory comprehensively covers these sources.
[237] ICF Federal and Tribal Lands analysis at 10 and supplemented by underlying data.

Table 2: Emissions by Type of Pneumatic Controller

Reporting Program 2014 reported emissions[238]		Metric tons methane			
		Low Bleed	Intermittent Bleed	High Bleed	**Total**
Production	Metric tons methane *(%)*	32,807 *(12%)*	849,096 *(85%)*	120,696 *(3%)*	**1,002,599**
	Number of controllers *(%)*	192,674 *(26%)*	521,318 *(71%)*	24,344 *(3%)*	**738,336**

Source: EPA Greenhouse Gas Reporting Program, 2014 data.
* The Reporting Program is always an underestimate of national emissions, because some facilities fall under the 25,000 metric ton CO2-e threshold and therefore do not have to report.

Specified Bleed Rate and Behavior vs. Observed Emissions. BLM's estimate also understates wasted natural gas from pneumatic controllers because it does not account for emissions from malfunctioning devices. Several recent studies report that pneumatic controllers often emit more than they are designed to emit.

- **Allen *et al*. (2015)**. As part of this study, an expert group reviewed the behavior of the 40 highest emitting controllers in the study, which were responsible for 81 percent of the emissions from all controllers in the study (377 controllers). The expert group concluded that "many of the devices in the high emitting group were behaving in a manner inconsistent with the manufacturer's design."[239] Of the forty high-emitting controllers, 28 were judged to be operating incorrectly due to equipment issues. The study reported that many devices observed to actuate, i.e. intermittent-bleed controllers, also had continuous emissions.

- **Allen *et al*. (2013)**. As noted above, this study reported that emissions from low-bleed pneumatic controllers were 270% higher than EPA's emissions factor for these devices—5.1 scfh.[240] Many low-bleed controllers are specified to emit far less than this: EPA's Gas Star program has documented many low-bleed controller models with bleed rates of less than 3 scfh,[241] and of course the emissions factor used by EPA for low-bleeds (1.39 scfh)[242] implies that many low-bleeds are expected to emit at a very low level. Assuming that some low-bleed controllers are performing as specified, the high emission rate observed by Allen *et al*. (2013) implies that many "low-bleed pneumatic controllers" are in fact emitting more

238 Reporting Program, *supra* note 240.
239 *Allen (2015) at* 639.
240 Allen, *et al*. (2013), at 17,771-72.
241 EPA, Lessons Learned from Natural Gas Star Partners: Options For Reducing Methane Emissions From Pneumatic Devices In The Natural Gas Industry (2006) at 1 at Appendix A, *available at* http://www3.epa.gov/gasstar/documents/ll_pneumatics.pdf.
242 40 C.F.R. § 98.233(a).

than the design threshold of 6 scfh for low-bleeds[243]—or much more than 6 scfh—simply to raise the average emission rate to 5.1 scfh.

- **City of Fort Worth Study**. The Fort Worth Study examined emissions from 489 intermittent pneumatic controllers using infrared cameras, Method 21, and a HiFlow sampler for quantification, and found that many of these controllers were emitting constantly and at very high rates, even though these devices were used to operate separator dump valves and were not designed to emit in between actuations.[244] Average emission rates for the controllers in the Fort Worth Study approached the average rate of a high-bleed pneumatic controller. According to the study authors, these emissions were frequently due to improperly functioning or failed controllers.[245]

- **British Columbia Study**. The Prasino study of pneumatic controller emissions in British Columbia also noted the potential for maintenance issues to lead to abnormally high bleed rates.[246] Although the researchers did not identify a cause for these unexpectedly high emission rates, the results are consistent with the observation that maintenance and operational issues can lead to high emissions.

- **The Carbon Limits Study**. The Carbon Limits Report confirms these findings and also concludes that LDAR programs may help to identify other improperly functioning devices like pneumatic controllers.[247]

ii. BLM Should Strengthen its Proposal to Minimize Waste of Natural Gas from Pneumatic Controllers.

BLM has proposed to require that existing *continuous-bleed* controllers on federal and Indian lands emit no more than 6 scfh of natural gas within one year of the effective date of the rule, unless an operator qualifies for an exemption or the three-year extension.

These standards build upon a proven and successful approach taken by EPA and various states to reduce emissions from continuous-bleed pneumatic controllers. As BLM notes, EPA requires the same approach for new and modified controllers in the production segment[248] and has proposed to extend this to existing controllers located in ozone nonattainment areas[249] and to new and modified

[243] *Id.* § 60.5390(c)(1).
[244] ERG and Sage Environmental Consulting, LP, *City of Fort Worth Natural Gas Air Quality Study, Final Report.* (July 13, 2011) ["Fort Worth Study"], *available at* http://fortworthtexas.gov/gaswells/default.aspx?id=87074.
[245] *See id.* at 3-99 to 3-100 ("Under normal operation a pneumatic valve controller is designed to release a small amount of natural gas to the atmosphere during each unloading event. Due to contaminants in the natural gas stream, however, these controllers eventually fail (often within six months of installation) and begin leaking natural gas continually").
[246] The Prasino Group, *Determining bleed rates for pneumatic devices in British Columbia; Final Report* (Dec. 18, 2013), at 19 ("Certain controllers can have abnormally high bleed rates due to operations and maintenance; however, these bleed rates are representative of real world conditions and therefore were included in the analysis.").
[247] EDF, Oil and Natural Gas Sector Leaks Peer Review Responses of Environmental Defense Fund, June 16, 2014 at 17, on file with EDF.
[248] 81 FR at 6651.
[249] 80 Fed. Reg. 56593 (September 18, 2015).

controllers in the storage and transmission segment.[250] Moreover, Colorado, Wyoming and Utah currently require both new and existing controllers to meet low bleed or no bleed requirements, or otherwise eliminate emissions. As discussed further below, California and Ohio have proposed even more rigorous requirements which effectively eliminate emissions from both new and existing continuous bleed controllers.

In light of these more rigorous state approaches and the strong evidence suggesting pneumatic controllers are responsible for an even greater amount of wasted natural gas, we urge BLM to strengthen its proposal in key respects.

Require the use of zero-emitting technologies where feasible. Technologies are available that can eliminate emissions from continuous and intermittent bleed pneumatic controllers. Specifically, operators can either utilize no-bleed controllers at facilities with access to grid or renewable energy or they can route the controller exhaust to a closed loop system.

Instrument air systems and other inherently non-emitting sources, such as electric actuators, are feasible at many sites of facilities. Many sites have electricity available,[251] and at others, operators may be able to use other approaches to generate power, either for instrument air or for electric actuators.

- **Grid connection**.[252] At sites that are connected to the electric grid, or with power available nearby, instrument air systems can replace gas-driven pneumatic controllers. For even modest facilities, instrument air is a low-cost option when power is available.

- **On-site generator**. Many sites produce power for on-site use using a natural gas-powered generator. Installing an instrument-air pneumatic system would be feasible in such cases. Beyond a traditional gas-powered generator, innovative technologies can bring electricity to remote sites. For example, thermoelectric generators are available that can be used to convert waste heat in compressor exhaust to electricity at remote oil and gas sites.[253]

- **Solar generator with battery storage**. Natural gas-driven devices can be replaced with electric actuators with low electricity requirements. Such devices are engineered by a variety of companies, and the technology continues to advance. One company has installed over 3,000 electric actuators at oil and gas sites in a variety of applications (dump valves, gas lift valves, separators, pressure valves, and compressor scrubbers).[254] In many geographic locations, the solar resource is sufficient to power these actuators.[255]

[250] NSPS OOOOa Proposed Rule at 80 FR 56610.
[251] 5 C.C.R. § 1009 XVIII.C.2.a.(ii).
[252] Alphabet Energy presentation at Natural Gas Star Annual Implementation Conference at 3, Nov. 18, 2015. Included here as an exhibit, will soon be posted on Gas Star website. Based on a survey of companies, 34% of companies in the U.S. report that their gathering compressor stations have grid access.
[253] Alphabet Energy, Oil and Gas Products, *available at* https://www.alphabetenergy.com/product_category/oil-and-gas/.
[254] Exlar presentation at Natural Gas Star Annual Implementation Conference, November 18, 2015. Included here as an exhibit, will soon be posted on Gas Star website. Exlar. *Industries and Applications: Oil and Gas Industry*, *available at*

- **Closed-loop pneumatic actuators**. Some pneumatic controllers use pressurized natural gas to operate but are designed to vent exhaust gas back into the line, as a "closed-loop" option. Assuming that the device does not leak, this is a zero-bleed technology, though it may be limited in applicability.[256]

Electricity availability at sites is increasing while the power required for zero-bleed pneumatic alternatives is decreasing. As a result, many sites, both in the production and transmission and storage segments, will be able to install zero-bleed pneumatic alternatives at low net cost.

A number of states require or have proposed to require operators utilize zero-emitting technologies. Colorado requires the use of zero-bleed devices at all new facilities where "on-site electrical grid power is being used" and where such use "is technically and economically feasible."[257] While Colorado's requirement is limited to sites where grid power is in use, operators also can utilize solar or other non-grid sources of electricity to power pneumatic controllers. Similarly, the Ohio EPA recently released a draft general permit that requires all pneumatic controllers located between the wellhead and the point of custody transfer to an oil pipeline or a natural gas transmission line or storage facility to be no-bleed or non-gas driven.[258]

Accordingly, we urge BLM to strengthen its rule by requiring zero-emitting alternatives, where feasible.

Route to process or flare. Wasted natural gas from pneumatic controllers can, alternatively, be minimized by routing the emissions to a process, such as an on-site VRU or fuel lines for an on-site engine, boiler, or heater, where available. This approach is likewise low-cost and creates opportunities to further minimize wasted natural gas.

For instance, BLM estimates that the capital and installation cost of routing emissions from a pneumatic pump to an existing VRU is $2,000; the annualized cost is $285.[259] These reasonable cost estimates are equally applicable to the costs of routing emissions from a pneumatic controller to process or control. Since most sites have multiple pneumatic controllers onsite, the per

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http://exlar.com/industry/oil-gas-applications/, http://exlar.com/pdf/?pdf=/content/uploads/2014/10/Exlar-Eliminates-Methane-Emmissions.pdf

[255] *See, e.g., id.* slide 16.

[256] EPA, Oil and Natural Gas Sector: Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, Background Technical Support Document, at 131. Note that API, in their comments on EPA's White Paper on Pneumatic Controllers, corrected EPA's statement in the White Paper that closed-loop controllers are only applicable "in applications with very low pressure." API stated, "Zero bleed controllers (integral controllers) are not limited to applications 'with very low pressure' and can operate over a wide range of pressures provided that the pressure downstream of the controller is sufficiently lower than the pressure upstream of the controller for the controller to function and allow upstream gas to discharge into the process flow downstream…They are common in high pressure applications." "API Comments on Oil & Natural Gas Sector Pneumatic Devices," June 14, 2014, at 9.

[257] 5 C.C.R. § 1009 XVIII.C.2.a.(ii).

[258] Ohio EPA, General Permit 18.1. Template, C.1.(c)(1), *available at* http://epa.ohio.gov/dapc/genpermit/permitsec.aspx.

[259] RIA at 88.

equipment cost of routing controller emissions to a VRU is likely less than the per equipment costs of routing a single pump's emissions to a VRU.

CARB has recently released a draft proposal requiring the retrofit or replacement of all pneumatic devices by January 1, 2018 in order to prevent natural gas from venting to the atmosphere. Operators can meet this requirement by either collecting all vented natural gas with the use of a vapor collection system or use compressor air or electricity to operate the device.[260] Wyoming similarly requires operators of new and existing pneumatic controllers to either route emissions to a closed loop system or limit emissions to low-bleed levels.[261]

As a last resort, if it is not feasible to replace a gas-powered device with a zero-bleed device, and it is not feasible to route emissions to a process, we suggest operators be required to flare the controller exhaust. This is consistent with the longstanding requirements in Wyoming and impliedly recognized by BLM as a means to minimize emissions since controllers whose exhaust is routed to a flare are not subject to the proposal.

Measure Emissions as Part of Compliance Demonstration. Controllers of all types frequently emit in excess of the amount they are designed to emit. BLM must ensure that emissions from controllers are regularly measured to ensure that they are not venting excessively. Such volumetric flow measurements can be done at low cost. CARB recently proposed draft regulatory language would require that operators of certain reciprocating compressors measure volumetric flow from cylinder rod packing.[262] Measuring the volumetric or mass flow rate from a pneumatic controller with methods such as a high volume sampler, bagging, or calibrated flow measuring instruments gives a real value for emissions, while hydrocarbon concentration (which would be measured while carrying out Method 21) is only weakly correlated with emissions.[263] Some leak-detection service providers routinely measure emissions from leaks with high volume samplers,[264] indicating that the cost of these measurements is quite reasonable. BLM should require operators to regularly measure the volumetric flow of emissions from controllers that vent natural gas to the atmosphere as part of their demonstration of continuous compliance with BLM's standards of performance for those devices.

Address Intermittent-vent Controllers. As noted above, BLM's proposal does not address intermittent vent controllers. This is a flaw in the proposal as intermittent vent controllers make up the majority of pneumatic controllers in the field and malfunctioning controllers can emit at levels equal to or higher than high-bleed continuous controllers. Intermittent controllers are responsible for 4.9 Bcf (or 60%) of the emissions from pneumatic of controllers on Federal and Indian lands

[260] California Draft Proposed Regulation Order, Feb. 1, 2016, Section 95668(f)(6), available at http://www.arb.ca.gov/cc/oil-gas/meetings/Draft%20ARB%20OG%20Regulation_Feb%201%202016%20Clean.pdf.
[261] Wyo. Dep't of Envtl. Quality, Oil and Gas Production Facilities: Chapter 6 Section 2 Permitting Guidance (June 1997, Revised Sept. 2013) ("WY Permitting Guidance"), 11, *available at* http://deq.wyoming.gov/media/attachments/Air%20Quality/New%20Source%20Review/Guidance%20Documents/2013-09_%20AQD_NSR_Oil-and-Gas-Production-Facilities-Chapter-6-Section-2-Permitting-Guidance.pdf..
[262] *See* CARB, California Draft Proposed Regulation Order, Feb. 1, 2016, at § 95213(d)(2)(E).
[263] Clearstone Engineering *et al.* (2006) at 3.
[264] Carbon Limits (2014), *supra* note **Error! Bookmark not defined.**, at 10.

and over 7% of total emissions on those lands.[265] Moreover, many of the same cost effective emission reduction measures that can be applied to continuous bleed controllers are applicable to intermittent vent controllers. Accordingly we urge BLM to require operators control emissions from intermittent vent controllers as follows:

First, BLM should require zero-bleed controllers at facilities where electricity is available (from the grid or generated on site). Electricity is generally available at large compressor stations, large production facilities, and sites of all sizes in urbanized areas.

Second, for specific cases where pneumatic controllers are required at sites where zero-bleed technology is not feasible, BLM should require that intermittent vent controllers emit below 6 scfh. Properly designed and well-functioning intermittent-bleed controllers can emit below 6 scfh in many applications.[266] Indeed, Wyoming requires that *all* pneumatic controllers emit below 6 scfh, regardless of whether they are continuous-bleed or intermittent-bleed, at new and modified facilities.[267]

Third, all intermittent bleed gas-driven controllers must be inspected as part of frequent and comprehensive LDAR surveys to ensure that they are not malfunctioning. Indeed, this is the approach that the California Air Resources Board has put forth as part of its proposed rules to reduce methane from oil and gas activities. Specifically, per the latest ARB proposal "[b]eginning January 1, 2018, intermittent bleed pneumatic devices shall not vent natural gas when not actuating determined by testing the device when not actuating in accordance with the leak detection and repair requirements specified in section 95669."[268]

e. Pneumatic Pumps

According to BLM, pneumatic pumps on Federal and Tribal lands vented 2.5 Bcf of natural gas to the atmosphere in 2013.[269] Of this, pumps subject to the proposal, namely chemical injection pumps and diaphragm pumps, were responsible for 0.65 Bcf of vented emissions, or 25% of the total gas emitted from the pneumatic pump category.[270] The majority of emissions (1.81 Bcf) come from glycol dehydrator pumps which are not part of the proposal.[271] Chemical injection pumps are used to pump chemicals into a well in order to increase production or into pipelines to prevent freezing. Diaphram pumps are used to circulate heat trace medium at well sites during winters or to pump out

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[265] ICF Federal and Tribal lands analysis at 10, and supplemented by underlying data.

[266] In their comments on EPA's 2012 oil and gas rules, the American Petroleum Institute stated, "Achieving a bleed rate of < 6 SCF/hr with an intermittent vent pneumatic controller is quite reasonable since you eliminate the continuous bleeding of a controller." In fact, API advocated intermittent-bleed devices to achieve the 6 scfh bleed rate, rather than continuous low-bleed devices. *See* API, *supra* note **Error! Bookmark not defined.**, at 7.

[267] WY Permitting Guidance, *supra* note 67, at 11. This requirement is applied to intermittent-bleed controllers in addition to continuous-bleed controllers. *See* Ex. 19, Email from Mark Smith, WDEQ, to David McCabe, 22 September 2014.

[268] *See* CARB Feb. 1, 2016 proposal, at 17 C.C.R. § 95668(f)(4).

[269] RIA at 211.

[270] RIA at 211.

[271] Id.; 81 FR at 6653.

sumps.[272]

To reduce emissions from existing chemical injection pumps and diaphragm pumps BLM proposes operators either replace the pneumatic pump with a zero-emissions pump or route the pump gas to a flare. An operator is exempt from these requirements upon demonstrating that a gas-powered pump is necessary based on functional needs, an existing flare is not present at the site, or routing emissions to a flare is not technically feasible.[273] In addition, operators may claim an exemption if they can demonstrate that replacing the pump with a zero-bleed pump would impose such costs as to cause the operator to cease production and abandon significant recoverable oil reserves under the lease.[274] Operators must comply with the proposal within one year of the effective date of the requirement unless the existing pump serves a well or facility with an estimated remaining productive life of three years or less. In this case, operators have three years to comply with the rule.[275]

BLM's proposal is highly cost effective. Per BLM, compliance with the proposed requirements would increase gas production by 0.46 Bcf per year and result in cost savings of $1.5-$1.9 or $1.75-$2.15 million per year, using a 7 and 3 percent discount rate, respectively. BLM anticipates the requirements would reduce methane emissions by 16,000 tpy and VOC emissions by 4,000 tpy.[276]

BLM has proposed feasible and cost effective requirements to reduce emissions from existing chemical injection pumps and diaphragm pumps. However, consistent with our comments on pneumatic controllers above, we urge BLM to strengthen the proposal as follows:

- Require replacement of gas-powered chemical injection pumps and diaphram pumps with zero-bleed pumps or require operators to route emissions to a process that captures the gas;
- Upon a showing that it is not technically feasible to eliminate emissions, require operators to route emissions to a flare;
- Allow an exception from the capture or control requirements outlined above upon a demonstration of technical infeasibility.

As discussed above in Section VI.d., operators can avail themselves of multiple options to eliminate emissions from gas-powered pumps. As BLM recognizes, operators can replace gas-powered pumps with electric or compressed air or capture the natural gas emitted from pumps and route it in into the natural gas sales stream. Where capture is not feasible, operators can capture the gas and combust it.[277] As BLM notes, replacing a pneumatic pump with a solar-charged electric pump costs only $2,000, has minimal operating costs, and results in annual gas savings of 183 Mcf per replaced pump. At $4/Mcf, this results in gas savings of $732 per year.[278] As BLM notes, Wyoming requires operators capture or control existing pump emissions in the UGRB by either using zero-bleed

[272] 81 FR at 6650-51.
[273] 81 FR 6652.
[274] *Id*.
[275] *Id*.
[276] 81 FR at 6653.
[277] 81 FR 6651-52.
[278] Id. at 6651.

technologies or routing emissions to a process or control device.[279] Similarly, CARB has proposed to phase out all natural-gas powered by 2018 by requiring operators either replace them with zero-bleed technologies or capture emissions.[280] We urge BLM to do the same.

Lastly, we suggest BLM expand its proposal to apply to glycol assist pumps. Glycol assist pumps, referred to as "Kimray Pumps" are responsible for the majority of pomp emissions on Federal and Indian lands. While control of emissions from these pumps is more complex than control of emissions from chemical injection pumps (because the natural gas used to drive the pump is emitted via the dehydrator vent stack), there are a number of options to reduce emissions from these pumps. As EPA notes, electrification is an option for these pumps.[281] A secondary option is the use of a low pressure glycol separator, which can separate methane-rich gas from the glycol before it enters the regenerator.[282] If this is done, the gas can be used to fuel the boiler on the regenerator or otherwise consumed for fuel on-site.[283]

For sites where electricity is present, BLM should require that new and modified glycol circulation pumps not emit any natural gas, since electric pumps are available for this purpose. BLM should consider requiring the use of low pressure glycol separators at other sites, since the methane separated from the glycol in this way can typically be directed to the boiler or the regenerator. It is important to consider that some natural gas dehydrators have emissions controls installed that control emissions of VOC, but do not control emissions of methane. If vented natural gas from a glycol circulation pump is routed into a glycol regenerator, the methane from the natural gas may be emitted to the atmosphere even if there are VOC controls on the dehydrator.

f. Storage Tanks

According to BLM, storage tanks on Federal and tribal lands vented 2.77 Bcf of natural gas in 2013 – making these facilities an important source of natural gas losses and methane emissions. BLM's estimate of gas losses is highly consistent with the inventory prepared by ICF, which found that oil tanks alone emitted 2.37 Bcf of whole gas in 2013.[284] According to ICF, oil tanks are the fourth-largest source of natural gas losses on tribal lands and the eighth-largest source on federal lands.[285]

BLM proposes to control losses of hydrocarbons from storage tanks by requiring existing tanks not subject to EPA's 2012 NSPS to control or capture 95 percent of their vented hydrocarbons. The requirements would apply to tanks with a rate of total VOC emissions equal to or greater than six tons per year that are not covered by EPA's 2012 NSPS.[286] To comply, operators must either

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[279] Id. at 6621.
[280] See CARB Feb. 1, 2016 proposal, at Section 95668(f)(6).
[281] 80 Fed. Reg. at 56,627.
[282] Kimray, Inc., "Glycol Pumps Product Bulletin," (July 2011), at 3, *available at*: https://kimray.com/Portals/0/Documents/PB0004.pdf .
[283] *Id.*
[284] The oil tanks total includes 2.25 Bcf from tanks and 0.12 from oil tanks dump valve vents. Based on ICF's analysis, we estimate that condensate tanks on federal and tribal lands vented an additional 0.5 Bcf of whole gas in 2013, for a total of about 2.8 Bcf total whole gas emissions from tanks
[285] ICF Federal and Tribal Lands Analysis at 10.
[286] Proposed 43 C.F.R. 3179.203(a).

retrofit the storage tank with a vapor recovery unit that captures vapor emissions and routes them to a sales line, or control the emissions through a combustion device.[287] Operators may qualify for an exemption upon a demonstration that compliance with the requirements would impose such costs as to cause the operator to cease production and abandon significant recoverable oil reserves under the lease.[288] BLM anticipates its proposed requirements will remove 7,000 tons of methane and 32,500 tons of VOCs from the atmosphere annually and result in net cost savings of $0.1-$0.2 million per year (using a 7 percent and 3 percent discount rates, respectively).

As BLM notes, these are substantially the same requirements that apply to new and modified storage vessels under EPA's current NSPS for the oil and gas sector, and they are also well-aligned with standards for both new and existing storage vessels in Colorado and in Wyoming's Upper Green River Basin. These proposed standards reflect basic, well-known techniques for reducing waste and pollution from storage vessels, and are eminently feasible and cost-effective. However, BLM can and should strengthen its proposal in light of compelling evidence that even controlled storage tanks can vent considerable natural gas if not designed and operated properly.

Accordingly, we urge BLM to:

- Explicitly prohibit venting from access points during normal operations;
- Require operators certify that their storage tanks can meet the "no venting" prohibition;
- Require operators inspect access points on tanks, control devices and vapor recovery units as part of mandatory leak detection and repair inspections;
- Specify that control devices used to meet the BLM requirement have at least a 98% destruction efficiency

Storage Tanks Can Vent Significantly if Not Improperly Designed or Operated. A number of scientific studies and regulatory agency investigations demonstrate that storage tanks equipped with improperly designed or poorly maintained control devices can emit significant quantities of gas. Specifically:

- EPA and the Colorado Air Pollution Control Division inspected ninety-nine storage tank facilities in Colorado's Denver-Julesburg basin in 2012. These inspections revealed that emissions were not making it to their intended control devices at 60% of the facilities. This was due in part to improperly designed storage tanks that could not handle the pressure of liquids when transferred from separators to tanks. If the tank vapor system is not adequately sized to handle the peak surge of flash emissions that occur when pressurized liquids dump to the atmospheric storage tanks, then flash emissions do not make it to the control devices. Rather, access points on tanks designed to only open during emergencies or maintenance, such as thief hatches and pressure relief valves, open, releasing uncontrolled flash emissions to the atmosphere. Moreover, the results of the investigations clearly show actual emissions are often much greater than what is reported in inventories, or calculated using flash

[287] *Id*. at Section 3179.203(c).
[288] *Id*.

analysis.289 These inspections formed the basis for a $73 million dollar settlement between Noble Energy, the U.S. EPA and the state of Colorado.[290]

- In 2015, researchers from Colorado State University published a series of direct measurement studies focusing on emissions from compressor stations in the gathering and processing segment. The researchers conducting the gathering and processing study found substantial venting from liquids storage tanks at approximately 20 percent of the sampled gathering facilities.[291] Emission rates at these facilities were on average four times higher than rates observed at other facilities and, at some of these sites with substantial emissions, the authors found that company representatives made adjustments resulting in immediate reductions in emissions.
- In 2011, the City of Forth Worth commissioned a comprehensive study of emissions from approximately 375 oil and gas production facilities. This study found that "the largest source of fugitive emissions detected with the IR camera was leaking tank thief hatches," and that these leaks were frequently due to operator error or inadequate maintenance.[292] The report also noted that emissions were found at 175 storage tank vents, which in "numerous instances" were associated with failures of pressure relief valves at manifolded vents.[293]
- Just this spring, EDF and a team of academic researchers conducted a large aerial survey of over 8,000 well sites in seven different production basins. Using an optical gas imaging instrument to identify high-emitting sites (emitting at least 1 to 3 grams of hydrocarbon per second), the survey revealed significant leaks and venting from storage tanks of various sizes including those equipped with flares and vapor recovery units.[294]

These scientific studies and inspections clearly demonstrating the importance of ensuring that operators design and operate storage tank facilities properly to ensure that all tank vapors are routed to capture or control devices.

Recommendations to Minimize Waste and Emissions from Storage Vessels. To address the significant venting from controlled storage tanks that are not designed or operated properly we urge BLM to revise its proposal as follows:

First, we suggest BLM make it clear that venting from access points or pressure relief devices during normal operation is prohibited. While this may be implicit in the BLM and EPA

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[289] *See e.g.*, Consent Decree *U.S. v. Noble Energy*, (No. 1:15 cv 00841, D. CO., April 22, 2015), available at http://www.justice.gov/sites/default/files/enrd/pages/attachments/2015/04/23/lodged_consent_decree.pdf.

[290] *Id*.

[291] Mitchell, A.L., et al, (2015) "Measurements of Methane Emissions from Natural Gas Gathering Facilities and Processing Plants," *Environ. Sci. Technol*, 2015, 49 (5), pp 3219–3227, *available at* http://pubs.acs.org/doi/abs/10.1021/es5052809.

[292] Eastern Research Group and Sage Environmental Consulting, City of Fort Worth Natural Gas Air Quality Study (Final Report) 3-99 (2011), *available at* http://www.shaledigest.com/documents/2011/Air%20Quality%20Studies/Ft%20Worth%20Natural%20Gas%20Air%20Quality%20Study%20Final%20Report%20ERG%20Research%207-13-2011r.pdf.

[293] *Id.* at 3-100.

[294] Lyon, et al., (2016) "Aerial surveys of elevated hydrocarbon emissions from oil and gas production sites," Environ. Sci. Technol. (Article ASAP), Web publication April 5, 2016 ("Lyon, et al. (2016)"), *available at* http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00705.

requirements, making this requirement explicit likely will improve compliance with the rule. To account for those instances where venting may be necessary, BLM could adopt the approach taken by Colorado by specifying those instances where venting is reasonably required, such as for "maintenance, gauging or safety of personnel and equipment."[295]

Second, we suggest BLM add a requirement that operators certify that their storage tank facilities are adequately sized in order to capture, convey and control emissions per the proposed requirement. Again, this is required in Colorado and is a direct response to the Air Pollution Control Division and EPA investigations discussed above that revealed significant leaks and venting from controlled facilities. Colorado now requires operators develop, certify and implement a "Storage Tank Emission Management System" plan.[296] The plan must "identify, evaluate, and employ appropriate control technologies" to ensure that the storage tank facility is designed and operated properly to ensure that tanks operate without venting from access points during normal operation. Per the plan requirements operators must:

- Monitor for venting using approved instrument monitoring methods and sensory detection methods;
- Document any training undertaken by operators conducting the monitoring;
- Analyze the engineering design of the storage tank and air pollution control equipment, and where applicable, the technological or operational methods employed to prevent venting;
- Identify the procedures to be employed to evaluate ongoing capture performance;
- Have in place a procedure to update the storage tank system if capture performance is found inadequate;
- Certify that they have complied with the requirement to evaluate the adequacy of their storage tank system.[297]

Third, we urge BLM include all access points and collection and control systems on tanks in the LDAR program. As discussed above, leaks and malfunctions can occur during both abnormal and normal operations, and routine inspections with modern leak detection equipment are a very effective way to identify and immediately mitigate such occurrences. Recognizing the benefits of regular LDAR in remediating storage tank fugitive emissions, EPA's proposed Subpart OOOOa would require that regular leak detection surveys at well production sites and compressor stations include "all ancillary equipment in the immediate vicinity" of the site, specifically including storage vessels.[298]

Lastly, we suggest that BLM require specify a destruction efficiency that all controls and vapor recovery systems must meet. We suggest BLM require a a 98% or better destruction efficiency and require all flares and combustion devices be equipped with an auto-igniter. This would align BLM's requirements with those of other leading states. Colorado requires that combustion devices used to

[295] 5 CCR 1001-9 §XVII.C.2.a.
[296] Id. at 1001-9 §XVII.C.2.b.
[297] 5 CCR 1001-9 §§, XVII.C.2.b.; XIX.N., Statement of Basis, Specific Statutory Authority, and Purpose (Feb. 23, 2014).
[298] *See* 80 FR 56611 (storage vessels at production sites covered by LDAR provisions); 80 FR 56613 (storage vessel thief hatches and pressure relief valves at compressor stations covered by LDAR provisions).

control hydrocarbons at tanks, glycol dehydrators, and gas "coming off a separator, [or] produced during normal operation" must have a design destruction efficiency of at least 98% for hydrocarbons.[299] Wyoming similarly requires that combustion devices used to control emissions from tanks, separation vessels, glycol dehydrators, and pneumatic pumps meet a 98% control requirement.[300] North Dakota also requires operators use control devices that achieve at least a 98% destruction removal efficiency for VOCs to control emissions from glycol dehydrators and tanks with the potential to emit greater than 20 tons of VOCs annually at production facilities in the Bakken Pool.[301] And on tribal lands, EPA's federal implementation plan for oil and gas production facilities on the Ft. Berthold Indian Reservation includes a 98% destruction efficiency requirement that is substantially identical to the North Dakota requirements.[302]

Colorado found that a requirement that storage vessel operators ensure proper design and operation of control devices can be met through highly cost effective techniques, such as installing a buffer bottle at existing tanks. Per the Colorado Air Pollution Control Division's final Cost Benefit analysis, the annualized total costs of installing a buffer bottle are $4,285 (annualized over 15 years at a 5% rate of return).[303] The Division noted that that buffer bottles offer a good alternative in retrofit situations for reducing pressures to the tank and increasing emission capture.[304] They also noted that "less costly technologies and operational practices" exists such as replacing seals, more frequent maintenance, changing the size of piping, and timing well dumps to avoid overloading the separator. Operators have flexibility to utilize any of these approaches when complying with Colorado's STEM requirements.

g. Variance Mechanism

Certain states have developed leading standards to reduce emissions and prevent waste from the oil and natural gas sector. In past rulemakings, BLM has incorporated variance mechanisms[305] and has likewise proposed to allow variances for "highly effective State or tribal requirements that reduce flaring and/or venting as much as, or more than, the proposed rule."[306] EDF supports protective state efforts, and we respectfully urge BLM to ensure the final variance mechanism is designed in a rigorous way that allows only those state standards that have equal or greater effectiveness to secure variances. In particular, we recommend:

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[299] 5 CCR 1001-9 §§ XVII.C.1.c, XVII.D.3, XVII.G.
[300] Wyoming Permitting Guidance, 6-10 (requirements for statewide sources. Same control efficiency required for sources located in other parts of the state), Sept. 2013.
[301] North Dakota Dep't of Health, Division of Air Quality, Air Pollution Control Permitting and Guidance, https://www.ndhealth.gov/AQ/Policy/20110502Oil%20%20Gas%20Permitting%20Guidance.pdf.
[302] Approval and Promulgation of Federal Implementation Plan for Oil and Natural Gas Well Production Facilities; Fort Berthold Indian Reservation (Mandan, Hidatsa, and Arikara Nation), North Dakota, 78 Fed. Reg. 17,836, 17,846 (Mar. 22, 2013).
[303] Colorado Air Pollution Control Division Cost Benefit Analysis for Proposed Revisions to AQCC Regulations No. 3 and 7, Feb. 7, 2014, Table 13.
[304] *Id*. at 16.
[305] *See* Oil and Gas; Hydraulic Fracturing on Federal and Indian Lands, 80 Fed. Reg. 16128, 16130 (March 6, 2015) (providing variance for state or tribal regulations and processes for permitting hydraulic fracturing operations). *See also* 43 CFR 3162.7–5(b)(9) (providing for approval variances from site security standards).
[306] 81 FR 6663.

- **Standard-focused variance procedure**. BLM should consider variance requests related to specific provisions of a state or tribal program and assess whether those provisions meet or exceed BLM's requirements. BLM should not, however, allow for programmatic variances, especially where those variance requests do not cover sources addressed by the BLM standards or otherwise incorporate less stringent requirements. Indeed, BLM has previously taken the position that it cannot provide for programmatic variances as such a provision would constitute an improper delegation of responsibility. [307]

- **Specific approval criteria**. Under proposed section 3179.401, the BLM State Director will make a determination based on whether the state or tribal rule "meets or exceeds the requirements of the provision(s) from which the State or tribe is requesting the variance."[308] In the Final Rule, we urge BLM to provide more specific approval criteria, such as the scope of review—and of information that should be included in an application, and the units and/or operations by which the relative 'effectiveness' of the state or tribal provision will be measured. This is particularly important for provisions related to flaring and leak detection and repair, where the standards' stringency is determined by the interaction of various policy design features. In these instances, it may be appropriate to require additional data or modeling to support a variance request. Likewise, BLM's written decision to approve or deny a variance request should specify the metrics that were weighted in making the determination.

- **Enforcement authority**. BLM must retain enforcement authority over state and tribal provisions that constitute compliance with the federal rule. The final rule should emphasize that a variance is neither an exemption from the federal standards nor a delegation of BLM's enforcement authority. A non-compliant operator in a state or jurisdiction whose regulations have been granted a variance must still be subject to federal enforcement provisions.

- **Public transparency**. We recommend that a variance request be publicly available and that there be an opportunity for the public to comment on the request. BLM has in the past acknowledged a legitimate public interest in variances from federal standards, making them available online.[309]

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[307] 80 FR 16176 ("The BLM may approve a variance . . . from one or more specific requirements of the rule, but not from the entire rule . . . Unlike several other environmental statutes, none of the BLM's statutory authorities authorize delegation of the BLM's regulatory duties to state or tribal agencies.")

[308] 81 FR 6686.

[309] *See* 80 FR 16175.

VII. CONCLUSION

We appreciate the opportunity to submit comments on BLM's proposal. These standards are essential to effectively reduce waste and conserve resources on Federal and Tribal lands. We urge BLM to strengthen the rule to minimize waste and pollution consistent with our above recommendations and agency's responsibilities under our nation's mineral leasing and management laws.

Respectfully submitted,

Tomás Carbonell
tcarbonell@edf.org

Peter Zalzal
pzalzal@edf.org

William Bittinger
Alice Henderson
Hillary Hull

Benjamin Levitan
Elizabeth Paranhos

Environmental Defense Fund

APPENDIX A – PROPOSED RULE AND LDAR ANNUAL COMPLIANCE COSTS AS A PERCENTAGE OF ANNUAL NET CASH AND REVENUE FOR SMALL BUSINESSES

The tables below illustrate annual compliance costs both for the proposed rule and for LDAR as a percentage of annual net cash and of annual revenue for small businesses. The tables assess semi-annual and quarterly LDAR and include cost comparisons both for new sources (based on average new wells drilled between 2012-2105) and for the entire population of existing wells that a company owns.

The analysis utilized to develop the tables below uses information from the BLM RIA[310] to analyze the cost of the proposed rule and of LDAR for smaller producers.[311] We identified certain exploration and production companies that meet the definition of a small business,[312] building from a list compiled for BLM's proposed rulemaking.[313] For these corporations, we analyzed available financial data from SEC filings and production, well, and drilling HPDI data from DI Desktop for the years 2012-2015. We then used company-level data on new and existing wells[314] to calculate semi-annual and quarterly proposed rule and LDAR compliance costs and to compare these costs to companies' reported annual net cash and annual revenue.

As noted in the footnotes for Tables 1 and 2, compliance with the full proposed rule, including semi-annual LDAR, is estimated to cost $4,237 per site and proposed rule compliance, including quarterly LDAR, is assumed to cost $5,500 per site. As noted in Tables 3 and 4, semi-annual LDAR compliance is estimated to cost $1,868 per site and quarterly LDAR is estimated to be $3,079 per site.

[310] BLM Proposed Rule RIA at page 5 for proposed rule costs and page 113 for LDAR costs.
[311] March 31, 2016 Supplemental Comments of Environmental Defense Fund on EPA's Proposed Rule, Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. 56593 (Sept. 18, 2015).
[312] "Small businesses" were identified by confirming employee counts of 500 or fewer per the company 10-K forms.
[313] RIA Appendix A-7: Detail of Small Business Impacts Analysis, at 183-184.
[314] HPDI data for 2012-2015 from DI Desktop, by operator.

TABLE A-1: PROPOSED RULE COMPLIANCE COSTS AS A PERCENTAGE OF SMALL COMPANY OPERATING ACTIVITIES NET CASH

Company [2]	Employees	Proposed Rule Annual Compliance Costs as a % of Net Cash Provided by Operating Activities [1]											
		New Sources Only [3]				All Wells [4]							
		2020		2025		2015		2014		2013		2012	
		Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly
1	500	0.06%	0.08%	0.36%	0.46%	NA	NA	0.58%	0.75%	0.65%	0.85%	0.83%	1.07%
A	488	0.03%	0.04%	0.18%	0.23%	0.02%	0.03%	0.14%	0.18%	0.19%	0.25%	0.23%	0.30%
2	484	0.02%	0.03%	0.15%	0.19%	1.35%	1.75%	1.11%	1.45%	1.37%	1.78%	1.42%	1.84%
3	470	0.03%	0.03%	0.16%	0.21%	1.21%	1.57%	1.20%	1.56%	0.87%	1.12%	NA	NA
4	459	0.03%	0.04%	0.18%	0.23%	0.30%	0.39%	0.67%	0.87%	0.77%	1.00%	NA	NA
5	381	0.09%	0.11%	0.52%	0.67%	2.45%	3.18%	2.68%	3.48%	3.43%	4.45%	4.36%	5.66%
G	379	0.02%	0.03%	0.13%	0.17%	NA	NA	4.67%	6.06%	4.00%	5.19%	6.38%	8.28%
6	362	0.11%	0.14%	0.67%	0.87%	1.16%	1.51%	1.83%	2.38%	2.61%	3.39%	NA	NA
R	323	0.02%	0.02%	0.09%	0.12%	0.07%	0.09%	0.04%	0.06%	0.03%	0.04%	NA	NA
7	315	0.09%	0.11%	0.51%	0.66%	7.27%	9.43%	3.76%	4.88%	3.80%	4.93%	NA	NA
B	310	0.01%	0.02%	0.07%	0.10%	0.08%	0.10%	0.10%	0.13%	0.05%	0.07%	0.05%	0.06%
E	293	0.07%	0.09%	0.42%	0.54%	NA	NA					0.56%	0.73%
M	282	0.15%	0.20%	0.92%	1.19%	1.71%	2.23%	0.41%	0.54%	0.34%	0.44%	NA	NA
8	264	0.00%	0.00%	0.00%	0.00%	0.25%	0.32%	0.05%	0.06%	0.06%	0.08%	0.07%	0.09%
9	230	0.05%	0.06%	0.30%	0.39%	0.20%	0.26%	0.14%	0.18%	0.19%	0.24%	NA	NA
J	215	0.05%	0.07%	0.31%	0.40%	0.26%	0.33%	0.18%	0.24%	0.18%	0.23%	NA	NA
10	210	0.31%	0.40%	1.83%	2.38%	0.12%	0.16%	NA	NA	NA	NA		
11	167	0.04%	0.06%	0.26%	0.34%	0.78%	1.02%	0.53%	0.68%	0.72%	0.94%	0.49%	0.63%
12	151	0.02%	0.02%	0.11%	0.14%	0.38%	0.49%	0.27%	0.35%	0.32%	0.42%	0.43%	0.56%
13	146	0.06%	0.08%	0.38%	0.49%	2.28%	2.96%	1.41%	1.83%	1.23%	1.59%	0.66%	0.85%
K	139	0.03%	0.04%	0.18%	0.24%	0.24%	0.31%	0.17%	0.22%	0.13%	0.16%	0.06%	0.08%
14	125	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.02%	0.02%	0.01%	0.01%	0.00%	0.01%
15	106	0.08%	0.10%	0.45%	0.58%	0.61%	0.80%	0.19%	0.24%	0.15%	0.20%		
L	99	0.04%	0.05%	0.24%	0.31%	8.67%	11.26%	0.63%	0.81%	1.05%	1.37%	1.02%	1.33%
16	87	0.07%	0.09%	0.43%	0.56%	NA	NA	0.43%	0.56%	0.40%	0.52%	0.39%	0.50%
17	50	0.06%	0.08%	0.38%	0.49%			0.31%	0.41%	1.31%	1.70%	NA	NA
18	42	0.24%	0.31%	1.43%	1.85%	NA	NA	0.28%	0.37%	1.54%	2.00%		
V	37	0.20%	0.26%	1.20%	1.56%	0.78%	1.01%	1.15%	1.50%	2.54%	3.30%	3.16%	4.10%
N	27	0.01%	0.01%	0.03%	0.04%	NA	NA	0.19%	0.25%	0.13%	0.17%	0.08%	0.10%
A1	73	0.00%	0.00%	0.01%	0.02%	0.13%	0.17%	0.01%	0.02%	0.03%	0.03%	NA	NA
A2	141	0.02%	0.02%	0.11%	0.15%	0.12%	0.16%	0.14%	0.18%	0.30%	0.38%	0.84%	1.08%
A3	10	0.01%	0.02%	0.08%	0.11%	0.08%	0.11%	0.13%	0.17%	0.14%	0.18%	NA	NA
A4	7	0.00%	0.00%	0.00%	0.00%	3.16%	4.10%	1.67%	2.16%	NA	NA	NA	NA
A5	212	0.10%	0.13%	0.60%	0.77%	0.40%	0.52%	0.34%	0.45%	0.93%	1.20%	7.80%	10.12%
A6	226	0.02%	0.03%	0.14%	0.18%	1.33%	1.73%	0.66%	0.85%	0.71%	0.93%	NA	NA
A7	274	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
A8	371	0.05%	0.06%	0.28%	0.36%	0.06%	0.08%	0.16%	0.21%	0.21%	0.28%	NA	NA
A9	51	0.05%	0.06%	0.27%	0.36%			0.13%	0.17%	0.18%	0.23%	NA	NA
A10	152	0.13%	0.16%	0.75%	0.98%	NA	NA	5.26%	6.82%	5.38%	6.99%	4.56%	5.93%
A11	440	0.03%	0.04%	0.19%	0.24%	NA	NA			1.80%	2.34%	0.24%	0.32%
A12	0	0.01%	0.01%	0.04%	0.05%	0.09%	0.12%	0.07%	0.09%	0.16%	0.21%	1.23%	1.60%
A14	112	0.00%	0.00%	0.00%	0.00%	0.04%	0.05%	0.03%	0.03%	0.03%	0.04%	NA	NA
A15	116	0.12%	0.15%	0.71%	0.93%	1.88%	2.43%	0.45%	0.59%	0.68%	0.88%	1.05%	1.36%
A16	30	0.06%	0.08%	0.37%	0.48%			0.45%	0.58%	0.78%	1.01%	NA	NA
A17	102	0.01%	0.02%	0.08%	0.11%	1.23%	1.59%	0.73%	0.94%	1.15%	1.49%	1.78%	2.32%
A18	93	0.02%	0.03%	0.14%	0.18%	0.13%	0.16%	0.12%	0.16%	0.21%	0.28%	0.19%	0.25%
A19	125	0.02%	0.03%	0.14%	0.18%	5.85%	7.60%	0.45%	0.58%	0.69%	0.89%	NA	NA
A20	55	0.07%	0.09%	0.40%	0.52%	NA	NA	11.39%	14.79%	10.19%	13.23%		
A21	51	0.16%	0.21%	0.97%	1.26%	0.52%	0.67%	0.69%	0.90%	0.78%	1.01%	NA	NA
A22	340	0.04%	0.05%	0.23%	0.30%	0.22%	0.29%	0.12%	0.16%	0.13%	0.17%	NA	NA
WEIGHTED AVERAGE		**0.04%**	**0.06%**	**0.27%**	**0.35%**	**1.01%**	**1.32%**	**0.84%**	**1.09%**	**0.96%**	**1.24%**	**1.83%**	**2.38%**

If cell is blank, Net Cash Provided by Operating Activities was negative

[1]Compliance Costs:

	Semi-Ann	Quarterly	
Annual compliance cost per site	$4,237	$5,500	BLM RIA (Jan 2016) Table 2b: Estimated Annual Costs if EPA Finalizes Subpart OOOOa, 2017 – 2026, Pg 5.
Average well density	2	wells/site	*Proposed rule is assumed to cost $161 million and effect 38,000 wellsites ($4,237/wellsite) w/ Semi-annual LDAR*
			Cost of Semi-Annual LDAR is $69 million and effects 38,000 wellsites ($1,816/wellsite)
			Cost of Quarterly LDAR is $117 million and effects 38,000 wellsites ($3,079/wellsite)

[2] Companies identified by letter were included in the BLM small business analysis. Companies identified by number are additional O&G companies with BLM leases that meet the definition of a small business. Companies identified with a letter and number are O&G companies that meet the definition of a small business that may or may not have BLM leases.

[3] Based on average annual count of new wells starting production for each company 2012 - 2015. LDAR applied to new wells starting in 2020. Based on average Net Cash Provided by Operating Activities, for 2012-2015.

[4] Based on actual Net Cash Provided by Operating Activities in each year.

TABLE A-2: PROPOSED RULE COMPLIANCE COSTS AS A PERCENTAGE OF SMALL COMPANY REVENUE

Company [2]	Employees	Proposed Rule Annual Compliance Costs as a % of Company Revenue [1]											
		New Sources Only [3]				All Wells [4]							
		2020		2025		2015		2014		2013		2012	
		Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly
1	500	0.019%	0.024%	0.111%	0.145%	NA	NA	0.28%	0.36%	0.27%	0.35%	0.29%	0.37%
A	488	0.010%	0.013%	0.059%	0.076%	0.01%	0.01%	0.05%	0.07%	0.08%	0.10%	0.10%	0.13%
2	484	0.013%	0.017%	0.077%	0.100%	0.82%	1.06%	0.50%	0.65%	0.70%	0.91%	0.87%	1.13%
3	470	0.013%	0.017%	0.077%	0.100%	0.99%	1.28%	0.50%	0.65%	0.67%	0.86%	0.66%	0.85%
4	459	0.015%	0.020%	0.092%	0.120%	0.17%	0.21%	0.38%	0.49%	0.45%	0.59%	1.78%	2.31%
5	381	0.047%	0.061%	0.282%	0.367%	1.60%	2.08%	1.15%	1.50%	1.97%	2.56%	2.57%	3.33%
G	379	0.008%	0.010%	0.046%	0.060%	2.87%	3.72%	1.82%	2.36%	1.98%	2.58%	2.75%	3.57%
6	362	0.037%	0.047%	0.219%	0.285%	0.80%	1.04%	0.51%	0.66%	1.06%	1.37%	NA	NA
R	323	0.009%	0.011%	0.052%	0.067%	0.06%	0.08%	0.02%	0.03%	0.02%	0.02%	0.03%	0.03%
7	315	0.033%	0.043%	0.200%	0.260%	2.97%	3.85%	2.06%	2.68%	2.10%	2.73%	NA	NA
B	310	0.007%	0.009%	0.039%	0.051%	0.04%	0.05%	0.05%	0.06%	0.03%	0.04%	0.03%	0.03%
E	293	0.006%	0.008%	0.038%	0.050%	NA	NA	0.24%	0.31%	0.23%	0.30%	0.18%	0.24%
M	282	0.074%	0.096%	0.444%	0.577%	0.56%	0.72%	0.24%	0.32%	0.25%	0.32%	0.36%	0.47%
8	264	0.000%	0.000%	0.001%	0.001%	0.06%	0.07%	0.03%	0.04%	0.03%	0.04%	0.03%	0.04%
9	230	0.021%	0.027%	0.127%	0.164%	0.09%	0.12%	0.08%	0.11%	0.14%	0.18%	NA	NA
J	215	0.032%	0.041%	0.189%	0.246%	0.22%	0.29%	0.13%	0.17%	0.13%	0.16%	0.11%	0.15%
10	210	0.073%	0.095%	0.441%	0.572%	0.04%	0.05%	1.68%	2.18%	NA	NA	NA	NA
11	167	0.027%	0.035%	0.161%	0.209%	0.48%	0.62%	0.30%	0.40%	0.37%	0.47%	0.39%	0.51%
12	151	0.012%	0.015%	0.072%	0.093%	0.25%	0.32%	0.16%	0.21%	0.22%	0.29%	0.32%	0.42%
13	146	0.038%	0.049%	0.227%	0.295%	0.91%	1.18%	0.63%	0.82%	0.75%	0.98%	NA	NA
K	139	0.017%	0.022%	0.103%	0.134%	0.22%	0.29%	0.09%	0.12%	0.06%	0.08%	0.03%	0.04%
14	125	0.000%	0.000%	0.002%	0.003%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	106	0.015%	0.019%	0.088%	0.114%	0.08%	0.11%	0.07%	0.09%	0.04%	0.05%	0.04%	0.05%
L	99	0.023%	0.030%	0.138%	0.179%	0.91%	1.18%	0.44%	0.57%	0.60%	0.78%	0.80%	1.04%
16	87	0.031%	0.040%	0.185%	0.240%	NA	NA	0.24%	0.31%	0.24%	0.32%	0.21%	0.28%
17	50	0.034%	0.044%	0.204%	0.265%	0.58%	0.76%	0.50%	0.64%	0.67%	0.87%	0.73%	0.95%
18	42	0.055%	0.071%	0.328%	0.426%	NA	NA	0.14%	0.19%	0.19%	0.24%	0.20%	0.26%
V	37	0.169%	0.220%	1.016%	1.319%	0.78%	1.01%	0.83%	1.08%	1.76%	2.29%	2.69%	3.49%
N	27	0.001%	0.002%	0.008%	0.011%	NA	NA	0.04%	0.05%	0.05%	0.06%	0.04%	0.05%
A1	73	0.001%	0.001%	0.007%	0.009%	0.03%	0.04%	0.01%	0.01%	0.02%	0.02%	NA	NA
A2	141	0.015%	0.020%	0.091%	0.118%	0.11%	0.15%	0.10%	0.13%	0.22%	0.29%	0.55%	0.72%
A3	10	0.005%	0.006%	0.030%	0.039%	0.03%	0.04%	0.06%	0.08%	0.08%	0.10%	0.12%	0.15%
A4	7	0.000%	0.000%	0.000%	0.000%	1.55%	2.02%	1.18%	1.53%	0.80%	1.03%	NA	NA
A5	212	0.057%	0.074%	0.341%	0.443%	0.26%	0.33%	0.21%	0.27%	0.41%	0.53%	1.04%	1.35%
A6	226	0.007%	0.009%	0.042%	0.055%	0.60%	0.78%	0.29%	0.37%	0.27%	0.35%	NA	NA
A7	274	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
A8	371	0.019%	0.024%	0.113%	0.146%	0.05%	0.07%	0.04%	0.05%	0.08%	0.11%	NA	NA
A9	51	0.012%	0.016%	0.072%	0.094%	0.22%	0.29%	0.08%	0.10%	0.06%	0.08%	0.07%	0.09%
A10	152	0.047%	0.061%	0.281%	0.365%	NA	NA	1.90%	2.46%	3.07%	3.98%	2.92%	3.79%
A11	440	0.004%	0.005%	0.025%	0.032%	NA	NA	0.02%	0.03%	0.66%	0.86%	0.09%	0.12%
A12	0	0.004%	0.005%	0.025%	0.032%	0.05%	0.07%	0.04%	0.05%	0.10%	0.13%	0.83%	1.08%
A14	112	0.000%	0.000%	0.000%	0.000%	0.02%	0.03%	0.01%	0.02%	0.02%	0.02%	NA	NA
A15	116	0.068%	0.089%	0.411%	0.533%	0.66%	0.85%	0.32%	0.41%	0.39%	0.50%	0.59%	0.77%
A16	30	0.019%	0.024%	0.112%	0.145%	0.46%	0.59%	0.26%	0.34%	0.42%	0.54%	NA	NA
A17	102	0.009%	0.012%	0.054%	0.071%	0.96%	1.24%	0.48%	0.63%	0.70%	0.91%	1.00%	1.30%
A18	93	0.013%	0.018%	0.081%	0.105%	0.08%	0.10%	0.08%	0.10%	0.11%	0.15%	0.09%	0.11%
A19	125	0.010%	0.012%	0.057%	0.075%	0.70%	0.91%	0.32%	0.42%	0.43%	0.55%	0.44%	0.57%
A20	55	0.001%	0.002%	0.009%	0.011%	NA	NA	0.64%	0.82%	0.68%	0.88%	0.67%	0.86%
A21	51	0.054%	0.070%	0.325%	0.422%	0.25%	0.32%	0.26%	0.34%	0.42%	0.55%	NA	NA
A22	340	0.016%	0.021%	0.098%	0.128%	0.12%	0.15%	0.08%	0.10%	0.07%	0.10%	NA	NA
WEIGHTED AVERAGE		**0.020%**	**0.026%**	**0.121%**	**0.157%**	**0.37%**	**0.48%**	**0.30%**	**0.39%**	**0.39%**	**0.50%**	**0.64%**	**0.83%**

[1] Compliance Costs:

	Semi-Ann	Quarterly	
Annual compliance cost per site	\$4,237	\$5,500	BLM RIA (Jan 2016) Table 2b: Estimated Annual Costs if EPA Finalizes Subpart OOOOa, 2017 – 2026, Pg 5.
Average well density	2	wells/site	*Proposed rule is assumed to cost \$161 million and effect 38,000 wellsites (\$4,237/wellsite) w/ Semi-annual LDAR*
			Cost of Semi-Annual LDAR is \$69 million and effects 38,000 wellsites (\$1,816/wellsite)
			Cost of Quarterly LDAR is \$117 million and effects 38,000 wellsites (\$3,079/wellsite)

[2] Companies identified by letter were included in the BLM small business analysis. Companies identified by number are additional O&G companies that meet the definition of a small business.

[3] Based on average annual count of new wells starting production for each company 2012-2015. LDAR applied to new wells starting in 2020. Based on avg revenue 2012-2015.

[4] Based on actual revenue in each year.

TABLE A-3: LDAR COMPLIANCE COSTS AS A PERCENTAGE OF SMALL COMPANY NET CASH

Company [2]	Employees	LDAR Annual Compliance Costs as a % of Net Cash Provided by Operating Activities [1]											
		New Sources Only [3]				All Wells [4]							
		2020		2025		2015		2014		2013		2012	
		Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly
1	500	0.03%	0.04%	0.16%	0.26%	NA	NA	0.26%	0.42%	0.29%	0.47%	0.37%	0.60%
A	488	0.01%	0.02%	0.08%	0.13%	0.01%	0.02%	0.06%	0.10%	0.08%	0.14%	0.10%	0.17%
2	484	0.01%	0.02%	0.06%	0.11%	0.59%	0.98%	0.49%	0.81%	0.60%	0.99%	0.63%	1.03%
3	470	0.01%	0.02%	0.07%	0.12%	0.53%	0.88%	0.53%	0.87%	0.38%	0.63%	NA	NA
4	459	0.01%	0.02%	0.08%	0.13%	0.13%	0.22%	0.29%	0.48%	0.34%	0.56%	NA	NA
5	381	0.04%	0.06%	0.23%	0.38%	1.08%	1.78%	1.18%	1.95%	1.51%	2.49%	1.92%	3.17%
G	379	0.01%	0.02%	0.06%	0.10%	NA	NA	2.06%	3.40%	1.76%	2.90%	2.81%	4.63%
6	362	0.05%	0.08%	0.29%	0.49%	0.51%	0.85%	0.81%	1.33%	1.15%	1.90%	NA	NA
R	323	0.01%	0.01%	0.04%	0.07%	0.03%	0.05%	0.02%	0.03%	0.01%	0.02%	NA	NA
7	315	0.04%	0.06%	0.23%	0.37%	3.20%	5.28%	1.66%	2.73%	1.68%	2.76%	NA	NA
B	310	0.01%	0.01%	0.03%	0.05%	0.03%	0.06%	0.04%	0.07%	0.02%	0.04%	0.02%	0.03%
E	293	0.03%	0.05%	0.18%	0.30%	NA	NA					0.25%	0.41%
M	282	0.07%	0.11%	0.40%	0.67%	0.76%	1.25%	0.18%	0.30%	0.15%	0.25%	NA	NA
8	264	0.00%	0.00%	0.00%	0.00%	0.11%	0.18%	0.02%	0.04%	0.03%	0.04%	0.03%	0.05%
9	230	0.02%	0.04%	0.13%	0.22%	0.09%	0.15%	0.06%	0.10%	0.08%	0.14%	NA	NA
J	215	0.02%	0.04%	0.14%	0.22%	0.11%	0.19%	0.08%	0.13%	0.08%	0.13%	NA	NA
10	210	0.13%	0.22%	0.81%	1.33%	0.05%	0.09%	12.01%	19.78%	7.83%	12.91%		
11	167	0.02%	0.03%	0.11%	0.19%	0.34%	0.57%	0.23%	0.38%	0.32%	0.52%	0.21%	0.35%
12	151	0.01%	0.01%	0.05%	0.08%	0.17%	0.27%	0.12%	0.20%	0.14%	0.23%	0.19%	0.31%
13	146	0.03%	0.05%	0.17%	0.27%	1.01%	1.66%	0.62%	1.02%	0.54%	0.89%	0.29%	0.48%
K	139	0.01%	0.02%	0.08%	0.13%	0.11%	0.17%	0.07%	0.12%	0.06%	0.09%	0.03%	0.04%
14	125	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%
15	106	0.03%	0.05%	0.20%	0.33%	0.27%	0.45%	0.08%	0.14%	0.07%	0.11%		
L	99	0.02%	0.03%	0.11%	0.18%	3.83%	6.30%	0.28%	0.46%	0.46%	0.76%	0.45%	0.74%
16	87	0.03%	0.05%	0.19%	0.31%	NA	NA	0.19%	0.31%	0.18%	0.29%	0.17%	0.28%
17	50	0.03%	0.05%	0.17%	0.27%			0.14%	0.23%	0.58%	0.95%	NA	NA
18	42	0.10%	0.17%	0.63%	1.04%	NA	NA	0.12%	0.21%	0.68%	1.12%		
V	37	0.09%	0.15%	0.53%	0.87%	0.34%	0.57%	0.51%	0.84%	1.12%	1.85%	1.39%	2.30%
N	27	0.00%	0.00%	0.01%	0.02%	NA	NA	0.09%	0.14%	0.06%	0.09%	0.03%	0.06%
A1	73	0.00%	0.00%	0.01%	0.01%	0.06%	0.09%	0.01%	0.01%	0.01%	0.02%	NA	NA
A2	141	0.01%	0.01%	0.05%	0.08%	0.05%	0.09%	0.06%	0.10%	0.13%	0.21%	0.37%	0.61%
A3	10	0.01%	0.01%	0.04%	0.06%	0.04%	0.06%	0.06%	0.09%	0.06%	0.10%	NA	NA
A4	7	0.00%	0.00%	0.00%	0.00%	1.39%	2.29%	0.74%	1.21%	NA	NA	NA	NA
A5	212	0.04%	0.07%	0.26%	0.43%	0.18%	0.29%	0.15%	0.25%	0.41%	0.67%	3.44%	5.67%
A6	226	0.01%	0.02%	0.06%	0.10%	0.59%	0.97%	0.29%	0.48%	0.32%	0.52%	NA	NA
A7	274	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
A8	371	0.02%	0.03%	0.12%	0.20%	0.03%	0.05%	0.07%	0.12%	0.09%	0.16%	NA	NA
A9	51	0.02%	0.03%	0.12%	0.20%			0.06%	0.10%	0.08%	0.13%	NA	NA
A10	152	0.06%	0.09%	0.33%	0.55%	NA	NA	2.32%	3.82%	2.37%	3.91%	2.01%	3.32%
A11	440	0.01%	0.02%	0.08%	0.13%	NA	NA			0.79%	1.31%	0.11%	0.18%
A12	0	0.00%	0.00%	0.02%	0.03%	0.04%	0.07%	0.03%	0.05%	0.07%	0.12%	0.54%	0.89%
A13	4							23.66%	38.99%	NA	NA	NA	NA
A14	112	0.00%	0.00%	0.00%	0.00%	0.02%	0.03%	0.01%	0.02%	0.01%	0.02%	NA	NA
A15	116	0.05%	0.09%	0.32%	0.52%	0.83%	1.36%	0.20%	0.33%	0.30%	0.49%	0.46%	0.76%
A16	30	0.03%	0.04%	0.16%	0.27%			0.20%	0.33%	0.34%	0.57%	NA	NA
A17	102	0.01%	0.01%	0.04%	0.06%	0.54%	0.89%	0.32%	0.53%	0.51%	0.83%	0.79%	1.30%
A18	93	0.01%	0.02%	0.06%	0.10%	0.06%	0.09%	0.05%	0.09%	0.09%	0.16%	0.08%	0.14%
A19	125	0.01%	0.02%	0.06%	0.10%	2.58%	4.25%	0.20%	0.33%	0.30%	0.50%	NA	NA
A20	55	0.03%	0.05%	0.18%	0.29%	NA	NA	5.02%	8.28%	4.49%	7.40%		
A21	51	0.07%	0.12%	0.43%	0.71%	0.23%	0.38%	0.30%	0.50%	0.34%	0.57%	NA	NA
A22	340	0.02%	0.03%	0.10%	0.17%	0.10%	0.16%	0.05%	0.09%	0.06%	0.10%	NA	NA
WEIGHTED AVERAGE		**0.02%**	**0.03%**	**0.12%**	**0.20%**	**0.45%**	**0.74%**	**0.37%**	**0.61%**	**0.42%**	**0.70%**	**0.81%**	**1.33%**

If cell is blank, Net Cash Provided by Operating Activities was negative

[1] Compliance Cost data:

	Semi-Annual	Quarterly	
Annual LDAR compliance cost	$1,868	$3,079	per site. Per BLM RIA (Jan 2016) Table 33 *Summary of Annual Impacts for LDAR Options and Alternative* , Pg 113.
Average well density	2	wells/site	*Semi-Annual is assumed to cost $71 million and effect 38,000 wellsites. Quarterly is assumed to cost $117 million and effect 38,000 wellsites.*

[2] Companies identified by letter were included in the BLM small business analysis. Companies identified by number are additional O&G companies with BLM leases that meet the definition of a small business. Companies identified with a letter and number are O&G companies that meet the definition of a small business that may or may not have BLM leases.

[3] Based on average annual count of new wells starting production for each company 2012 - 2015. LDAR applied to new wells starting in 2020. Based on average Net Cash Provided by Operating Activities, for 2012-2015.

[4] Based on actual Net Cash Provided by Operating Activities in each year.

TABLE A-4: LDAR COMPLIANCE COSTS AS A PERCENTAGE OF SMALL COMPANY REVENUE

Company [2]	Employees	LDAR Annual Compliance Costs as a % of Company Revenue [1]											
		New Sources Only [3]				All Wells [4]							
		2020		2025		2015		2014		2013		2012	
		Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly	Semi-annual	Quarterly
1	500	0.008%	0.013%	0.049%	0.081%	NA	NA	0.12%	0.20%	0.12%	0.20%	0.13%	0.21%
A	488	0.004%	0.007%	0.026%	0.043%	0.00%	0.00%	0.02%	0.04%	0.03%	0.06%	0.05%	0.08%
2	484	0.006%	0.009%	0.034%	0.056%	0.36%	0.59%	0.22%	0.36%	0.31%	0.51%	0.38%	0.63%
3	470	0.006%	0.009%	0.034%	0.056%	0.43%	0.72%	0.22%	0.37%	0.29%	0.48%	0.29%	0.48%
4	459	0.007%	0.011%	0.041%	0.067%	0.07%	0.12%	0.17%	0.28%	0.20%	0.33%	0.79%	1.30%
5	381	0.021%	0.034%	0.125%	0.205%	0.71%	1.16%	0.51%	0.84%	0.87%	1.43%	1.13%	1.86%
G	379	0.003%	0.006%	0.020%	0.034%	1.26%	2.08%	0.80%	1.32%	0.88%	1.44%	1.21%	2.00%
6	362	0.016%	0.027%	0.097%	0.159%	0.35%	0.58%	0.22%	0.37%	0.47%	0.77%	NA	NA
R	323	0.004%	0.006%	0.023%	0.038%	0.03%	0.04%	0.01%	0.02%	0.01%	0.01%	0.01%	0.02%
7	315	0.015%	0.024%	0.088%	0.146%	1.31%	2.16%	0.91%	1.50%	0.93%	1.53%	NA	NA
B	310	0.003%	0.005%	0.017%	0.029%	0.02%	0.03%	0.02%	0.04%	0.01%	0.02%	0.01%	0.02%
E	293	0.003%	0.005%	0.017%	0.028%	NA	NA	0.10%	0.17%	0.10%	0.17%	0.08%	0.13%
M	282	0.033%	0.054%	0.196%	0.323%	0.25%	0.40%	0.11%	0.18%	0.11%	0.18%	0.16%	0.26%
8	264	0.000%	0.000%	0.000%	0.001%	0.02%	0.04%	0.01%	0.02%	0.01%	0.02%	0.01%	0.02%
9	230	0.009%	0.015%	0.056%	0.092%	0.04%	0.07%	0.04%	0.06%	0.06%	0.10%	NA	NA
J	215	0.014%	0.023%	0.083%	0.138%	0.10%	0.16%	0.06%	0.09%	0.06%	0.09%	0.05%	0.08%
10	210	0.032%	0.053%	0.194%	0.320%	0.02%	0.03%	0.74%	1.22%	7.53%	12.41%	NA	NA
11	167	0.012%	0.019%	0.071%	0.117%	0.21%	0.35%	0.13%	0.22%	0.16%	0.27%	0.17%	0.29%
12	151	0.005%	0.009%	0.032%	0.052%	0.11%	0.18%	0.07%	0.12%	0.10%	0.16%	0.14%	0.23%
13	146	0.017%	0.028%	0.100%	0.165%	0.40%	0.66%	0.28%	0.46%	0.33%	0.55%	NA	NA
K	139	0.008%	0.012%	0.045%	0.075%	0.10%	0.16%	0.04%	0.07%	0.03%	0.04%	0.01%	0.02%
14	125	0.000%	0.000%	0.001%	0.002%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	106	0.006%	0.011%	0.039%	0.064%	0.04%	0.06%	0.03%	0.05%	0.02%	0.03%	0.02%	0.03%
L	99	0.010%	0.017%	0.061%	0.100%	0.40%	0.66%	0.20%	0.32%	0.26%	0.43%	0.35%	0.58%
16	87	0.014%	0.022%	0.082%	0.135%	NA	NA	0.11%	0.17%	0.11%	0.18%	0.09%	0.15%
17	50	0.015%	0.025%	0.090%	0.148%	0.26%	0.42%	0.22%	0.36%	0.29%	0.49%	0.32%	0.53%
18	42	0.024%	0.040%	0.145%	0.238%	NA	NA	0.06%	0.10%	0.08%	0.13%	0.09%	0.14%
V	37	0.075%	0.123%	0.448%	0.738%	0.34%	0.57%	0.37%	0.60%	0.78%	1.28%	1.19%	1.95%
N	27	0.001%	0.001%	0.004%	0.006%	NA	NA	0.02%	0.03%	0.02%	0.03%	0.02%	0.03%
A1	73	0.001%	0.001%	0.003%	0.005%	0.01%	0.02%	0.00%	0.01%	0.01%	0.01%	NA	NA
A2	141	0.007%	0.011%	0.040%	0.066%	0.05%	0.08%	0.04%	0.07%	0.10%	0.16%	0.24%	0.40%
A3	10	0.002%	0.004%	0.013%	0.022%	0.01%	0.02%	0.03%	0.04%	0.04%	0.06%	0.05%	0.09%
A4	7	0.000%	0.000%	0.000%	0.000%	0.69%	1.13%	0.52%	0.86%	0.35%	0.58%	NA	NA
A5	212	0.025%	0.041%	0.150%	0.248%	0.11%	0.19%	0.09%	0.15%	0.18%	0.30%	0.46%	0.76%
A6	226	0.003%	0.005%	0.019%	0.031%	0.26%	0.43%	0.13%	0.21%	0.12%	0.20%	NA	NA
A7	274	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
A8	371	0.008%	0.014%	0.050%	0.082%	0.02%	0.04%	0.02%	0.03%	0.04%	0.06%	NA	NA
A9	51	0.005%	0.009%	0.032%	0.052%	0.10%	0.16%	0.03%	0.06%	0.03%	0.05%	0.03%	0.05%
A10	152	0.021%	0.034%	0.124%	0.204%	NA	NA	0.84%	1.38%	1.35%	2.23%	1.29%	2.12%
A11	440	0.002%	0.003%	0.011%	0.018%	NA	NA	0.01%	0.02%	0.29%	0.48%	0.04%	0.06%
A12	0	0.002%	0.003%	0.011%	0.018%	0.02%	0.04%	0.02%	0.03%	0.04%	0.07%	0.37%	0.60%
A14	112	0.000%	0.000%	0.000%	0.000%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	NA	NA
A15	116	0.030%	0.050%	0.181%	0.299%	0.29%	0.48%	0.14%	0.23%	0.17%	0.28%	0.26%	0.43%
A16	30	0.008%	0.014%	0.049%	0.081%	0.20%	0.33%	0.12%	0.19%	0.18%	0.30%	NA	NA
A17	102	0.004%	0.007%	0.024%	0.040%	0.42%	0.70%	0.21%	0.35%	0.31%	0.51%	0.44%	0.72%
A18	93	0.006%	0.010%	0.036%	0.059%	0.04%	0.06%	0.03%	0.05%	0.05%	0.08%	0.04%	0.06%
A19	125	0.004%	0.007%	0.025%	0.042%	0.31%	0.51%	0.14%	0.24%	0.19%	0.31%	0.20%	0.32%
A20	55	0.001%	0.001%	0.004%	0.006%	NA	NA	0.28%	0.46%	0.30%	0.49%	0.29%	0.48%
A21	51	0.024%	0.039%	0.143%	0.236%	0.11%	0.18%	0.11%	0.19%	0.19%	0.31%	NA	NA
A22	340	0.007%	0.012%	0.043%	0.071%	0.05%	0.08%	0.03%	0.06%	0.03%	0.05%	NA	NA
WEIGHTED AVERAGE		**0.009%**	**0.015%**	**0.053%**	**0.088%**	**0.16%**	**0.27%**	**0.13%**	**0.22%**	**0.17%**	**0.28%**	**0.28%**	**0.47%**

Notes:

[1] Compliance Cost data:

	Semi-Annual	Quarterly	
Annual LDAR compliance cost	$1,868	$3,079	per site. Per BLM RIA (Jan 2016) Table 33 *Summary of Annual Impacts for LDAR Options and Alternative*, Pg 113.
Average well density	2	wells/site	*Semi-Annual is assumed to cost $71 million and effect 38,000 wellsites. Quarterly is assumed to cost $117 million and effect 38,000 wellsites.*

[2] Companies identified by letter were included in the BLM small business analysis. Companies identified by number are additional O&G companies that meet the definition of a small business. Companies identified with a letter and number are O&G companies that meet the definition of a small business that may or may not have BLM leases.

[3] Based on average annual count of new wells starting production for each company 2012-2015. LDAR applied to new wells starting in 2020. Based on average revenue 2012-2015

[4] Based on actual revenue in each year.