PIPELINE & HAZARDOUS MATERIALS SAFETY ADMINISTRATION,
U.S. DEPARTMENT OF TRANSPORTATION

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Notice of Proposed Rulemaking:	)	**Docket No. PHMSA–2021–0039**
Pipeline Safety: Gas Pipeline Leak	)	
Detection and Repair	)	*Via regulations.gov*
	)	*August 16, 2023*
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	)	

COMMENTS OF ENVIRONMENTAL DEFENSE FUND, NATURAL RESOURCES DEFENSE COUNCIL, SIERRA CLUB, EARTHJUSTICE

We submit these comments on behalf of Environmental Defense Fund ("EDF"), Natural Resources Defense Council ("NRDC"), Sierra Club, and Earthjustice (together, "Joint Environmental Commenters"). The Joint Environmental Commenters' comments are informed by the urgent need to reduce emissions of methane and other harmful pollutants from U.S. gas pipeline infrastructure, while continuing to improve the safety of pipelines. Based on the scientific imperative to rapidly mitigate the climate crisis, the Joint Environmental Commenters strongly support PHMSA's proposed regulations for gas pipeline management and leak detection and repair, and we urge PHMSA to strengthen key provisions.

ATTACHMENTS

Attachment A. Fugitive Emissions Abatement Simulation Testbed (FEAST) Model, Pipeline Modeling Results (Aug. 2023)

Attachment B. Renee McVay, Methane Emissions from U.S. Gas Pipeline Leaks, Env't Def. Fund (Aug. 2023)

Attachment C. Kate Roberts, Analysis: Natural Gas Gathering and Hydrogen Pipeline Reported Data (Aug. 2023)

Attachment D. Comparison of Current and Proposed PHMSA Leak Survey Standards

Attachment E. Highwood Emissions Management, *Technical Report: Leak detection methods for natural gas gathering, transmission, and distribution pipelines* (2022)

I. Introduction

The climate crisis is an urgent and pressing threat to humanity's physical, social, and economic well-being, and methane emissions from pipelines are a significant contributor to near-term warming that must be rapidly abated using all available tools. Natural gas pipeline infrastructure connects across the United States, with about 3 million miles of pipelines transporting gas through our neighborhoods, cities, and rural communities. It is essential that gas pipelines be effectively operated and managed to ensure safety and environmental protection, and PHMSA's Proposed Rule will significantly raise the bar nationwide regarding pipeline leak management. As a bipartisan Congress noted in enacting the PIPES Act of 2020, advanced leak detection technologies and analytics are widely commercially available and proven to be effective in finding more pipeline leaks. PHMSA must act rapidly, consistent with recent Congressional direction and the agency's core statutory authority, to finalize rigorous and comprehensive standards for the use of advanced leak detection technologies to find and fix more leaks. This comment presents analysis to support the Proposed Rule, and recommendations to strengthen key provisions and ensure that PHMSA's objective of safer communities and greater environmental protection is achieved. In addition to addressing pipeline leak survey and repair standards and mitigation of operational gas releases from pipelines, this comment presents key recommendations regarding the importance of expanding oversight of natural gas gathering pipelines, underground natural gas storage facilities, and hydrogen pipelines. The Joint Environmental Commenters call on PHMSA to adopt protective and enforceable standards for gas pipeline and infrastructure oversight.

II. Background – Climate

A. Climate change is an existential threat to humanity

1. *Scientific Evidence Overwhelmingly Demonstrates that Climate Change is Already Causing Immediate, Devastating Impacts on Communities and These Harms Will Worsen Dramatically as Greenhouse Gas Pollution Continues to Rise*

The urgency of the climate crisis, and the impact of human activities on global warming, is clear. As the Intergovernmental Panel on Climate Change ("IPCC") stated in its most recent report, "Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming….Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years (*high confidence*)."[1] Climate impacts are already being felt across the U.S. and the globe, and while "[m]any changes due to past and future greenhouse gas emissions are irreversible for centuries to millennia,"[2] extreme weather events are projected to be "larger in frequency and intensity with every additional increment of

[1] AR6 Synthesis Report: Climate Change 2023, Summary for Policymakers (2023), at A.1-A.1.1 [hereinafter AR6 SYR 2023].
[2] Climate Change 2021: The Physical Science Basis, Summary for Policymakers (2021), at B.5 [hereinafter AR6 2021].

global warming."[3] As the U.S. Global Change Research Program ("USGCRP")—a federal program in which the EPA participates along with NASA, NOAA, the National Science Foundation, and others—has concluded "evidence of human-caused climate change is overwhelming and continues to strengthen," "the impacts of climate change are intensifying across the country," and "climate-related threats to Americans' physical, social, and economic well-being are rising."[4] In its Fourth National Assessment, the USGCRP found that "there is no convincing alternative explanation" for the observed warming of the climate over the last century other than human activities.[5]

The following section discusses the established and mounting scientific evidence demonstrating that climate harms are tangible, current, and will increase unless GHG emissions, including methane, are curbed dramatically. To put their findings in context, scientific reports often express the extent of scientific understanding of key findings by means of clearly defined metrics expressing the degree of confidence in those findings.[6] Where the following discussion uses these metrics, it presents them in italics.

2. *Greenhouse gas emissions are making the Earth's climate hotter and more extreme.*

According to the 2020 Annual National Climate Report from the National Oceanic and Atmospheric Association ("NOAA"), 2020 was the fifth-warmest year on record, with an average annual temperature about 2.4 degrees Fahrenheit hotter than the twentieth century average.[7] The 2020 data confirms a warming trend that has accelerated in recent years and decades. In fact, over the last 126 years, the five warmest years in the contiguous U.S. have all occurred since 2012.[8] Moreover, "[e]ach of the last four decades has been successively warmer

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[3] *Id.* at 18.

[4] Alexa Jay et al., *Fourth National Climate Assessment Vol. II, Impact, Risks, and Adaptation in the United States, Chapter 1: Overview*, U.S. GLOBAL CHANGE RESEARCH PROGRAM, at 36 (Reidmiller et al. eds.) (2018) [hereinafter USGCRP 2018].

[5] Donald Wuebbles et al., *Fourth National Climate Assessment Vol. I, Climate Science Special Report,* at 10 U.S. GLOBAL CHANGE RESEARCH PROGRAM, (Dokken et al. eds.) (2017), https://science2017.globalchange.gov/downloads/CSSR2017_FullReport.pdf at 10 [hereinafter USGCRP 2017].

[6] The USGCRP communicates the extent of scientific understanding of its key findings with two metrics: "confidence", and "likelihood." Confidence is defined as "the validity of a finding based on the type, amount, quality, strength, and consistency of evidence (such as mechanistic understanding, theory, data, models, and expert judgment); the skill, range, and consistency of model projections; and the degree of agreement within the body of literature." The scale is very high confidence (strong evidence and high consensus), high confidence (moderate evidence and medium consensus), medium confidence (suggestive evidence and competing schools of thought), and low confidence (inconclusive evidence and disagreement or lack of expert opinion). Likelihood is defined as the "probability of an effect or impact occurring," and is "based on measures of uncertainty expressed probabilistically … e.g., resulting from evaluating statistical analyses of observations or model results or on expert judgment." The scale is virtually certain (99 to 100 percent likelihood), extremely likely (95 to 100 percent likelihood), very likely (90 to 100 percent likelihood), likely (66 to 100 percent likelihood), about as likely as not (33 to 66 percent likelihood), unlikely (0 to 33 percent likelihood), very unlikely (0 to 10 percent likelihood), extremely unlikely (0 to 5 percent likelihood), and exceptionally unlikely (0 to 1 percent likelihood). USGCRP 2017 at 6, 7.

[7] NAT'L OCEANIC ATMOSPHERIC ASS'N, NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, NATIONAL CLIMATE REPORT, 2020 ANNUAL, *Temperature and Precipitation Analysis* (2020), https://www.ncdc.noaa.gov/sotc/national/202013.

[8] *Id.*

than any decade that preceded it since 1850."[9] The IPCC also reported with *high confidence* that "[g]lobal surface temperature has increase faster since 1970 than in any other 50-year period over at least the last 2000 years."[10]

The U.S. is expected with *high confidence* to warm by an additional 2.5°F, on average, over the next few decades.[11] Daily highs are likewise projected with *very high confidence* to increase.[12] Under business as usual, the hottest days of the year could be at least 5°F (2.8°C) warmer in most areas by mid-century and 10°F (5.5°C) by late this century.[13] The urban heat island effect—which is expected with *high confidence* to strengthen as urban areas expand and become denser—will amplify climate-related warming even beyond those dangerous increases.[14] Not only is the climate warming overall, extreme weather events are becoming more intense, dangerous, and frequent. The 2020 U.S. Climate Extremes Index[15] was the seventh highest on record in over 110 years, with an index 80 percent above average.[16] As an IPCC 2021 report explained:

> Many change in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, heavy precipitation, and, in some regions, agricultural and ecological droughts; an increase in the proportion of intense tropical cyclones; and reductions in Arctic sea ice, snow cover and permafrost.[17]

Human activities have contributed to the upward trend in North Atlantic hurricane activity since the 1970s (*medium confidence*).[18] In a 2020 study, researchers from NOAA and the University of Wisconsin Madison estimated that hurricanes and tropical cyclones have become about 5 percent more likely to reach "major" hurricane status in each successive decade since 1979.[19] The 2020 hurricane season, for example, broke or tied several records. With 13 hurricanes and six major hurricanes, 2020 had the second most hurricanes and major hurricanes on record, behind 2005,[20] the year that Hurricane Katrina devasted New Orleans. The year 2020 also tied for the largest number of Category 4 and 5 hurricanes in the Atlantic.[21] Climate change is projected to continue to increase hurricane intensity, making hurricanes more destructive by fueling higher wind

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[9] AR6 2021, at 5, A.1.2.
[10] *Id.* at 8, A.2.2.
[11] USGCRP 2017, at 11.
[12] *Id.* at 185.
[13] *Id.* at 197.
[14] *Id.* at 17; AR6 2021, at 25, C.2.6. In addition, expanding urban areas and populations will also increase precipitation in and near cities (*medium confidence*). AR6 2021, at 25, C.2.6.
[15] "The USCEI is an index that tracks extremes (falling in the upper or lower 10 percent of the record) in temperature, precipitation, drought and landfalling tropical cyclones across the contiguous U.S." NAT'L OCEANIC ATMOSPHERIC ASS'N, NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, NATIONAL CLIMATE REPORT, 2020 ANNUAL, *Other Notable Extremes* (2020), https://www.ncdc.noaa.gov/sotc/national/202013.
[16] *Id.*
[17] AR6 2021, at 15, B.2.
[18] USGCRP 2017, at 257.
[19] James P. Kossin et al., *Global increase in major tropical cyclone exceedance probability over the past four decades*, 117 PROCEEDINGS NAT'L ACAD. SCI. 11975 (June 2, 2020), https://www.pnas.org/content/117/22/11975.
[20] NAT'L OCEANIC ATMOSPHERIC ASS'N, NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, NATIONAL CLIMATE REPORT, 2020 ANNUAL, *Other Notable Extremes* (2020), https://www.ncdc.noaa.gov/sotc/national/202013.
[21] *Id.*

speeds and more rainfall.[22] A 2016 study suggests the average intensity of Atlantic hurricanes will increase 1.8 to 4.2 percent by the 2080s, compared to a 1981 to 2000 baseline.[23]

Adding to increase in hurricane intensity, there is *very high confidence* that sea level rise will make coastal floods more frequent and severe during storms.[24] For example, the rise in sea levels also increased the height of flooding, during Hurricane Sandy from 7.5 to 9.2 feet (2.3 to 2.8 meters).[25] Combined with sea level rise, more intense hurricanes could result in a median increase in storm surge from 25 to 47 percent along the U.S. Gulf and Florida coasts.[26]

In a 2021 report, the IPCC found with *high confidence* that global sea level rise occurred in 2016 at the fastest rate "since 1900 than over any preceding century in at least the last 3000 years."[27] Global average sea level rose by seven to eight inches between 1900 and 2017, and the rate of sea level rise is accelerating.[28] Global sea level is likely to rise by 1.0 and 4.3 feet by the end of the century relative to the year 2000, with sea level rise of 8.2 feet possible.[29] Sea level rise is already making flooding more likely. For instance, since the 1960s, sea level rise has contributed to a 5- to 10-fold increase in minor tidal floods along the U.S. coast (*very high confidence*), which are expected to become more frequent, deeper, and wider in extent as sea level continue to rise (*very high confidence*).[30] The IPCC forecasts with *high confidence* that flooding will become more likely in coastal cities due to "the combination of more frequent extreme sea level events (due to sea level rise and storm surge).[31]

Heavy precipitation has likewise become more frequent and intense in most regions of the U.S. since 1901 (*high confidence*),[32] even as average annual precipitation has decreased in some regions (*medium confidence*).[33] This finding is consistent with the scientific understanding that more water vapor is available to fuel extreme rain and snowstorms as the world warms (*medium*

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[22] USGCRP 2017, at 257.
[23] Karthik Balaguru et al., *Future hurricane storm surge risk for the U.S. gulf and Florida coasts based on projections of thermodynamic potential intensity*, 138 CLIMATIC CHANGE 99, 108 (2016), https://link.springer.com/article/10.1007/s10584-016-1728-8.
[24] USGCRP 2017, at 27.
[25] Ning Lin et al., *Hurricane Sandy's flood frequency increasing from year 1800 to 2100*, 113 PROCEEDINGS NAT'L ACAD. SCI. 12071 (2016), www.pnas.org/content/113/43/12071.
[26] Karthik Balaguru et al., *Future hurricane storm surge risk for the U.S. gulf and Florida coasts based on projections of thermodynamic potential intensity*, 138 CLIMATIC CHANGE 99, 108 (2016), https://link.springer.com/article/10.1007/s10584-016-1728-8.
[27] AR6 2021, at 8, A.2.4.
[28] USGCRP 2017, at 339.
[29] *Id.* at 25-26, 333, 343.
[30] *Id.* at 333.
[31] AR6 2021, at 25, C.2.6.
[32] *Id.* at 20.
[33] *Id.* at 207.

confidence).[34] Recent studies of Hurricane Harvey[35] and the 2016 flood in south Louisiana[36] concluded that climate warming made the record rainfall totals of both disasters more likely and intense. According to a 2020 study, the best estimate of the direct economic costs of Hurricane Harvey that are attributable to human-caused climate change is $67 billion.[37] Importantly, this estimate excludes other damages that are less easily measured, including mortality, morbidity, and temporary or permanent dislocations resulting from Hurricane Harvey.

Just like other climate change impacts, precipitation, both very wet and very dry, events will also get more extreme with additional warming (*high confidence*).[38] Under continued high GHG emissions, most U.S. regions are projected to experience two to three times more extreme precipitation events by the end of the century than they do now.[39] Rainfall during hurricanes making landfall in the eastern U.S. could also increase by 8 to 17 percent over the next century, compared to 1980-to-2006 levels.[40] Even under deep emission reductions scenarios that keep global warming to within 1.5°C, AR6 finds that "heavy precipitation and associated flooding are projected to intensify and be more frequent in most regions in Africa and Asia (*high confidence*), North America (*medium to high confidence*) and Europe (*medium confidence*)."[41] With 2°C or more of global warming, changes in droughts and heavy and mean precipitation will be even more dramatic.[42]

In the continental western U.S., human-caused climate change accounted for more than half of observed increases in forest fuel aridity from 1979 to 2015.[43] Drying of forest fuels has help increase the number of large fires (*high confidence*) and has contributed to a doubling in fire area since the early 1980s.[44] The risk of severe wildfire in Alaska has likely increased by 33 to 50 percent because of climate change.[45] One model suggests that anthropogenic climate change may have quintupled the risk of extreme vapor pressure deficit (a measure of atmospheric moisture)

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[34] *Id.* at 214.
[35] David J. Frame, *The economic costs of Hurricane Harvey attributable to climate change*, 160 CLIMATIC CHANGE 271 (2020), https://doi.org/10.1007/s10584-020-02692-8; Kerry Emanuel, *Assessing the present and future probability of Hurricane Harvey's rainfall*, 114 PROCEEDINGS NAT'L ACAD. SCI. 12681 (2017), https://doi.org/10.1073/pnas.1716222114; Mark D. Risser & Michael F. Wehner, *Attributable Human-induced Changes in the Likelihood and Magnitude of the Observed Extreme Precipitation During Hurricane Harvey*, 44 GEOPHYS. RSCH. LETTERS 12457 (2017), https://doi.org/10.1002/2017gl075888; Geert Jan van Oldenborgh, et al., *Attribution of Extreme Rainfall from Hurricane Harvey*, 13 ENV'T RSCH. LETTERS 124009 (2017), https://iopscience.iop.org/article/10.1088/1748-9326/aa9ef2.
[36] Karin van der Wiel et al., *Rapid attribution of the August 2016 flood-inducing extreme precipitation in south Louisiana to climate change*, 21 HYDROLOGY & EARTH SYSTEM SCIS. 897 (2017), https://doi.org/10.5194/hess-21-897-2017.
[37] David J. Frame, *The economic costs of Hurricane Harvey attributable to climate change*, 160 CLIMATIC CHANGE 271 (2020).
[38] AR6 2021, at 19, B.3.2.
[39] USGCRP 2017, at 218.
[40] Daniel B. Wright et al., *Regional climate model projections of rainfall from U.S. landfalling tropical cyclones*, 45 CLIMATE DYNAMICS 3365 (2015), https://link.springer.com/article/10.1007%2Fs00382-015-2544-y.
[41] AR6 2021, at 24, C.2.2.
[42] *Id.* at 24, C.2.3.
[43] *Id.* at 243.
[44] *Id.*
[45] *Id.* at 244.

in the western U.S. and Canada in 2016, increasing the risk of wildfire.[46] While the eastern U.S. experienced above-average annual precipitation in 2020—with the second- and third-wettest years on record in North Carolina and Virginia, respectively—the western U.S. suffered from below-average precipitation.[47] For example, in two western states, Nevada and Utah, 2020 was the driest year on record, and two other western states experienced their second-driest year in 2020.[48] The dryness in the west has contributed to 2020 being "the most active wildfire year on record (1983 to present) across the West," with nearly 10.3 million acres consumed.[49] California experienced its largest wildfire season on record, with approximately 4% of the state's land consumed by fire.[50] A 2021 study that examined wildfire risk in the Sierra Nevada found that, relative to a 2011-2020 baseline, the number of fires will increase by more than 20% and burned area will increase by at least 25% through the 2040s.[51] In 2020, Colorado experienced the three largest wildfires in its history.[52]

Higher warming also increases the probability and frequency of compound events, such as concurrent heatwaves and droughts, in many regions.[53] For example, the Fourth National Climate Assessment concluded with *very high confidence* that large-scale shifts in the climate system, also known as tipping points, and the compound effects of simultaneous extreme climate events have the potential to create unanticipated, and potentially abrupt and irreversible, "surprises" that become more likely as warming increases.[54] Moreover, the IPCC concludes that "[i]f global warming increases, some compound extreme events with low likelihood in past and current climate will become more frequent, and there will be a higher likelihood that events with increased intensities, durations and/or spatial extents unprecedented in the observational record will occur (*high confidence*)."[55] The crossing of tipping points could result in climate states wholly outside human experience and result in severe physical and socioeconomic impacts.[56]

The disastrous effects of compound extreme events are, in fact, already occurring. In 2021, the IPCC stated that anthropogenic emissions since the 1950s have *likely* "increased the chance of compound extreme events," including "increases in the frequency of concurrent heatwaves and droughts on the global scale (*high confidence*), fire weather in some regions of all inhabited continents (*medium confidence*), and compound flooding in some locations (*medium*

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[46] Simon Tett et al., *Anthropogenic forcings and associated changes in fires risk in Western North America and Australia during 2015-2016*, 99 BAMS S60 (2018), https://journals.ametsoc.org/view/journals/bams/99/1/bams-d-17-0096.1.xml.
[47] NAT'L OCEANIC ATMOSPHERIC ASS'N, NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, NATIONAL CLIMATE REPORT, 2020 ANNUAL, *Temperature and Precipitation Analysis* (2020), https://www.ncdc.noaa.gov/sotc/national/202013.
[48] *Id.*
[49] NAT'L OCEANIC ATMOSPHERIC ASS'N, NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, NATIONAL CLIMATE REPORT, 2020 ANNUAL, *Other Notable Extremes* (2020), https://www.ncdc.noaa.gov/sotc/national/202013.
[50] *Id.*
[51] Aurora Gutierrez et al., *Wildfire response to changing daily temperature extremes in California's Sierra Nevada*, 7 SCIENCE ADVANCES eabe6417 (2021), https://www.science.org/doi/epdf/10.1126/sciadv.abe6417.
[52] NAT'L OCEANIC ATMOSPHERIC ASS'N, NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, NATIONAL CLIMATE REPORT, 2020 ANNUAL, *Other Notable Extremes* (2020), https://www.ncdc.noaa.gov/sotc/national/202013.
[53] AR6 2021, at 25, C.2.7.
[54] USGCRP 2017, at 411-23.
[55] *Id.* at 26, C.3.3.
[56] USGCRP 2017, at 411.

confidence).”[57] In 2020 and 2021, for example, record heat waves across the West combined with extremely dry conditions to create two of the worst wildfire seasons on record.[58] NOAA estimates the cost of the California, Washington, and Oregon “firestorms” alone resulted in nearly 50 deaths and cost over $17 billion.[59] Similarly, sea level rise, abnormally high ocean temperatures, and high tides combined during Hurricane Sandy to intensify the storm and associated storm surge, and an atmospheric pressure field over Greenland steered the hurricane inland to an “exceptionally high-exposure location.”[60]

B. Recent Scientific Studies Confirm that Climate Change Harms are Escalating and that the U.S. Must Take Immediate Action to Rapidly Reduce Greenhouse Gas Pollution to Avoid Catastrophic Damages

Recent studies have reiterated the vast and escalating harms wrought by climate change and the disproportionate harms suffered by communities of color and low-income communities. This section summarizes key findings from several of the most prominent recent reports: the Fourth National Climate Assessment prepared by hundreds of scientific experts and reviewed by the National Academy of Sciences, NOAA, NASA and many other federal agencies; two IPCC reports, including the AR6 “The Physical Science Basis” released in August 2021 and the AR6 Synthesis Report, released March 2023; and the EPA’s September 2021 report “Climate Change and Social Vulnerability in The United States: A Focus on Six Impacts.”[61] While there are numerous other reports and studies from these and other institutions (many of which are referenced in these comments), we focus on these three here to emphasize that the longstanding scientific consensus regarding climate harms continues to strengthen, and that the severity of climate harms will only continue to increase without drastic steps to reduce GHG emissions.

First, the Fourth National Climate Assessment, which comprises two volumes from 2017-2018, makes clear that climate change harms will be long-lived, and the choices we make now to reduce greenhouse gas pollution will affect the severity of the climate change damages in the coming decades and centuries: “The impacts of global climate change are already being felt in the United States and are projected to intensify in the future—but the severity of future impacts will depend largely on actions taken to reduce greenhouse gas emissions and to adapt to the changes that will occur.”[62] While “[i]t is very likely that some impacts … will be irreversible for many thousands of years, and others … will be permanent,”[63] the report also explains that “[m]any climate change impacts and economic damages in the United States can be substantially reduced through global-scale reductions in greenhouse gas emissions.”[64] The report also

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[57] AR6 2021, at 9, A.3.5.
[58] NOAA, *Billion-Dollar Weather and Climate Disasters 1980-2023*, https://www.ncdc.noaa.gov/billions/events/US/1980-2021 (accessed Dec. 10, 2021) (“The combined drought and heat also assisted in drying out vegetation across the West that contributed to the Western wildfire potential and severity.”).
[59] *Id.*
[60] USGCRP 2017, at 416.
[61] U.S. EPA, *Climate Change and Social Vulnerability in the United States* (2021), https://www.epa.gov/system/files/documents/2021-09/climate-vulnerability_september-2021_508.pdf [hereinafter “EPA Climate & Social Vulnerability Report”].
[62] USGCRP 2018, at 34.
[63] *Id.* at 45.
[64] *Id.* at 60.

emphasizes that, "without substantial and sustained reductions in greenhouse gas emissions and regional adaptation efforts, there will be substantial and far-reaching changes over the course of the 21st century with negative consequences for a large majority of sectors," including the U.S. economy, human health, and the environment.[65] Specifically, "in the absence of increased adaptation efforts[,] [t]he potential for losses in some sectors could reach hundreds of billions of dollars per year by the end of this century."[66]

Despite pledges at global climate summits, the "Production Gap Report 2021" facilitated by the U.N. Environment Programme has found that "the world's governments still plan to produce more than double the amount of fossil fuels in 2030 than would be consistent with limiting global warming to 1.5°C."[67] Preventing the worst impacts of climate change "requires steep and sustained reductions in fossil fuel production and use" in addition to measures that reduce production-cycle emissions.[68] Reducing methane emissions from oil and gas production is an important component in the U.S. government's strategy to "tackle the climate crisis,"[69] but "minimizing methane emissions from fossil fuels extraction and distribution alone is not a substitute for a rapid wind-down in fossil fuel production itself."[70] Alongside reducing methane pollution, governmental actors must take separate steps to accelerate a rapid, just, and equitable transition to clean sources of energy, in line with the Paris Agreement's temperature limits.[71]

Second, even more recently, the IPCC's March 2023 AR6 Synthesis Report paints a staggering and terrifying picture of a climate-destabilized future absent urgent and aggressive carbon emission reductions. For instance, the report confirms that "[h]uman-induced climate change is already affecting many weather and climate extremes in every region across the globe," and evidence demonstrating the link between human GHG emissions and "changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones" has strengthened since the prior IPCC report, which was published in 2014.[72] Based on current evidence from a subsequent IPCC report, "[i]t is *virtually certain* that hot extremes (including heatwaves) have become more frequent and more intense across most land regions since the 1950s, while cold extremes (including cold waves) have become less frequent and less severe, with *high confidence* that human-induced climate change is the main driver of these changes."[73] Moreover, certain "hot extremes observed over the past decade would have been *extremely unlikely to occur* without human influence on the climate system."[74] In addition to exacerbating extreme weather, "[h]eating of the climate system has caused global means sea level rise through ice loss on land

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[65] *Id.* at 58.
[66] *Id.* at 46.
[67] SEI, IISD, ODI, E3G, & UNEP, *The Production Gap Report 2021*, at 3 (2021), http://productiongap.org/2021report.
[68] *Id.* at 4.
[69] Exec. Order No. 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, 86 Fed. Reg. 7037 (Jan. 25, 2021).
[70] SEI, IISD, ODI, E3G, & UNEP, *The Production Gap Report 2021*, at 5 (2021), http://productiongap.org/2021report.
[71] *Id.* at 6.
[72] AR6 SYR 2023, at A.2-A.2.1.
[73] AR6 2021, at 8, A.3.1.
[74] *Id.* at 8, A.3.1.

and thermal expansion from ocean warming." Increasing sea level rise is caused in part by the rate of ice-sheet loss globally, which quadrupled between the 1990s and 2010s.[75]

Looking to the future, AR6 SYR reports that, "global warming is *more likely than not* to reach 1.5°C even under the very low GHG emission scenario and *likely* or *very likely* to exceed 1.5°C under the high emissions scenarios[76] Cutting GHG emissions now is critical because "there is a near-linear relationship" between human-caused GHG emissions and related global warming, meaning that each additional increment of global warming exacerbates changes in extreme weather events. For example, the IPCC reported in 2021 that "every additional 0.5°C of global warming causes clearly discernible increases in the intensity and frequency of hot extremes, including heatwaves (*very likely*), and heavy precipitation (*high confidence*), as well as agricultural and ecological droughts in some regions (*high confidence*)."[77] Globally, the IPCC forecasts that each additional 1°C of global warming will cause about a 7% increase in the intensity of extreme daily precipitation events (*high confidence*).[78] Based on this demonstrated relationship, the IPCC concludes that "reaching net zero anthropogenic CO2 emissions is a requirement to stabilize human-induced global temperature increase at any level."[79] Every increment of warming has dire consequences on society, as the IPCC warns that "[w]ith further warning, every region is projected to increasingly experience concurrent and multiple changes in climatic impact-drivers", including "[c]ompound heatwaves and droughts" (*high confidence*), dangerous "sea level rise[s]" (*high confidence*), "intensification of tropical cyclones and/or extratropical storms (*medium confidence*)," and "increased in aridity and fire weather (*medium* to *high confidence*)."[80] In order to limit global warming to a specific temperature level, global, cumulative CO2 would need to be kept within a discrete carbon budget.[81]

Third, the EPA's September 2021 report, "Climate Change and Social Vulnerability in The United States: A Focus on Six Impacts," finds that communities of color and low-income communities in the U.S. are at increased risk of climate-driven harms compared to other communities.[82] For instance, "Black and African American individuals are 40-59% more likely than non-Black and non-African American individuals to currently live in . . . areas with the highest projected increases in temperature mortality from climate-driven changes in extreme temperatures."[83] The report also found that, with 2°C of warming, "Hispanic and Latino individuals are 43% more likely than non-Hispanic and non-Latino individuals to live" in areas that have "the highest projected labor hours losses due to climate-driven increases in high-temperature days."[84] Indigenous individuals are similarly 37% more likely to live in these high-labor-impact areas than non-Indigenous counterparts.[85] In addition, "[c]oastal road networks and the communities they support are increasingly at risk of impacts from sea level rise and

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[75] *Id.* at 11, A.4.3.
[76] AR6 SYR 2023, at B.1.1.
[77] AR6 2021, at 15, B.2.2.
[78] *Id.* at 16, B.2.4.
[79] *Id.* at 28, D.1.1.
[80] AR6 SYR 2023, at B.1.4.
[81] AR6 2021 at 28, D.1.1.
[82] EPA Climate & Social Vulnerability Report.
[83] *Id.* at 35.
[84] *Id.* at 40.
[85] *Id.* at 41.

intensifying coastal flood events," a risk which again disproportionately impacts communities of color and low-income communities. Communities of color are 41 percent more likely to live in areas projected to have the highest increase in traffic delays due to climate-driven changes in high-tide flooding with 50 cm of global sea level rise;[86] and Pacific Islanders are 112% percent more likely to live in areas likely to be excluded from protective adaptation measures that would reduce flooding-related delays.[87]

The takeaway from these most recent reports is clear: the scientific evidence consistently reaffirms that human-caused climate change is already and will continue causing vast and escalating harms—which disproportionately impact communities of color and low-income communities—absent urgent action to reduce GHG emissions.

C. Climate Change Threatens Human Health

Anthropogenic climate change is already affecting public health and will pose even more severe threats without action to greatly limit GHGs.[88] EPA has previously recognized that "climate change is expected to increase ozone pollution over broad areas of the U.S., especially on the highest ozone days and in the largest metropolitan areas with the worst ozone problems, and thereby increase the risk of morbidity and mortality."[89] It further summarized findings that "climate change, in addition to chronic stresses such as extreme poverty, is negatively affecting Indigenous peoples' health in the U.S. through impacts such as reduced access to traditional foods, decreased water quality, and increasing exposure to health and safety hazards."[90] The agency also explained that

> children's unique physiology and developing bodies contribute to making them particularly vulnerable to climate change. Impacts on children are expected from heat waves, air pollution, infectious and waterborne illnesses, and mental health effects resulting from extreme weather events.[91]

Heat is the most direct health threat from climate change,[92] causing increases in "extreme heat events [that] have resulted in human mortality and morbidity (*very high confidence*)," as well as food-, water-, and vector-born diseases (*very high* and *high confidence*), displacement (*high confidence*), mental health challenges (*high confidence*), and "loss of livelihood and culture (*high confidence*)."[93] Extreme temperatures are particularly harmful to older adults and young children, outdoor workers, low-income communities, communities of color, and people with chronic illnesses (*very high confidence*).[94] A 2017 review found evidence for 27 different ways in which extreme heat leads to deadly organ failure, including (but not limited to) such

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[86] *Id.* at 48.
[87] *Id.* at 50.
[88] AR6 SYR 2023, at A.2.2.
[89] Clean Power Plan, 80 Fed. Reg. at 64,682.
[90] *Id.* at 64,682.
[91] *Id.*
[92] John Balbus et al., *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*, U.S. GLOBAL RESEARCH PROGRAM, at 30 (2016).
[93] AR6 SYR 2023, at A.2.5.
[94] *Id.* at 44.

pathologies as ischemia (inadequate blood supply), heat cytotoxicity, and inflammatory response—conditions that can affect the brain, heart, intestines, kidneys, and liver.[95] It is very likely that the United States will see thousands to tens of thousands more premature heat-related deaths in the summer under business as usual. The increase in heat deaths will likely be larger than a concomitant decrease in cold-related deaths.[96] Climate-related disasters like inland flooding, wildfires, and hurricanes are also associated with myriad heath threats including injuries, skin infections, mental health conditions, and deaths (*high confidence*).[97]

The danger of extreme heat was horrifically clear during the unprecedented heat wave in the Pacific Northwest in June 2021, which resulted in hundreds of deaths.[98] Over a 5-day period, heat records were broken in seven different states,[99] including Oregon which suffered from 117-degree temperatures.[100] The Centers for Disease Control found that, during the height of the Pacific Northwest heat wave from June 25 to 30, 2021, the number of heat-related emergency room visits was 69 times higher than that during corresponding days in 2019.[101] A recent study concluded that this extreme heat event "was virtually impossible without human-caused climate change."[102] While this type of extreme heat event is currently considered a 1 in 1000 year event, if global warming reaches 2°C, the report concludes that this type of extreme event would occur roughly once every 5 to 10 years.[103]

By one estimate, nearly one-third of the world's population is currently exposed to a deadly combination of heat and humidity for at least 20 days a year; without deep cuts in global GHG emissions, that percentage is projected to rise to nearly three-quarters of the world's population by the end of the century.[104] By 2090, 49 U.S. cities will see an estimated 9,300 additional premature deaths due to heat.[105] Although air conditioning and other responses measure can help

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[95] Camilo Mora et al., *Twenty-Seven Ways a Heat Wave Can Kill You: Deadly Heat in the Era of Climate Change*, 10 CIRC. CARDIOVASC. QUAL. OUTCOMES e004233 (2017).
[96] USGCRP 2016, at 44.
[97] *Id.* at 100.
[98] Eleanor Aspegren, *Authorities investigate hundreds of deaths linked to torrid Pacific Northwest weathe*r, USA TODAY (June 30, 2021), https://www.usatoday.com/story/news/weather/2021/06/30/heat-wave-deaths-pacific-northwest-authorities/7819604002/; Nadja Popovich & Winston Choi-Schagrin, *Hidden Toll of the Northwest Heat Wave: Hundreds of Extra Deaths*, N.Y. TIMES (Aug. 11, 2021), https://www.nytimes.com/interactive/2021/08/11/climate/deaths-pacific-northwest-heat-wave.html.
[99] Tom Di Liberto, *Record-breaking June 2021 heatwave impacts the U.S. West*, CLIMATE.GOV (Jun. 23, 2021), https://www.climate.gov/news-features/event-tracker/record-breaking-june-2021-heatwave-impacts-us-west.
[100] Jaclyn Diaz, *The West Coast Heat Has Killed Dozens and Hospitalized More in Canada and the U.S.*, NAT'L PUB. RADIO (June 30, 2021), https://www.npr.org/2021/06/30/1011622492/the-west-coast-heat-has-killed-dozens-and-hospitalized-more-in-canada-and-the-u-#:~:text=Press-,The%20West%20Coast%20Heat%20Wave%20Kills%20Dozens%2C%20Hospitalizes%20More%20In,deaths%20from%20Friday%20to%20Monday.-
[101] Paul J. Schramm, *Heat-Related Emergency Department Visits During the Northwestern Heat Wave — United States, June 2021*, 70 MORBIDITY & MORTAL WKLY REP. 1020 (2021), https://www.cdc.gov/mmwr/volumes/70/wr/mm7029e1.htm#suggestedcitation.
[102] Sjoukje Y. Philip et al., *Rapid attribution analysis of the extraordinary heat wave on the Pacific Coast of the U.S. and Canada June 2021*, 13 EARTH SYST. DYNAM. 1689 (2022), https://doi.org/10.5194/esd-13-1689-2022.
[103] *Id.*
[104] Camilo Mora et al., *Global risk of deadly heat*, 7 NATURE CLIMATE CHANGE 501 (2017), www.nature.com/articles/nclimate3322.
[105] US EPA, *Multi-Model Framework for Quantitative Sectoral Impacts Analysis: A Technical Report for the Fourth National Climate Assessment*, at 48 (2017),

limit heat-related deaths and illnesses, future increases in heat could "recurrently 'imprison people' indoors and may turn infrastructure failures (e.g., power outages) into catastrophic events."[106] Florida got a taste of that future in 2017 after Hurricane Irma knocked out electricity at a nursing home and at least 14 residents tragically lost their lives due to heat.[107] Extreme heat similarly meant that an Arizona woman's inability to pay her $176 electric bill tragically led to her death in 2019.[108] Similarly, a preliminary study of the June 2021 heat wave showed that all of the people who died in Multnomah County, Oregon, which includes Portland, lacked air conditioning.[109]

Climate change also is likely to worsen air quality by accelerating the formation of ground-level ozone pollution (*high confidence*), increasing fine particle pollution and ozone pollution from wildfires (*high confidence*), and making pollen and mold allergy seasons longer and more severe (*high confidence*).[110] For example, there is consistent evidence that wildfire smoke exacerbates existing respiratory health problems, including increased risk of respiratory infections.[111] One recent study estimated that wildfire smoke from August 1 through September 10, 2020, indirectly led to as many as 3,000 excess deaths in California alone.[112] Similarly, the severe wildfires in summer and fall of 2017 sent people across Washington and California to triage centers, hospitals, and doctors' offices with breathing problems.[113] Communities already suffer a considerable economic burden from the illnesses and deaths related to wildfire smoke. A study that modeled wildfire smoke exposures over the continental U.S. from 2008 to 2012 found that health costs from short-term smoke exposures totaled $63 billion in net present value over the study period, and $450 billion for long-term exposure effects.[114]

In addition to heat-related health risks, the IPCC reports that changes in temperatures and precipitation resulting from climate change will impact the "distribution and range of vector-

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https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=335095 [hereinafter USEPA 2017].

[106] Camilo Mora et al., *Twenty-Seven Ways a Heat Wave Can Kill You: Deadly Heat in the Era of Climate Change*, 10 CIRC. CARDIOVASC. QUAL. OUTCOMES e004233 (2017), http://circoutcomes.ahajournals.org/content/10/11/e004233.

[107] Michael Nedelman, *Husband and wife among 14 dead after Florida nursing home lost A/C*, CNN (Oct. 9, 2017), www.cnn.com/2017/10/09/health/florida-irma-nursing-home-deaths-wife/index.html.

[108] Elizabeth Whitman, *On 107-Degree Day, APS Cut Power to Stephanie Pullman's Home. She Didn't Live*, PHOENIX NEW TIMES (June 13, 2019), https://www.phoenixnewtimes.com/news/aps-cut-power-heat-customer-dead-phoenix-summer-shutoff-11310515.

[109] Nadja Popovich & Winston Choi-Schagrin, *Hidden Toll of the Northwest Heat Wave: Hundreds of Extra Deaths*, N.Y. TIMES (Aug. 11, 2021), https://www.nytimes.com/interactive/2021/08/11/climate/deaths-pacific-northwest-heat-wave.html.

[110] USGCRP 2016, at 70.

[111] Colleen E. Reid et al., *Critical Review of Health Impacts of Wildfire Smoke Exposure*, 124 ENV'T HEALTH PERSPECTIVES 1334 (2016), http://dx.doi.org/10.1289/ehp.1409277.

[112] Alan Buis, *The Climate Connections of a Record Fire Year in the U.S. West*, GLOBAL CLIMATE CHANGE (Feb. 22, 2021), https://climate.nasa.gov/ask-nasa-climate/3066/the-climate-connections-of-a-record-fire-year-in-the-uswest/ (last accessed Apr. 18, 2023).

[113] John Upton, *Breathing Fire: Health Is A Casualty of Climate-Fueled Blazes*, CALIFORNIA HEALTHLINE (Nov. 7, 2017), https://californiahealthline.org/news/breathing-fire-health-is-a-casualty-of-climate-fueled-blazes/.

[114] Neal Fann et al., *The health impacts and economic value of wildland fire episodes in the U.S.: 2008–2012*, 610-611 SCI. TOTAL ENV'T 802 (2018), www.sciencedirect.com/science/article/pii/S0048969717320223?via%3Dihub.

borne diseases, such as malaria."[115] The USGCRP has similarly determined with *high confidence* that climate change will alter the geographical extent and seasonal timing of tick- and mosquito-borne diseases like Lyme disease and West Nile Virus.[116] The two species of ticks capable of spreading Lyme disease—the most common vector-borne illness in the U.S.[117]—have already expanded to new regions of the U.S. partly because of rising temperatures,[118] and their range expanded by roughly 45 percent between 1998 and 2015.[119] Globally, climate change has also increased the capacity of mosquitoes to generate new infections of dengue fever, and the number of dengue cases each year has doubled every decade since 1990.[120]

In addition, rising temperatures, more extreme rainfall, and coastal storm surges are expected with *medium confidence* to increase the risk of water-[121] and food-borne illnesses.[122] For example, vibriosis is an infection contracted through contaminated shellfish or seawater that can lead to diarrhea, skin infections, or even death.[123] The bacteria that cause vibriosis grow more quickly in warmer waters and are restricted to warmer months of the year along much of the eastern U.S. coast.[124] Reported cases of vibriosis tripled in the U.S. from 1996 to 2010.[125]

D. Climate Change and Ocean Acidification Harm Biodiversity, Ecosystem Services, and Public Lands

In addition to warming Earth's climate generally, it is *virtually certain* that temperatures in the top layer of global oceans have increased since the 1970s, with human influence as the *extremely likely* main driver.[126] Beyond warming the oceans, CO2 emissions have made the surface of global oceans about 30 percent more acidic over the last 150 years.[127] There is medium

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[115] DEP'T OF DEFENSE, *Department of Defense Climate Risk Analysis* at 9 (2021), (report submitted to National Security Council), https://media.defense.gov/2021/Oct/21/2002877353/-1/-1/0/DOD-CLIMATE-RISK-ANALYSIS-FINAL.PDF [hereinafter "DoD 2021"].
[116] USGCRP 2016, at 130.
[117] Amy M. Schwartz et al., *Surveillance for Lyme Disease — United States, 2008-2015*, 66 MORBIDITY & MORTAL WKLY REP. 1 (2017), www.cdc.gov/mmwr/volumes/66/ss/ss6622a1.htm.
[118] Rebecca J. Eisen et al., *Tick-Borne Zoonoses in the United States: Persistent and Emerging Threats to Human Health*, ILAR J. (2017), https://academic.oup.com/ilarjournal/advance-article/doi/10.1093/ilar/ilx005/3078806.
[119] Rebecca J. Eisen et al. *County-Scale Distribution of* Ixodes scapularis *and* Ixodes pacificus *(Acari: Ixodidae) in the Continental United States*, 53 J. MED. ENTOMOLOGY 349 (2016), https://academic.oup.com/jme/article/53/2/349/2459744.
[120] Nick Watts et al., *The* Lancet *Countdown on health and climate change: from 25 years of inaction to a global transformation for public health*, LANCET (2017), www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32464-9/fulltext.
[121] USGCRP 2016, at 158.
[122] *Id.* at 190.
[123] CENTERS FOR DISEASE CONTROL AND PREVENTION, Vibrio vulnificus *& Wounds*, https://www.cdc.gov/vibrio/wounds.html (accessed Aug. 16, 2023).
[124] Barbara A. Muhling et al., *Projections of the future occurrence, distribution, and seasonality of three Vibrio species in the Chesapeake Bay under a high-emission climate change scenario*, 1 GEOHEALTH 278 (2017), https://doi.org/10.1002/2017GH000089.
[125] USGCRP 2016, at 164.
[126] AR6 2021, at 5, A.1.6.
[127] USGCRP 2017, at 372. Acidification is causing many parts of the ocean to be undersaturated with the calcium carbonate minerals that are the building blocks for the skeletons and shells of many marine organisms, which impairs these organisms' ability to produce and maintain their skeletons and shells. *See* NOAA, *What Is Ocean*

confidence that the current rate of acidification is higher than at any time in at least the last 66 million years.[128] Under continued high emissions of CO2, surface acidity is expected with high confidence to increase by another 100 to 150 percent by the end of the century.[129] Human-caused CO2 emissions are *virtually certain* to be the main driver of acidification in the open ocean.[130]

Species can respond to climate change in three ways: they can cope through temporary changes or evolutionary adaptation, relocate to new habitats, or go extinct.[131] Both geographic shifts and extinctions will have dramatic consequences for biodiversity and the ecosystem functions on which humans depend.[132]

Because attempting to shift its range is often a species' first response to new environmental pressures, climate change is already "impelling a universal redistribution of life on Earth."[133] In fact, many species have experienced local extinctions at the warm edge of their range as they have shifted to cooler latitudes or elevations. A recent review of 976 plant and animal species around the world found that 47 percent have experienced climate-related local extinctions, with the highest extinction rates occurring in tropical species, animals, and freshwater habitats.[134] The redistribution of species has been linked to reduced terrestrial productivity, alterations in ecological networks in marine habitats, and the development of toxic algal blooms.[135]

Many species will be unable to move quickly enough—or at all—due to geographical barriers such as oceans or mountains, characteristics of their life history, a lack of suitable new habitat, or the rapid pace of local changes in climate.[136] For instance, high temperatures, ocean acidification, and non-climate stressors are already causing significant losses of shallow coral reefs in the U.S.[137] By one estimate, 4.3°C of additional global warming caused by continued high levels of GHGs could lead to the extinction of 1 in 6 of the world's species.[138]

America's national parks are bellwethers for many of these changes. A recent spatial analysis, which examined past and future impacts at 417 national parks, concluded that "climate change exposes the national park area more than the US as a whole."[139] Because national parks are often

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Acidification?, PACIFIC MARINE ENVIRONMENTAL LABORATORY, https://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F (last accessed Apr. 18, 2023).

[128] USGCRP 2017, at 364.

[129] *Id.*

[130] AR6 2021, at 5, A.1.6.

[131] John J. Wiens, *Climate-Related Local Extinctions are Already Widespread Among Plant and Animal Species*, 14 PLOS BIOLOGY e2001104 (2016), http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.2001104 [hereinafter Wiens 2016].

[132] Gretta T. Pecl et al., *Biodiversity redistribution under climate change: Impacts on ecosystems and human well-being*, 355 SCIENCE eaai9214 (2017) [hereinafter Pecl et al. 2017]; *see also* Wiens 2016.

[133] Pecl et al. 2017.

[134] Wiens 2016.

[135] Pecl et al. 2017.

[136] Wiens 2016; Diego P. Vázquez et al., *Ecological and evolutionary impacts of changing climatic variability*, 92 BIO. REV. 22 (2017; first published Aug 2015), http://onlinelibrary.wiley.com/doi/10.1111/brv.12216/abstract.

[137] USEPA 2017, at 171.

[138] Mark C. Urban, *Accelerating extinction risk from climate change*, 348 SCIENCE 571 (2015), https://www.science.org/doi/pdf/10.1126/science.aaa4984.

[139] Patrick Gonzalez et al., *Disproportionate magnitude of climate change in United States national parks*, 13 ENV'T RSCH. LETTERS 104001 (2018), https://iopscience.iop.org/article/10.1088/1748-9326/aade09.

located in already more extreme environments, they are more vulnerable to climate change. For example, the study concluded that the average annual temperature in national parks increased at twice the rate of the rest of the country between 1895 and 2010.[140] Looking forward to 2100, "under the highest emissions scenario . . . , park temperatures would increase 3°C–9°C, with climate velocities outpacing dispersal capabilities of many plant and animal species."[141] While reducing emissions would not eliminate this trend, "greenhouse gas emissions reductions could reduce projected temperature increases in national parks by one-half to two-thirds."[142] Our national parks are living emblems of our nation's heritage, and they warrant regulations and policies that promote ecosystem resilience, enhance restoration and conservation of the system's essential resources, and preserve America's natural and cultural legacy.

E. Climate Change Hurts the U.S. Economy

Climate- and weather-related disasters are already harming the U.S. economy. Since 1980, there have been 308 weather and climate disasters that cost the country at least $1 billion each, for a total cost of more than $2 trillion.[143] And data indicates that the economic damage from extreme weather events has been increasing in recent years.[144] In the last five years, there have been 81 such events, resulting in nearly 4,000 deaths and over $640 billion in damages.[145] In 2017 alone, there were 16 separate weather and climate disaster events in the U.S. with damages exceeding $1 billion each, totaling $306 billion—a new single-year record.[146] In 2020, there were 22 weather and climate disaster events with losses exceeding $1 billion each.[147] Overall, with annual losses exceeding $95 billion, 2020 ranked as the fourth highest annual loss year on record.[148]

According to a 2017 technical assessment by EPA's Climate Change Impacts and Risk Analysis ("CIRA") project, climate change will cost the U.S. economy hundreds of billions of dollars each year under conservative estimates.[149] Projected damages are significantly larger under a high-emissions scenario. Damages also increase over time, but not necessarily gradually; abrupt changes in climate may likewise lead to abrupt increases in economic harm.[150] Some of the major climate-related economic impacts examined include: labor losses ($160 billion per year), heat-related deaths ($140 billion per year),[151] damage to coastal property ($120 billion per year),

[140] *Id.*
[141] *Id.*
[142] *Id.*
[143] NOAA, *U.S. Billion-Dollar Weather and Climate Disasters*, https://www.ncdc.noaa.gov/billions/ (accessed Dec. 14, 2021).
[144] *Id.*
[145] *Id.*
[146] *Id.*
[147] *Id.*
[148] *Id.*
[149] USEPA 2017.
[150] *Id.* at 3, 4.
[151] *Id.* at 48.

damage to roads ($20 billion per year), need for increased electricity generation ($9.2 billion per year),[152] and disruption of international supply chains.[153]

Changes in extreme temperature, particularly heat, are expected to reduce the number of suitable working hours in the contiguous U.S. by 1.9 billion hours in 2090.[154] Globally, heat has already reduced outdoor labor capacity in rural areas by approximately 5.3 percent from 2000 to 2016.[155] In 2013, 16,320 U.S. workers missed work because of heat-related illnesses.[156] By the end of the century, warming on our current high emissions trajectory could cost the U.S. economy hundreds of billions of dollars each year and up to 10 percent of U.S. GDP due to damages including lost crop yields, lost labor, increased disease incidence, property loss from sea level rise, and extreme weather damage.[157] To put that worst case estimate into context, 10 percent of the U.S.' gross domestic product for 2020 amounts to nearly 2.1 trillion dollars.[158]

F. Climate Change Threatens National Security

Military and intelligence leaders have long recognized the national security threats of climate change.[159] Most recently, in a 2021 report to the National Security Council, the Department of Defense concluded:

> To keep the nation secure, we must tackle the existential threat of climate change. The unprecedented scale of wildfires, floods, droughts, typhoons, and other extreme weather events of recent months and years have damaged our installations and bases, constrained force readiness and operations, and contributed to instability around the world.[160]

The Department of Defense "sees climate change as a present security threat, not strictly a long-term risk," and is "already observing the impacts of climate change in shocks and stressors to

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[152] *Id.* at 120.
[153] DoD 2021, at 9 ("Global supply chains are at risk to extreme weather events exacerbated by climate change. For example, the 2011 floods in Thailand disrupted production of components for global companies including computer disk drives and cars.").
[154] *Id.* at 54.
[155] Nick Watts et al., *The* Lancet *Countdown on health and climate change: from 25 years of inaction to a global transformation for public health*, LANCET (2017), at 581, www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32464-9/fulltext.
[156] OFF. CONG. WORKPLACE RIGHTS, F*ast Facts — Heat Stress: Don't Let the Heat Get You Down*, https://www.ocwr.gov/publications/fast-facts/heat-stress/ (last accessed Apr. 18, 2023).
[157] USGCRP 2018, at 1347 to 1367.
[158] Countryeconomy.com, *United States (USA) GDP – Gross Domestic Product*, https://countryeconomy.com/gdp/usa?year=2020 (accessed Dec. 14, 2021).
[159] CLIMATE & SECURITY ADVISORY GROUP, *A Responsibility to Prepare: Strengthening National and Homeland Security in the Face of a Changing Climate* (2018), https://climateandsecurity.files.wordpress.com/2018/02/climate-and-security-advisory-group_a-responsibility-to-prepare_2018_02.pdf.
[160] DoD 2021, at 4, 8 ("As the frequency and intensity of these hazards increase, impacts are likely to expand competition over regions and resources, affect the demands on and functionality of military operations, and increase the number and severity of humanitarian crises, at times threatening stability and security."); *see also* KELLY M. SAYLER, CONG. RSCH. SERV., IF12161, CLIMATE CHANGE AND ADAPTATION: DEPARTMENT OF DEFENSE 1 (2023), https://crsreports.congress.gov/product/pdf/IF/IF12161#:~:text=DOD's%20Climate%20Risk%20Analysis%20report,holds%20implications%20for%20international%20security.

vulnerable nations and communities, including in the United States, and in the Arctic, Middle East, Africa, Asia, and South America."[161]

The threats posed to national security will only increase as climate change gets worse. In its 2021 report, the Department explained that, "in worst-case scenarios, climate change-related impacts could stress economic and social conditions that contribute to mass migration events or political crises, civil unrest, shifts in the regional balance of power, or even state failure."[162] In fact, the Department warned that, "[a]s the likelihood of multiple converging extreme events increases with climate change, risks can compound and put enormous pressure on any government's capacity to respond, increasing the possibility of cascading security impacts."[163] Extreme heat, storms and floods, sea level rise, and loss of natural resources will damage military installations, disrupt supply chains, imperil the safety of personnel, hamper training and readiness, increase the need for deployments in high risk areas of the world, and dramatically increase operating costs—exposing America's service personnel and citizens at home and abroad to needless risks and preventable harms.[164]

G. Methane is an Extremely Potent Greenhouse Gas that Exacerbates Climate Change

Methane, the main component of natural gas, is far more potent as a greenhouse gas than CO2, especially over shorter time periods. The IPCC reports that, over a twenty-year timeframe, methane has approximately 83 times the global warming potential (GWO") of CO2, and approximately 30 times the CO2 value over a 100-year time frame.[165] Given the urgency of near-term GHG reductions, particularly dramatic cuts in the next two decades, the 20-year GWP is the more appropriate metric to use when evaluating the climate impacts of government policies (such as the current rule proposal) that will affect methane emissions.

Along with CO2, methane is considered one of the "well-mixed" GHGs that unequivocally "are the main driver of increases in atmospheric GHG concentrations since the pre-industrial period."[166] It is also unequivocal that the increased concentration of methane, as well as other well-mixed GHGs, "over the industrial era is the result of human activities (*very high confidence*)."[167] Comparisons between CO2 and methane depend on methane's "shorter atmospheric lifetime, stronger warming potential, and variations in atmospheric growth rate over

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[161] DoD 2021, at 14.
[162] *Id.* at 8.
[163] *Id.* at 9.
[164] NAT'L INTELLIGENCE COUNCIL, *Implications for US National Security of Anticipated Climate Change* (2016), https://www.dni.gov/index.php/newsroom/reports-publications/reports-publications-2016/item/1629-implications-for-us-national-security-of-anticipated-climate-change; OFF. UNDER SECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY, AND LOGISTICS, *Climate-Related Risk to DoD Infrastructure Initial Vulnerability Assessment Survey (SLVAS) Report* (2018), https://reliefweb.int/report/world/department-defense-climate-related-risk-dod-infrastructure-initial-vulnerability; Gregg M. Garfin, *Climate Change Impacts and Adaptation on Southwestern DoD Facilities,* Def. Technical Info Ctr. (2017), https://www.serdp-estcp.org/Program-Areas/Resource-Conservation-and-Resiliency/Infrastruct7607ure-Resiliency/Vulnerability-and-Impact-Assessment/RC-2232; DoD 2021, at 9.
[165] AR6 2021.
[166] AR6 2021, at 5-6.
[167] *Id.*

the past decade."[168] Methane also contributes to the creation of ground-level ozone, which is itself a powerful greenhouse gas that also causes direct health harms.[169] For this reason, "[c]ontrolling methane has been shown to be a win-win, benefiting both climate and air quality."[170]

Over the past two centuries, methane emissions have nearly doubled, humans have been the primary cause of the growth since 1900, and emissions increases have "persistently exceeded the losses," leading to accumulation of methane in the atmosphere.[171] According to the IPCC 2021 report, the average global concentration of methane increased over 150% between 1750 and 2019 (*high confidence*),[172] and "[c]urrent atmospheric concentrations of [methane and other well-mixed] GHGs are higher than at any point in the last 800,000 years."[173] Most recently, from 2010-2019, the atmospheric methane concentration grew on average 7.6 ppb per year, although the growth rate was faster (9.3 ppb/yr) from 2014-2019 (*high confidence*). Methane concentration increased by nearly 15 ppb in 2020, "which is by far the largest annual increase since systematic atmospheric CH4 measurements began."[174] The IPCC concluded with *high confidence* that the growth in methane since the early 2000s "is dominated by anthropogenic activities," primarily "emissions from both fossil fuels and agriculture (dominated by livestock) sectors (*medium confidence*)."[175] The Global Methane Assessment concluded that fossil fuels were responsible for 35% of human-caused methane emissions globally.[176]

Due to the immense warming potential of methane and the available technologies and practices dedicated to preventing its leakage, methane mitigation is considered low-hanging fruit as a climate mitigation action. The International Energy Agency (IEA) recently found that "more than 70% of [global oil and gas methane] emissions can be abated with existing technologies" and "the cost of mitigation is often lower than the market value of the gas that is captured."[177] The IEA estimates that "almost 45% of oil and gas methane emissions can be avoided with measures that would come at no net cost," and identifies leak detection and repair standards as one of the most important measures.[178] In a 2021 report, the United Nations Environment Programme and the Climate and Clean Air Coalition concluded that "[r]educing human-caused methane emissions is one of the most cost-effective strategies to rapidly reduce the rate of

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[168] Marielle Saunios et al., *The Global Methane Budget 2000–2017*, 12 EARTH SYST. SCI. DATA 1561–1623 (2020), https://doi.org/10.5194/essd-12-1561-2020.
[169] Global Methane Assessment 2021.
[170] Jian He et al., *Investigation of the global methane budget over 1980–2017 using GFDL-AM4.1*, 20 ATMOS. CHEM. PHYS. 805–827 (2020), https://doi.org/10.5194/acp-20-805-2020.
[171] AR6 2021.
[172] *Id.* at 5-6; Jessica Blunden, *State of the Climate in 2020*, 102 BULL. AM. METEOROLOGICAL SOC'Y S1, S84 (Aug. 2021), https://ametsoc.net/sotc2020/State_of_the_Climate_in_2020_LowRes96.pdf ("[Methane's] abundance in the atmosphere increased to 1879.2 ± 1.0 ppb (parts per billion by moles in dry air) in 2020, a 160% increase compared to its pre-industrial level of 722 ± 15 ppb.").
[173] AR6 2021, at 5-6.
[174] Jessica Blunden, *State of the Climate in 2020*, 102 BULL. AM. METEOROLOGICAL SOC'Y S1 (Aug. 2021), https://ametsoc.net/sotc2020/State_of_the_Climate_in_2020_LowRes96.pdf.
[175] AR6 2021, at 5-7.
[176] Global Methane Assessment 2021.
[177] IEA, *Curtailing Methane Emissions from Fossil Fuel Operations: Pathways to a 75% cut by 2030* (October 2021), https://www.iea.org/reports/curtailing-methane-emissions-from-fossil-fuel-operations
[178] *Id.*

warming and contribute significantly to global efforts to limit temperature rise to 1.5°C."[179] That report found that targeted cuts in methane emissions of ~45% (180 metric tons a year) by 2030 are considered necessary to meet the 1.5°C climate limit and would "avoid nearly 0.3°C of global warming by the 2040s."[180] Such cuts would also, each year, "prevent 255,000 premature deaths, 775,000 asthma-related hospital visits, 73 billion hours of lost labour from extreme heat, and 26 million tonnes of crop losses globally."[181] Because methane has a relatively short lifetime, urgent steps to reduce methane emissions "can quickly reduce atmospheric concentrations and result in similarly rapid reduction in climate forcing and ozone pollution."[182] Reducing methane emissions also reduces the risk of dangerous climate-warming feedback loops.[183] In total, the report estimates that "global monetized benefits for all market and non-market impacts are approximately $4300 per tonne of methane reduced."[184]

H. Methane Emissions from the Natural Gas Sector are Significant and Must be Mitigated to Slow the Rate of Global Warming

Over the past decade, a substantial body of scientific literature has developed documenting the significance of methane emissions caused by oil and gas operations.[185] Methane emissions from the oil and gas sector are a significant driver of near-term climate change, and reducing them is one of the easiest and most cost-effective ways to immediately slow the rate of global warming.[186] Under the International Energy Agency's (IEA) "net-zero by 2050" scenario, methane from fossil fuel operations needs to decline by around 75% between 2020 and 2030.[187] Because of methane's extreme climate-forcing power and its relatively short atmospheric lifespan, immediate reductions are critical. Peer-reviewed research found that "[p]ursuing all [methane] mitigation measures now could slow the global-mean rate of near-term decadal warming by around 30%, avoid[ing] a quarter of a degree centigrade of additional global-mean

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[179] CLIMATE AND CLEAN AIR COALITION & UNITED NATIONS ENVIRONMENT PROGRAMME, *Global Methane Assessment: Summary for Decision Makers,* at 1 (2021), https://www.ccacoalition.org/en/resources/global-methane-assessment-summary-decision-makers [hereinafter "Global Methane Assessment 2021"].

[180] *Id.*; *see also* Tianyi Sun et al., *Path to net zero is critical to climate outcome*, 11 SCI. REPORTS 22173 (2021), https://www.nature.com/articles/s41598-021-01639-y ("[D]ifferent pathways of carbon dioxide and methane . . . can lead to nearly 0.4 °C of warming difference in midcentury and potential overshoot of the 2°C target, even if they technically reach global net zero greenhouse gas emissions in 2050.").

[181] Global Methane Assessment 2021, at 1.

[182] *Id.* at 8.

[183] *Id.*

[184] *Id.*

[185] *See e.g.,* Ramón A. Alvarez et al., *Assessment of Methane Emissions from the U.S. Oil and Gas Supply Chain* 361 SCIENCE 186, 186 (2018); Benjamin Hmiel et al., *Preindustrial 14CH4 Indicates Greater Anthropogenic Fossil CH4 Emissions*, 578 NATURE 409, 409 (2020); Stefan Schwietzke et al., *Upward Revision of Global Fossil Fuel Methane Emissions Based on Isotope Database*, 538 NATURE 88 (2016); Robert W. Howarth, *A bridge to nowhere: methane emissions and the greenhouse gas footprint of natural gas*, 2 ENERGY SCI. ENG. 47 (2014).

[186] Ilissa Ocko et al., *Acting rapidly to deploy readily available methane mitigation measures by sector can immediately slow global warming*, 16 ENV'T RSCH. LETTERS 054042 (2021), https://iopscience.iop.org/article/10.1088/1748-9326/abf9c8; Tomás de Oliveira Bredariol et al., *Methane Emissions from Oil and Gas Operations,* IEA (2021), https://policycommons.net/artifacts/2677189/methane-emissions-from-oil-and-gas-operations/3700394/ https://www.iea.org/reports/methane-emissions-from-oil-and-gas-operations ("Fossil fuel operations generated nearly one-third of all methane emissions from human activity. Action on methane is therefore one of the most effective steps the energy sector can take to mitigate climate change.") [hereinafter "IEA 2021"].

[187] IEA 2021 ("Methane emissions from oil and gas operations must be the first to go.").

warming by midcentury, and set[ting] ourselves on a path to avoid more than half a degree centigrade by end of century."[188]

The UNEP has similarly highlighted the critical importance of reducing methane from fossil fuel operations, finding that these emissions must decline 59% from 2020 levels by 2030 in scenarios where the 1.5°C goal is attained.[189]

Figure 1.[190]

ANNUAL METHANE EMISSIONS FROM U.S. PIPELINE LEAKS (IN METRIC TONS)		
	EDF Analysis	**EPA 2022 GHGI**
Gathering	**482,000 – 1,890,000**	**127,000**
Transmission	**6,400**	**3,300**
Distribution	**761,000**	**203,000**
TOTAL	**1,250,000 – 2,660,000**	**333,000**

Natural gas gathering, transmission, and distribution pipelines are an integral and sprawling part of natural gas infrastructure, transporting natural gas around the country in a network of about 3 million miles of pipelines. This infrastructure significantly contributes to nationwide methane emissions. New analysis by Environmental Defense Fund finds that between 1.2 and 2.7 million metric tons of methane emissions are leaked from U.S. natural gas pipelines.[191] The assessment analyzed published field survey data in relation to known characteristics of the U.S. pipeline system, relying on emissions factors from peer-reviewed research, and included "over 4,000 leak indications on distribution pipelines and over 500 emissions sources on gathering pipelines."[192] According to EDF's analysis, methane leaked from U.S. natural gas pipelines is between 3.75 and 8 times greater than EPA estimates. This analysis indicates that EPA's greenhouse gas inventory (GHGI) estimates for methane emissions from natural gas pipelines are substantially undervalued.[193] The EPA greenhouse gas emissions inventory bases its estimates for the national pipeline leakage rate on just two studies that measured only distribution pipelines. Independent studies deploying advanced leak-detection ("ALD") technology have found that

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[188] Ilissa Ocko et al., *Acting rapidly to deploy readily available methane mitigation measures by sector can immediately slow global warming*, 16 ENV'T RSCH. LETTERS 054042 (2021), https://iopscience.iop.org/article/10.1088/1748-9326/abf9c8.
[189] Global Methane Assessment 2021, at 89.
[190] Renee McVay, Methane Emissions from U.S. Gas Pipeline Leaks, Env't Def. Fund (Aug. 2023), https://www.edf.org/sites/default/files/documents/Pipeline%20Methane%20Leaks%20Report.pdf.
[191] Renee McVay, *Methane Emissions from U.S. Gas Pipeline Leaks*, ENV'T DEF. FUND (Aug. 2023), https://www.edf.org/sites/default/files/documents/Pipeline%20Methane%20Leaks%20Report.pdf.
[192] Renee McVay, Methane Emissions from U.S. Gas Pipeline Leaks, Env't Def. Fund (Aug. 2023), https://www.edf.org/sites/default/files/documents/Pipeline%20Methane%20Leaks%20Report.pdf.
[193] Jevan Yu et al., *Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin*, 9 ENV'T SCI. & TECH. LETTERS 969 (2022) https://pubs.acs.org/doi/10.1021/acs.estlett.2c00380.

emissions from gathering natural gas pipelines are fourteen times higher greater than EPA's estimates.[194]

In 2021, the Biden Administration released a U.S. Methane Emissions Reduction Action Plan,[195] which outlines a multi-agency approach to commit funding, policy development, and research toward reducing methane emissions. The Action Plan explicitly lists PHMSA's directive to reduce methane leaks as a key strategy, acknowledging that "when aging or damaged gas distribution pipelines are repaired or replaced, methane emissions can be cut by up to 90%." PDF 10. The Action Plan summarizes the domestic effort to meet the Administration's international target to cut methane emissions by 30% by 2030, as compared to 2020 levels. Thus, achieving U.S. national climate goals will require steep and rapid reductions in methane emissions from natural gas pipeline infrastructure.

I. The Effects of Climate Change Pose Safety and Environmental Threats to Pipeline Infrastructure

Extreme heat can be both the consequence and cause of natural gas pipeline methane emissions. As discussed above, the methane that leaks from natural gas infrastructure is a potent greenhouse gas that significantly contributes to climate change and all of its physical manifestations in the natural world—including extreme temperatures and increased flooding events. Extreme heat and flooding, in turn, can damage natural gas infrastructure, leading to more leaks of atmospheric-warming methane. This cyclical causality is referred to as a positive feedback loop, which the Intergovernmental Panel on Climate Change has defined as a non-linear response in which "the result of the process affects its origin thereby intensifying … the original effect."[196]

Climate change phenomena like extreme heat and flooding can impact pipeline integrity in multiple ways. Gas expands as it warms, which can lead to dangerous pressure spikes during heat waves. Recently during a record-breaking heat wave in June 2023, operators in Texas had to quickly release massive amounts of natural gas from pipelines to avoid a catastrophic breach in pipeline integrity, resulting in the release of "hundreds of tons of toxic gases into the air."[197] The emissions were mostly of methane, "but also include[d] cancer-causing chemicals like benzene, xylene and ethylbenzene."[198] In 2018, a major storm in Montecito, California caused flooding and mudslides. The resulting soil shift ruptured a gas transmission line, leading to structure fires and evacuations.[199]

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[194] Yu et al. 2022.

[195] White House Off. Domestic Climate Policy, U.S. Methane Emissions Reduction Action Plan (Nov. 2021), https://www.whitehouse.gov/wp-content/uploads/2021/11/US-Methane-Emissions-Reduction-Action-Plan-1.pdf; Press Release, White House, FACT SHEET: Biden Administration Tackles Super-Polluting Methane Emissions (Jan. 31, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/31/fact-sheet-biden-administration-tackles-super-polluting-methane-emissions/.

[196] IPCC, TAR Climate Change 2001: The Scientific Basis, Ch. 1 The Climate System: An Overview, at 91 (2001), https://www.ipcc.ch/site/assets/uploads/2018/03/TAR-01.pdf.

[197] Dylan Baddour, *Texas Pipeline Operators Released or Flared Tons of Gas to Avert Explosions During Heatwave*, INSIDE CLIMATE NEWS (June 30, 2023), https://insideclimatenews.org/news/30062023/texas-pipeline-flare-release-gasheat/ (last accessed August 10, 2023).

[198] *Id.*

[199] Tom Piozet & Erik Ortiz, *Deadly rains in Southern California send rivers of mud into homes, trigger fire, flooding*, NBC NEWS (Jan. 9, 2018), https://www.nbcnews.com/news/weather/rains-southern-california-send-rivers-

The proposed rule acknowledges the "threat to pipeline infrastructure from natural force damage (which includes incidents caused by act of nature such as flooding, land movement, and lightning) are likely to be exacerbated by climate change."[200] In June 2022, PHMSA issued a bulletin warning operators about the environmental hazards that climate change can create for pipeline integrity, including extreme heat, flooding, and soil erosion.[201] The agency issued similar bulletins in the past warning about the increased threat of flooding and large earth movements to pipeline integrity, and the increased intensity and frequency of both types of events due to climate change.[202]

J. Pipeline Infrastructure Contributes to Adverse Health Impacts

Natural gas gathering pipelines transport unprocessed natural gas from production areas like well sites to facilities where the gas can be processed.[203] Unprocessed gas is typically comprised of about 70-80% methane, with the remaining 20-30% containing several air pollutants such as volatile organic compounds (VOCs), benzene, and sometimes carbon dioxide (CO2).[204] Thus, in addition to methane, which is both explosive and has a powerful global warming potential, leaks and operational releases on gathering pipelines can emit VOCs and hazardous air pollutants (HAPs). As the Proposed Rule notes, exposure to VOCs and HAPs can lead to short- and long-term respiratory distress, cancer, or other illnesses.[205]

1. Releases of Volatile Organic Compounds (VOCs) and Hazardous Air Pollutants (HAPs) Harm Human Health

VOCs and Ozone. In addition to methane, gas operations emit volatile organic compounds which contribute to the formation of ground-level ozone (a primary component of smog). A longstanding body of scientific research, including numerous U.S. Environmental Protection Agency (EPA) assessments, demonstrates that exposure to ground-level ozone harms human

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mud-homes-trigger-fire-n836016; *see also Thirteen Dead in Powerful Storm, Mudslides in Santa Barbara County*, NBC LOS ANGELES (Jan. 9, 2018), https://www.nbclosangeles.com/news/local/explosion-debris-flow-reported-after-house-fire-in-montecito/166181/.

200 Proposed Rule at 31897.

201 PHMSA, ''Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards,'' 87 Fed. Reg. 33576 (June 2, 2022) (Docket No. PHMSA-2022-0063).

202 PHMSA, ''Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Earth Movement and Other Geological Hazards,'' 84 Fed. Reg. 18919 (May 2, 2019) (Advisory Bulletin ADB–2019–02); PHMSA, ''Pipeline Safety: Potential for Damage to Pipeline Facilities Caused by Flooding, River Scour, and River Channel Migration,'' 84 Fed. Reg. 14715 (Apr. 11, 2019) (Advisory Bulletin ADB–2019–01).

203 U.S. GOV'T ACCOUNTABILITY OFF., *Pipelines Safety: Operators of Natural Gas and Hazardous Liquid Gathering Lines Face Data Collection Challenges,* GAO-22-104817 (Jan. 13, 2022), https://www.gao.gov/products/gao-22-104817.

204 EPA, "Oil and Natural Gas Sector: Emissions Standards for New, Reconstructured, and Modified Sources Review," 85 Fed. Reg. 57018, 57028 (2020) (Docket No. EPA-HQ-OAR-2017-0757).

205 Draft Environmental Assessment at 5 ("As discussed at greater length in EPA (2022b), VOC emissions are a precursor to ozone and ambient ozone is associated with adverse health effects, including respiratory morbidity, asthma attacks, hospital and emergency department visits, lost school days, and premature respiratory mortality. HAPs associated with natural gas production include several substances that are known or suspected carcinogens, including but not limited to benzene, formaldehyde, toluene, xylenes, ethylbenzene.").

health. In its 2013 Integrated Scientific Assessment for Ozone, EPA concluded that "a very large amount of evidence spanning several decades supports a relationship between exposure to [ozone] and a broad range of respiratory effects."[206] These effects range from decreases in lung function among healthy adults to increases in respiratory-related hospital admissions and emergency room visits, to premature death.[207] For example, there is a strong link between ozone and asthma. Multiple studies across various states (California, Georgia, North Carolina), counties (Maricopa County, AZ; Erie County, NY) and cities (Seattle, New York, Newark, Atlanta, Houston, Dallas, San Antonio, Austin, Indianapolis, St. Louis) have found that changes in ozone concentrations were associated with higher asthma emergency room visits, most at concentrations below the current standard.[208] According to the Centers for Disease Control and Prevention, asthma affects 25 million Americans and resulted in almost 1 million emergency room visits with over 90,000 hospitalizations in 2020.[209] Asthma costs the U.S. economy more than $80 billion annually in medical expenses, missed work and school days, and deaths.[210]

Long-term exposure to ozone can have particularly severe health implications. Susan C Anenberg *et al.* has concluded that there is likely a causal relationship between long-term exposure to ozone and respiratory effects.[211] Some longitudinal studies have further demonstrated that "long-term [ozone] exposure influences the risk of asthma development in children"[212] and a recent study of 5,780 adults followed for a decade across six U.S. metropolitan regions found that long-term ozone was significantly associated with development of emphysema. This was equal to that of 29 pack-years of smoking or three years of aging.[213] Additionally, in a study of 11 million Medicare enrollees in the Southeastern U.S., long-term ozone was associated with increased risk of first hospital admissions for stroke, chronic obstructive pulmonary disease, pneumonia, myocardial infarction, lung cancer, and heart failure.[214]

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[206] U.S. EPA, *Integrated Science Assessment of Ozone and Related Photochemical Oxidants*, EPA/600/R-10/076F (2013), at 1-6, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492.
[207] *Id.* at 6-131 to 6-158, 6-162--63.
[208] Stephanie Holm et al., *Human Health Effects of Ozone: The State of Evidence Since EPA's Last Integrated Science Assessment*, ENV'T DEF. FUND (2018), https://library.edf.org/AssetLink/jts6mhyx0i11hm1ve25r60n881kqnghs.pdf; *see also* Ananya Roy, *The science is clear: We need a stronger smog standard*, EDF BLOGS: CLIMATE 411 (Sept. 4, 2018), https://blogs.edf.org/climate411/2018/09/04/the-science-is-clear-we-need-a-stronger-smog-standard/.
[209] CDC, *Most Recent National Asthma Data*, https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm (last accessed on July 25, 2023).
[210] Tursynbek Nurmagambetov et al., *The Economic Burden of Asthma in the United States, 2008 – 2013*, ANNALS AM. THORACIC SOC. (2017), https://doi.org/10.1513/AnnalsATS.201703-259OC. .
[211] Susan C. Anenberg et al., *Estimates of the Global Burden of Perspectives Ambient PM2.5, Ozone, and NO2 on Asthma Incidence and Emergency Room Visits*, 126 ENV'T HEALTH PERSPECTIVES 107004 (2018), https://doi.org/10.1289/EHP3766.
[212] U.S. EPA, *Integrated Science Assessment of Ozone and Related Photochemical Oxidants*, EPA/600/R-10/076F (2013), at 7-2, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492.
[213] Meng Wang et al., *Association Between Long-term Exposure to Ambient Air Pollution and Change in Quantitatively Assessed Emphysema and Lung Function*, 322 JAMA 546, 551 (2019), https://jamanetwork.com/journals/jama/fullarticle/2747669.
[214] Mahdieh Danesh Yazdi et al., *Long-term exposure to PM2. 5 and ozone and hospital admissions of Medicare participants in the Southeast USA*, 130 ENV'T INT'L 104879 (2019), https://doi.org/10.1016/j.envint.2019.05.073.

Even short-term exposure to ozone can be quite damaging to cardiovascular and respiratory systems. For instance, there is evidence of an association between out-of-hospital cardiac arrests and short-term exposure to ozone.[215] Other studies indicate higher rates of stroke in populations following higher exposures to ozone. A study in Pennsylvania that used a time-stratified case-crossover analysis to evaluate the relationships between stroke hospital admissions and ozone among 26,219 patients in Allegheny County, PA, found that exposures to ozone on the current day increased the risk of total stroke hospitalization.[216] Another study in Nunces County, Texas evaluated associations with incident stroke and stroke severity in cases identified in the Brain Attack Surveillance in Corpus Christi project between 2000 and 2012 and found elevated risk of having a first stroke with higher ozone concentrations in the preceding 2 days.[217] This is supported by two independent meta-analyses of multiple studies.[218] This evidence augments the long-standing body of literature demonstrating the serious impacts from short-term exposure to ozone pollution, including the increased risk of premature death.[219] EPA has also recognized that positive associations have been reported between "short-term [ozone] exposures and respiratory mortality, particularly during the summer months."[220]

Health effects other than those impacting cardiovascular or respiratory systems are also likely. A 2017 study suggested that ozone exposure may be linked to approximately 8,000 stillbirths per year.[221] Studies carried out in California and Florida, of over 400,000 births each, found that elevated exposure to ozone during pregnancy was associated with higher risk of preterm birth.[222] There is also now accumulating evidence that suggests that ozone exposure during pregnancy can result in Autism Spectrum Disorder among children.[223]

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[215] Katherine B. Ensor et al., *A case-crossover analysis of out-of-hospital cardiac arrest and air pollution*, 127 CIRCULATION 1192 (2013), https://doi.org/10.1161/circulationaha.113.000027.

[216] Xiaohui Xu et al., *Association between ozone exposure and onset of stroke in Allegheny County, Pennsylvania, USA, 1994-2000*, 41 NEUROEPIDEMIOLOGY 2 (2013), https://doi.org/10.1159/000345138.

[217] Jeffery Wing et al., *Short-term exposures to ambient air pollution and risk of recurrent ischemic stroke*, 152 ENV'T RSCH. 304 (2017), https://doi.org/10.1016/j.envres.2016.11.001.

[218] Anoop SV Shah et al., *Short term exposure to air pollution and stroke: systematic review and meta-analysis*, 350 BMJ h1295 (2015), https://www.bmj.com/content/bmj/350/bmj.h1295.full.pdf; Wan-Shui Yang et al., *An evidence-based appraisal of global association between air pollution and risk of stroke*, 175 INT'L J. CARDIOLOGY 307 (2014), https://doi.org/10.1016/j.ijcard.2014.05.044.

[219] U.S. EPA, *Integrated Science Assessment of Ozone and Related Photochemical Oxidants*, EPA/600/R-10/076F (2013), at 1-14, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492 (concluding that there is "likely to be a causal relationship between short-term exposures to [ozone] and total mortality").

[220] EPA, *National Ambient Air Quality Standards for Ozone*, 80 Fed. Reg. 65,292, 65,307 (Oct. 26, 2015); *see also* U.S. EPA, *Integrated Science Assessment of Ozone and Related Photochemical Oxidants*, EPA/600/R-10/076F (2013), at 6-220 to 6-221, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492.

[221] Pauline Mendola et al., *Chronic and Acute Ozone Exposure in the Week Prior to Delivery is Associated with the Risk of Stillbirth*, 14 INT'L J. ENVT'L RSCH. & PUB. HEALTH 731 (2017).

[222] Olivier Laurent et al., *A Statewide Nested Case-Control Study of Preterm Birth and Air Pollution by Source and Composition: California, 2001-2008*, 124 ENVT'L HEALTH PERSPECTIVES 1479 (2016), https://doi.org/10.1289%2Fehp.1510133; Sandie Ha et al., *The effects of air pollution on adverse birth outcomes*, 134 ENVT'L RSCH. 198 (2014), https://doi.org/10.1016/j.envres.2014.08.002.

[223] Tracy Ann Becerra et al., *Ambient air pollution and autism in Los Angeles county, California*, 121 ENVT'L HEALTH PERSPECTIVES 380 (2012), https://doi.org/10.1289/ehp.1205827; Heather E. Volk et al., *Traffic-Related Air Pollution, Particulate Matter, and Autism*, 70 JAMA PSYCHIATRY 71 (2013), https://jamanetwork.com/journals/jamapsychiatry/fullarticle/1393589.

Prolonged exposure to ozone may also accelerate cognitive decline in the early stages of dementia.[224]

Ozone pollution is particularly harmful for vulnerable populations, such as people with respiratory diseases or asthma, older adults, and people who are active outdoors, especially outdoor workers.[225] Children with asthma face heightened risks from ozone exposure. Many studies have demonstrated that children with asthma experience decrements in lung function and increases in respiratory symptoms when exposed to ozone pollution.[226]

Hazardous Air Pollutants. Hazardous Air Pollutants ("HAPs"), which are also released alongside methane during the course of gas operations, can cause cancer and seriously impair human neurological systems.

For example, EPA has found that benzene, found in unprocessed gas, is a known human carcinogen.[227] Further, several adverse noncancer health effects have been associated with chronic inhalation of benzene in humans including arrested development of blood cells, anemia, leukopenia, thrombocytopenia, and aplastic anemia.[228] Acute inhalation of benzene is also associated with respiratory distress.[229]

EPA has also cataloged the harmful effects of other specific air toxics emitted from unprocessed natural gas, including formaldehyde, toluene, xylenes, and ethylbenzene.[230] Each of these hazardous pollutants is harmful to human health. For instance, the serious health effects associated with exposure to toluene range from dysfunction of the central nervous system to narcosis, with effects frequently observed in humans acutely exposed to low or moderate levels of toluene by inhalation.[231]

2. Gathering Pipelines Can Contribute to Harmful Ozone and HAP Emissions

Gathering pipelines have historically been subject to minimal federal oversight and are drawing increasing scrutiny as an environmental and safety concern. There are over 430,000 miles of onshore gas gathering lines in the United States, yet until 2021 PHMSA regulated only 11,569

[224] Ekaterina Galkina Cleary et al., *Association of Low-Level Ozone with Cognitive Decline in Older Adults*, 61 J. ALZHEIMERS DISEASE 67-78 (2018), https://doi.org/10.3233/jad-170658.
[225] U.S. EPA, *Integrated Science Assessment of Ozone and Related Photochemical Oxidants*, EPA/600/R-10/076F (2013), at 1-8, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492.
[226] K.M. Mortimer et al., *The Effect of Air Pollution on Inner-City Children with Asthma*, 19 EUR. RESPIRATORY J. 699 (2002), https://erj.ersjournals.com/content/erj/19/4/699.full.pdf; U.S. EPA, *Integrated Science Assessment of Ozone and Related Photochemical Oxidants*, EPA/600/R-10/076F (2013), at 6-120-21, 6-160, https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247492.
[227] Draft Environmental Assessment, at 33.
[228] Draft Environmental Assessment, at 33.
[229] Draft Environmental Assessment, at 33.
[230] Draft Environmental Assessment, at 33-34 (citing U.S. EPA, *Chemical Assessment Summary: Toluene; CASRN 108-88-3*, NAT'L CTR. ENV'T ASSESSMENT (2005), https://iris.epa.gov/static/pdfs/0118_summary.pdf. & U.S. EPA, *Toxicological Review of Toluene*, CAS No. 108-88-3, EPA/635/R-05/004 (2005), https://iris.epa.gov/static/pdfs/0118tr.pdf.).
[231] *Id.*

miles of onshore gas gathering lines.[232] The surge in domestic U.S. gas production since 2006 resulted in a significant expansion in the mileage of the gathering pipeline network and the volume of gas transported by gathering lines. As industry expansion over the past two decades has placed increasing demand on this infrastructure, "[m]odern gas gathering lines often bear a closer resemblance to large interstate transmission lines than the diffuse network of small, low-pressure lines that previously characterized gathering lines."[233] Gathering pipelines pose unique risks to human health and safety because they transport unprocessed gas. Leaks, blowdowns, and other releases of unprocessed gas create VOC and HAP emissions, contributing to negative health impacts for surrounding communities. Gathering pipelines that transport unprocessed gas from well sites to processing facilities can be a source of these harmful air pollutants, especially those gathering lines that fall outside of PHMSA's leakage survey or repair requirements. People within a half mile of a pipeline leaking VOCs and HAPs are at particular risk of negative health impacts from the gases.[234]

K. Pipeline Infrastructure and Leaks can Disproportionately Burden Environmental Justice Communities

1. Gathering and Transmission Lines are Disproportionately Located in Disadvantaged Communities

The Draft Environmental Assessment correctly acknowledges the positive correlation between the density of gathering and transmission pipelines and the location of environmental justice communities.[235] A study by Emanuel et al. (2021), which accounted for both demographic and socioeconomic factors, found a national trend of "counties with more socially vulnerable populations experience[ing] higher densities of gathering and transmission pipelines than counties with less socially vulnerable populations."[236] The high concentration of gathering and transmission pipelines in socially vulnerable communities inherently increase the risk of the pipeline-associated health, safety, and environmental risks that members of these communities face.

Emanuel et al. expounds on the additional unique burdens that those living specifically near gathering and transmission lines face, including the degradation of environments essential to indigenous groups' "knowledge systems, cultures, and identities," which are "inextricably tied to certain landscapes."[237] More generally, the risk of ruptures or explosions due to pipeline malfunction or degradation is often culturally overlooked in discussions on pipeline

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[232] PHMSA, Annual Report Mileage for Natural Gas Transmission & Gathering Systems, https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-natural-gas-transmission-gathering-systems (last updated Aug. 1, 2022).
[233] PHMSA, Final Rule, "Pipeline Safety: Safety of Gas Gathering Pipelines: Extensions of Reporting Requirements, Regulation of Large, High-Pressure Lines, and Other Related Amendments, 86 Fed. Reg. 63,266, 63,271 (Nov. 15, 2021).
[234] Jane C.S. Long et al., An Independent Scientific Assessment of Well Stimulation in California, Volume III, Cal. Council Sci. & Tech. (July 2015), at 14, https://ccst.us/wp-content/uploads/160708-sb4-vol-III.pdf.
[235] Draft Environmental Assessment, at 36.
[236] Ryan E. Emanuel et al., *Natural Gas Gathering and Transmission Pipelines and Social Vulnerability in the United States*, GEOHEALTH, at 6 (2021), https://doi.org/10.1029/2021GH000442.
[237] *Id*. at 7.

infrastructure and hidden behind the notion that rural areas are key candidates to shoulder this risk because they are less densely populated than urban and suburban areas. This notion disregards the inherent safety risk that accompanies explosive infrastructure, which impacts property values, land use restrictions, and personal security. Moreover, a study conducted in Appalachia documents how the physical divides between neighborhoods– imposed by the construction and maintenance of midstream pipeline infrastructure– can create emotional, political, and economic rifts between residents, eroding the communal bonds in rural areas that are essential for healthy lives, local economies, and robust democracies.[238]

The increased survey frequencies, advanced survey technologies, and shortened leak repair timelines in the proposed rule can alleviate the elevated burden on environmental justice communities by making gathering and transmission pipelines safer and decreasing negative health and environmental impacts. Additionally, more routine survey and better maintenance of pipelines could create a more efficient system, decreasing the need for excavations or adding additional infrastructure in more rural communities.

2. *Distribution Pipelines Present Higher Leak Densities in Disadvantaged Communities*

Leaks on distribution pipelines have been found to disproportionately burden disadvantaged communities. One study of the Massachusetts gas distribution system revealed the "inequities in the geographic distribution of" distribution pipeline leaks.[239] The study determined that "People of Color (especially people who identify racially as Asian or Black), limited English speaking households, lower income persons, renters, and adults with lower levels of education live in neighborhoods or areas with higher leak densities, even when controlling for housing density."[240] A different study, which focused on nine U.S. cities, also found that the average leak density increased with the percentage of people of color.[241] Leak density measures the number of leaks per mile, and the study found its average value to be 37 percent higher in communities of color than in predominantly white neighborhoods. The study also found "statistical evidence for a decrease in leak density with increasing income."[242]

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[238] *See generally* Martina Angela Caretta & Kristen Abatis McHenry, Pipelining Appalachia: A perspective on the everyday lived experiences of rural communities at the frontline of energy distribution networks development, 63 ENERGY RSCH. & SOC. SCI. 1010403 (2020), https://doi.org/10.1016/j.erss.2019.101403.
[239] Marcos Luna & Dominic Nicholas, *An environmental justice analysis of distribution-level natural gas leaks in Massachusetts, USA*, 162 ENERGY POLICY 112778, at 13-14 (2022), https://doi.org/10.1016/j.enpol.2022.112778.
[240] *Id.*
[241] Zachary Weller et al., *Environmental Injustices of Leaks from Urban Natural Gas Distribution Systems: Patterns among and within 13 U.S. Metro Areas*, 56 ENV'T SCI. & TECH. 8599, 8602 (2022). https://pubs.acs.org/doi/epdf/10.1021/acs.est.2c00097; see also Erin Murphy & Joe von Fischer, *Methane gas leaks present environmental justice concerns*, EDF ENERGY EXCHANGE (May 11, 2022), https://blogs.edf.org/energyexchange/2022/05/11/methane-gas-leaks-present-environmental-justice-concerns/.
[242] Zachary Weller et al., *Environmental Injustices of Leaks from Urban Natural Gas Distribution Systems: Patterns among and within 13 U.S. Metro Areas*, 56 ENV'T SCI. & TECH. 8599, 8602 (2022), https://pubs.acs.org/doi/epdf/10.1021/acs.est.2c00097.

One contributing factor to this disparity is the shorter leak repair timeframe that white communities experience in comparison to communities of color.[243] Leaks deemed "non-hazardous" still pose a health risk to nearby residents, and utilities have "significant discretion" over when to repair non-hazardous leaks.[244] Compounding the problem, leak data on distribution systems are largely incomplete and therefore undercount leak inventories. One study that focused on six east coast cities reveals that methane emissions from distribution leaks are twice the value reported to EPA,[245] suggesting a leak reporting rate inconsistent with reality.[246]

The increased survey frequencies, advanced survey technologies, and shortened leak repair timelines in the proposed rule can alleviate the elevated burden on environmental justice communities by facilitating faster repairs and identifying previously undiscovered leaks. There is a major knowledge gap in research on natural gas pipelines,[247] which could contribute to the racial and income disparity on distribution leak densities. The robust reporting requirements mandated by the proposed rule can help fill that knowledge gap and arm decisionmakers with the information needed to alleviate these environmental injustices.

III. Legal Authority

A. PHMSA Must Issue Gas Pipeline Standards that Address Public Safety and Environmental Protection

PHMSA has statutory authority and a clear mandate to set protective pipeline standards that ensure public safety and environmental protection.

In the Pipeline Safety Act of 1992, Congress first directed the Secretary of Transportation to develop pipeline standards with consideration for environmental protection in addition to safety. The 1992 Act amended both the Natural Gas Pipeline Safety Act of 1968 and the Hazardous Liquid Pipeline Act of 1979 to state: "In prescribing standards … the Secretary shall consider … the extent to which the standards will contribute to public safety and the protection of the environment."[248] Congress updated this language in 1996, enacting the provision in place today: "A standard … shall be … (B) designed to meet the need for (i) gas pipeline safety … and (ii) protecting the environment."[249] The 1996 Act also added a requirement that the Secretary must consider certain information when prescribing pipeline standards, including "relevant available (i) gas pipeline safety information; (ii) hazardous liquid pipeline safety information; and (iii) environmental information."[250] Pursuant to these provisions, PHMSA must design pipeline

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[243] Marcos Luna & Dominic Nicholas, *An environmental justice analysis of distribution-level natural gas leaks in Massachusetts, USA*, 162 ENERGY POLICY 112778, at 13-14 (2022), https://doi.org/10.1016/j.enpol.2022.112778.
[244] *Id.*
[245] Genevieve Plant et al., *Large Fugitive Methane Emissions from Urban Centers Along the U.S. East Coast*, 46 GEOPHYSICAL RSCH. LETTERS. 8500 (2019), https://doi.org/10.1029/2019GL082635.
[246] Zachary D. Weller et al., *A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems*, 54 ENV'T SCI. TECH. 8958 (2020), https://doi.org/10.1021/acs.est.0c00437.
[247] Ryan E. Emanuel et al., *Natural Gas Gathering and Transmission Pipelines and Social Vulnerability in the United States*, 5 GEOHEALTH e2021GH000442, at 2 (2021), https://doi.org/10.1029/2021GH000442.
[248] Pipeline Safety Act of 1992, P.L. 102-508 (Oct. 24, 1992).
[249] Accountable Pipeline Safety and Partnership Act of 1996, Public L. No. 104-304, 110 Stat 3793, §4(b); 49 U.S.C. § 60102(b)(1).
[250] Accountable Pipeline Safety and Partnership Act of 1996 §4(b); 49 U.S.C. § 60102(b)(2).

standards to achieve both safety and protection of the environment, and PHMSA must consider safety and environmental information in establishing such standards. The agency's mission is consistent with this directive: "PHMSA's mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives."[251]

Section 118 of the PIPES Act of 2020 builds on these provisions by directing that when evaluating the costs and benefits of adopting a standard—a requirement first instituted by Congress in 1996—PHMSA must consider both safety and environmental benefits. The statute now states that the Secretary "shall propose or issue a standard . . . only upon a reasoned determination that the benefits, including safety and environmental benefits, of the intended standard justify its costs."[252] 49 U.S.C. § 60102(b)(5). The Proposed Rule states that Section 118 "reinforced the environmental purpose of … historical provisions (e.g., 49 U.S.C. 60102(b)(1)(B)(ii) and (b)(2)(A)(3)) within the Federal Pipeline Safety Laws that authorize PHMSA to issue regulations acknowledging the environmental protection benefits from regulation of gas pipeline facilities."[253]

While a directive to address safety *and* the environment has been in place since 1992, until recently PHMSA has neglected to address environmental protection in most gas pipeline rulemakings.[254] The agency acknowledges that it has prioritized safety without addressing environmental protection in its oversight of gas pipelines,[255] stating, "PHMSA's current regulatory requirements pertaining to gas pipeline leak detection, repair, maintenance, and reporting reflect a focus on public safety risks from ignition of instantaneous, large-volume releases or accumulated gas while treating risks to the environment as less important."[256]

Improving pipeline safety and protecting the environment are not at odds – these are mutually reinforcing objectives in the context of natural gas infrastructure. Gas pipeline leaks that pose a risk of a safety incident are also a source of methane emissions that contribute to harmful climate change, and finding and fixing leaks can remediate both of these concerns. PHMSA explains this connection in the Proposed Rule, stating for example that "[i]nfrequent leak detection and patrol periodicities provide extended time intervals within which leaks can develop and worsen, thereby resulting in prolonged methane and other emissions to the atmosphere … [and] also entail increased public safety risks."[257]

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[251] U.S. DOT PHMSA, PHMSA's Mission, https://www.phmsa.dot.gov/about-phmsa/phmsas-mission (accessed Aug. 10, 2023).
[252] 49 U.S.C. § 60102(b)(5); *see* PIPES Act of 2020, P.L. 116-260, § 118.
[253] Proposed Rule at 31922.
[254] By contrast, PHMSA has long incorporated consideration of both safety and environmental protection in its oversight of hazardous liquids pipelines. *See, e.g.*, PHMSA, Notice of Proposed Rulemaking: Pipeline Safety: High Consequence Areas for Gas Transmission Pipelines, 67 Fed. Reg. 1108, 1113 (Jan. 9, 2002) (proposing to include "sensitive environmental areas" in the definition of HCAs for hazardous liquid pipelines but not for gas pipelines, in part because of the agency's conclusion that gas releases "cannot pollute drinking water or ecological resources").
[255] *See* Proposed Rule at Parts II.D-E.
[256] Proposed Rule at 31906.
[257] Proposed Rule at 31910.

The Proposed Rule is a major step forward in incorporating both safety and environmental protection considerations into gas pipeline standards. PHMSA explains that its existing standards have numerous shortcomings, and the agency proposes improvements across the board regarding leak survey frequency, leak grading, leak repair timelines, use of advanced leak detection technology, reporting, and minimizing operational gas releases. Throughout these comments are recommendations to further strengthen the proposal to enhance safety and reduce methane emissions. PHMSA must fulfill its statutory mandate to set protective pipeline standards that ensure public safety and environmental protection, by finalizing comprehensive, rigorous standards for leak detection and repair, management of operational releases, and reporting.

B. The Primary Elements of this Rulemaking Fulfill Mandates in the PIPES Act of 2020

The bipartisan PIPES Act of 2020 directed PHMSA to develop new policies to improve leak management of gas pipelines, and further strengthened and clarified the agency's responsibility to incorporate consideration for the environment into pipeline oversight. Section 113 of the Act requires the agency to set standards for leak detection and repair programs that utilize advanced leak detection technologies and practices, applicable to regulated gathering, transmission, and distribution pipelines.[258] Congress directed that such leak detection and repair standards must "meet the need for gas pipeline safety" and "protect the environment," and leak detection and repair programs under the standard must be able to identify, locate, and categorize all leaks that "are hazardous to human safety or the environment."[259] The Act also prohibits the agency from decreasing the frequency by which surveys are required.[260]

The Proposed Rule seeks to satisfy these detailed instructions from Congress by proposing to adopt technology performance standards and to require that all operators establish Advanced Leak Detection Programs consistent with the performance threshold.[261] Some improvements are needed to ensure that the minimum performance standards and Advanced Leak Detection Program standards are comprehensive and enforceable—see Part V of these comments. The agency's proposal, with improvements, will fulfill the mandate of Section 113. PHMSA must act expeditiously to complete this rulemaking, and is already behind schedule. Congress directed PHMSA to complete its Section 113 advanced leak detection rulemaking by December 27, 2021; the agency published its proposal in May 2023.[262]

In addition to the rulemaking directed by Section 113, the PIPES Act of 2020 also contains self-executing provisions demonstrating further Congressional intent to mitigate the environmental impacts of pipeline infrastructure. Section 114 requires that pipeline operators' written inspection and maintenance plans must contribute to "public safety," "eliminating hazardous leaks and minimizing releases of natural gas," and "protection of the environment"; and operator plans

[258] P.L. 116-260, §113; 49 U.S.C. § 60102(q)(1-3), available at: https://www.congress.gov/116/plaws/publ260/PLAW-116publ260.pdf#page=1030.
[259] P.L. 116-260, §113; 49 U.S.C. § 60102(q)(1), (2).
[260] P.L. 116-260, §113; 49 U.S.C. § 60102(q)(4).
[261] *See* Proposed Rule at 31932.
[262] P.L. 116-260, §113; 49 U.S.C. § 60102(q)(1); PHMSA, Notice of Proposed Rulemaking: *Pipeline Safety: Gas Pipeline Leak Detection and Repair*, 88 Fed. Reg. 31890 (May 18, 2023).

must meet the requirements of agency standards promulgated pursuant to Section 113.[263] Further, Section 119 calls for a study from the National Academy of Sciences on "potential methodologies or standards for the installation of automatic or remote-controlled shut-off valves" on existing pipelines.[264] The Act requires the Academy to consider "methodologies that maximize … environmental benefits."[265]

While Section 114 is a self-executing provision, PHMSA's proposal to adopt regulatory standards in this area will provide clarity to operators and should improve compliance and enforceability. The PIPES Act of 2020 required that operators complete the updates of their inspection and maintenance plans pursuant to Section 114 within 1 year after the date of enactment, by December 27, 2021, and the Act also directed PHMSA (or the relevant State authority) to inspect each operator plan by the end of 2022, to ensure compliance with the Section 114 directive.[266] Even as these dates have passed, industry groups and operators have raised questions and concerns about lack of clarity on what compliance with Section 114 looks like, and what standard operators will be held to.[267] PHMSA issued an advisory bulletin in June 2021 and hosted an information webinar in January 2022 to provide guidance to operators regarding Section 114 compliance.[268] The components of this Proposed Rule addressing mitigation of operational gas releases build constructively upon the standard set by Section 114 and are consistent with PHMSA's authority to set minimum standards for safety and the environment.

C. PHMSA Has Authority to Extend Minimum Pipeline Safety Standards for Gas Gathering Pipelines

PHMSA has clear statutory authority to regulate gas gathering pipelines and extend minimum pipeline safety standards, including those for leak detection and repair, to additional gathering pipelines. The Proposed Rule appropriately extends leak detection and repair requirements to all Type C gathering lines, and PHMSA should further extend these requirements to all gas gathering lines.

Federal law directs PHMSA to "prescribe minimum safety standards" for pipeline transportation and pipeline facilities to meet the need for "gas pipeline safety" and "protecting the environment."[269] This directive applies to natural gas gathering lines, as Congress in 1968 authorized the Department of Transportation to regulate nonrural gas gathering lines, and in 1992

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[263] P.L. 116-260, §114; 49 U.S.C. § 60108(a)(2).
[264] P.L. 116-260, §119(a).
[265] P.L. 116-260, §119(b)(3).
[266] P.L. 116-260, §114; 49 U.S.C. § 60108(a)(3)
[267] *See, e.g.*, USDOT, PHMSA, Transcript, Liquid and Gas Pipeline Advisory Committee Joint Meeting, at 237-282 (Oct. 20, 2021), https://primis.phmsa.dot.gov/meetings/MtgHome.mtg?mtg=154.
[268] *See* PHMSA, Notice, Issuance of Advisory Bulletin: *Pipeline Safety: Statutory Mandate To Update Inspection and Maintenance Plans To Address Eliminating Hazardous Leaks and Minimizing Releases of Natural Gas From Pipeline Facilities*, 86 Fed. Reg. 31002 (June 10, 2021); PHMSA, Notice of Public Informational Webinar: *Pipeline Safety: Informational Webinar Addressing Inspection of Operators' Plans To Eliminate Hazardous Leaks, Minimize Releases of Methane, and Remediate or Replace Leak-Prone Pipe*, 87 Fed. Reg. 4327 (Jan. 27, 2022).
[269] 49 U.S.C. § 60102(a)(2), (b)(1).

authorized the regulation of all gathering lines.[270] PHMSA is directed to designate "regulated gathering lines" based on consideration of a number of factors such as location and operating pressure.[271] To inform its definition of "regulated gathering lines," the agency can require owners and operators of any gathering line to submit information to allow the agency "to make a determination as to whether and to what extent to regulate gathering lines."[272]

As gathering infrastructure experienced immense buildout with the expansion of unconventional shale drilling practices beginning in the mid-2000s, Congress and other stakeholders expressed growing concerns about networks of unregulated gathering pipelines.[273] In the bipartisan 2011 Pipeline Safety Act, enacted "to provide for enhanced safety and environmental protection in pipeline transportation,"[274] Congress directed the Secretary of Transportation to review existing standards for gathering lines.[275] After PHMSA proposed to expand oversight of gathering lines in 2016 but did not finalize the rule, Congress issued a mandate to the agency to set clear standards for gathering lines, directing PHMSA in the bipartisan PIPES Act of 2020 to "issue a final rule" regulating gathering lines by March 27, 2021.[276]

PHMSA issued the final Gas Gathering Pipelines Rule in November 2021. The rule established a new category of regulated gas gathering line, Type C, for more rural gathering lines with an outer diameter of 8.625 inches or greater that operate at higher stress levels or pressure.[277] All Type C gathering lines are subject to emergency planning and damage prevention requirements under the Final Rule, and more than 20,000 miles are subject to leak survey and repair standards and certain other requirements.[278]

Section 113 of the PIPES Act of 2020 directs PHMSA to set standards for advanced leak detection and repair programs for "regulated gathering lines (as defined pursuant to subsection (b) of section 60101 for purposes of subsection (a)(21) of that section) in a Class 2 location, Class 3 location, or Class 4 location."[279] This provision includes Type A and B regulated gathering lines, which are defined to include all regulated gathering lines in Class 2, 3, and 4 locations (while Type C gathering lines are defined to include lines in Class 1 location areas).[280] Section 113, however, does not preclude PHMSA from determining that additional gathering lines should also participate in advanced leak detection and repair programs. The Type C category of regulated gathering lines did not exist at the time Congress enacted the PIPES Act of

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[270] *See* Natural Gas Pipeline Safety Act of 1968, Pub. L. 90-481, 82 Stat. 720 (1968); Pipeline Safety Act of 1992, Pub. L. 102-508, § 109, 106 Stat. 3310 (1992).
[271] 49 U.S.C. § 60101(b)(2)(A).
[272] 49 U.S.C. § 60117(c).
[273] *See* PHMSA, Final Rule: *Pipeline Safety: Safety of Gas Gathering Pipelines: Extension of Reporting Requirements, Regulation of Large, High-Pressure Lines, and Other Related Amendments*, 86 Fed. Reg. 63266, 63269-70 (Nov. 15, 2021) [hereinafter "Gas Gathering Final Rule"].
[274] House Report No. 112–297, Pt. 1 (Comm. on Transportation and Infrastructure) (Dec. 1, 2011).
[275] Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011, P.L. 112-90, Section 21 (Jan. 3, 2012) ("2011 Pipeline Safety Act").
[276] PIPES Act of 2020, Section 112(a), P.L. 116-260 (Dec. 27, 2020).
[277] Gas Gathering Final Rule, 86 Fed. Reg. at 63268.
[278] PHMSA, Final Regulatory Impact Analysis, Pipeline Safety: Expansion of Gas Gathering Regulation Final Rule at 15 (Nov. 2021).
[279] Pub. L. No. 116-260, § 113 (2020).
[280] 49 C.F.R. § 192.8(c); *id.* at Table 1.

2020, and the only rules of construction that Congress included in Section 113 are clear indications that the provision does *not* restrict PHMSA's oversight and cannot be used to *weaken* oversight.[281]

It is appropriate and needed for PHMSA to extend leak survey and repair requirements, including the proposed new advanced leak detection standard, to all Type C gathering lines. Type C lines are already "regulated" by PHMSA pursuant to the 2021 Gas Gathering Pipelines Rule.[282] The Proposed Rule states that "PHMSA has long recognized the public safety risks associated with gathering pipelines and has general authority under 49 U.S.C. 60102 to issue minimum Federal pipeline safety standards necessary to 'meet the need for gas pipeline safety […] and protect [] the environment.'"[283] Just as the agency has authority to apply leak detection and repair standards to Type C gathering lines, PHMSA has clear authority to expand the definition of "regulated gathering lines" to encompass all gathering lines. The agency solicited comments in the Proposed Rule regarding "whether it would be appropriate to apply any of the requirements proposed herein to Type R gathering pipelines not currently regulated under part 192."[284]

PHMSA acknowledges that it has more than the authority to regulate gathering lines—it has a responsibility to do so. In the Proposed Rule, the agency justifies its decision to expand safety and survey requirements to Type B and C pipelines by admitting that "the historical, limited approach in applying §§ 192.705 (patrol) and 192.706 (leakage survey) requirements to Types B and C gathering lines is inadequately protective of public safety and the environment."[285] In order to maximize the Proposed Rule's positive impact on pipeline safety and the environment, the agency should exercise its authority and extend minimum safety requirements to Type R gathering lines.

The Proposed Rule explains that "any leak from gas gathering pipelines entails unique public safety risks" because gathering lines "are often located in the vicinity of socially vulnerable populations" and "unprocessed natural gas within gathering pipelines typically contains significant quantities of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) such as benzene (a known carcinogen)."[286] The negative climate, health, and safety impacts of leaked unprocessed natural gas are present regardless of pipeline diameter or location.

[281] *See* PIPES Act of 2020, Section 113, 49 U.S.C. 60102(q)(4) (stating that the Secretary "may not reduce the frequency of surveys required under any other provision of this chapter," and "may not extend the duration of any timelines for the repair or remediation of leaks," and further stating: "Nothing in this subsection may be construed to alter the authority of the Secretary to regulate gathering lines as defined pursuant to section 60101").
[282] Proposed Rule at 31898; 49 C.F.R. § 192.9(e).
[283] Proposed Rule at 31931.
[284] Proposed Rule at 31932.
[285] Proposed Rule at 31931.
[286] Proposed Rule at 31912.

D. PHMSA's Authority and Obligation to Set Pipeline Standards is Independent from EPA Clean Air Act Oversight of Oil and Gas Infrastructure

PHMSA and EPA exercise overlapping but independent regulatory authority over oil and gas pipeline infrastructure. In *Massachusetts v. EPA*, 549 U.S. 497, 531–32 (2007), the Supreme Court acknowledged that federal agencies may have overlapping authority. There, the Court held that although EPA's duty to regulate carbon dioxide emissions from motor vehicles might overlap with the Department of Transportation's duty to set mileage standards, that overlap "in no way licenses EPA to shirk its environmental responsibilities" to protect the public's health and welfare. *Id.*; *see also Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin.*, 538 F.3d 1172, 1219 (9th Cir. 2008).

As discussed above, PHMSA has both authority and an obligation to set minimum pipeline safety standards that ensure both safety and "protect[] the environment." 49 U.S.C. § 60102(b)(1)(B). And as discussed, PHMSA's longstanding statutory obligation to protect the environment was built upon and reinforced by the PIPES Act of 2020. In contrast, EPA has a statutory duty under the Clean Air Act to protect the public against health- and welfare-harming air pollution through regulations that set emissions limits focused on the technologies and practices that form the best system of emissions reductions to decrease that pollution. 42 U.S.C § 7411. As the Supreme Court explained in *Massachusetts*, while the agencies' "obligations may overlap... there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency." 549 U.S. at 532. PHMSA appropriately states in the Proposed Rule that it and EPA have "distinguishable, but mutually-reinforcing, regulatory responsibilities."[287]

In this proposal, PHMSA's standards for improving safety and methane pollution primarily apply at facilities that are currently not subject to EPA Clean Air Act methane standards. These facilities include local gas distribution pipeline systems, transmission and gathering pipelines, and certain components of LNG and underground gas storage facilities. Where PHMSA standards have the potential to apply at facilities that would also be regulated under leak monitoring standards in place or proposed by EPA, PHMSA has largely proposed to streamline compliance.

For example, PHMSA has proposed an exemption from its leak survey and repair requirements for any transmission or gathering compressor station that is subject to fugitive methane emission monitoring and repair requirements in "(i) 40 CFR part 60, subparts OOOOa or OOOOb; or (ii) an EPA-approved State plan or Federal plan which includes relevant standards at least as stringent as EPA's finalized emissions guidelines in 40 CFR part 60, subpart OOOOc."[288] If EPA's proposed standards at OOOOb and OOOOc are not in effect, then PHMSA's leak standards would apply to those compressor stations.[289] PHMSA explains that EPA's proposed regulatory regime for compressor stations "provides public safety and environmental protection comparable to PHMSA's proposals."[290] While it would also be reasonable and beneficial to

[287] Proposed Rule at 31946.
[288] Proposed Rule at 31924.
[289] Proposed Rule at 31939.
[290] *Id.*

require transmission and gathering compressor stations to comply with both PHMSA and EPA standards, PHMSA's proposed approach appropriately ensures that these facilities are conducting leak inspections and repairing issues on suitable timelines.

E. PHMSA Has Clearly Demonstrated that the Benefits of the Proposal Justify the Costs

PHMSA has obligations to complete a cost-benefit analysis to support policymaking, and it has satisfied those obligations in support of this Proposed Rule.

Executive Order 12866 directs federal agencies to conduct an assessment of costs and benefits for any proposed significant regulatory action, and to assess the costs and benefits of feasible alternatives to the planned regulation.[291] The pipeline safety law states that "[e]xcept where otherwise required by statute," PHMSA (through the Secretary of Transportation) "shall propose or issue a standard under this chapter only upon a reasoned determination that the benefits, including safety and environmental benefits, of the intended standard justify its costs." 49 U.S.C. § 60102(b)(5). And when prescribing any minimum pipeline safety standard, PHMSA must consider a number of factors, including "relevant available" "gas pipeline safety information" and "environmental information"; as well as, based on a risk assessment, the "reasonably identifiable or estimated" benefits and costs "expected to result from implementation or compliance with the standard." 49 U.S.C. § 60102(b)(2). There are statutory parameters for the agency's conduct of a risk assessment, including requirements to "identify the costs and benefits associated with the proposed standard" and to present "an explanation of the reasons for the selection of the proposed standard in lieu of the other options identified." 49 U.S.C. § 60102(b)(3).

The agency has conducted a thorough analysis of the costs and benefits of its Proposed Rule, constituting the components of the required risk assessment and enabling the agency to make an appropriately reasoned determination that the benefits of its proposal justify the costs. The Preliminary Regulatory Impact Analysis details PHMSA's assessment of the costs for industry compliance and the benefits associated with the proposal. As the agency states, this rulemaking "addresses a negative externality in gas transportation wherein the cost of emissions of methane and other gases associated with leaks from gas pipeline facilities are borne not by pipeline operators responsible for detecting and repairing leaks, but by society as a whole."[292] The benefits evaluated by PHMSA include environmental and climate benefits, safety benefits, health benefits, and economic benefits from the value of reduced natural gas product losses. PHMSA appropriately deploys the Social Cost of Methane metric to quantify a monetized estimate of the climate benefit of avoided methane emissions associated with the Proposed Rule.[293] PHMSA also presents a qualitative analysis of safety benefits associated with the Proposed Rule, which is appropriate for an area where there is less certainty and clarity in a quantification option. The qualitative analysis of the safety benefits of the proposal underscores that the extent to which the

[291] Exec. Order 12866, 58 Fed. Reg. 51735 (Sept. 30, 1993), https://www.archives.gov/files/federal-register/executive-orders/pdf/12866.pdf.
[292] Preliminary RIA at 9.
[293] *See id.* at 73-86.

benefits outweigh the costs of the proposal is not fully captured by a monetized comparison of costs and benefits.

The agency states that provisions of its proposal are "are expected to improve public safety, reduce threats to the environment (including, but not limited to, reduction of methane emissions contributing to the climate crisis), and promote environmental justice for minority populations, low-income populations, and other underserved and disadvantaged communities," as well as "reducing product losses results in cost savings for natural gas shippers and consumers and improves the efficiency and reliability of U.S. energy infrastructure." Proposed Rule at 31893.

IV. Analysis: Improved Leak Management Practices Will Mitigate Leaks and Methane Emissions

Identifying methane leaks from pipelines, which are invisible and may be odorless, is best achieved through a combination of instrument-based surveys, including monitoring with handheld technologies and screening with advanced mobile technologies.[294] Legacy methods, which have existed for decades, include walking along pipelines with handheld instruments (e.g., organic vapor analyzers and combustible gas indicators) and flying aircraft along rights-of-way to search for visual signs of disturbance (e.g., dead vegetation and encroachment).[295] Although legacy methods find some leaks, their overall effectiveness remains unclear and there is little data demonstrating the emission reductions they can achieve because these are not quantitative methods.[296] At the same time, a growing body of research demonstrates that pipeline methane emissions are of greater significance than previously thought.[297] These findings underscore that current regulatory and voluntary leak management practices are not effectively controlling and reducing emissions.

Newer advanced solutions are being widely deployed in the upstream sector voluntarily by operators and are increasingly being incorporated into regulatory leak detection and repair programs.[298] There is widespread recognition and empirical data demonstrating the effectiveness of leak monitoring approaches using advanced technologies, with some analyses showing that

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[294] Highwood Emission Management, *Technical Report: Leak detection methods for natural gas gathering, transmission, and distribution pipelines*, at 23 (2022), https://highwoodemissions.com/wp-content/uploads/2022/04/Highwood_Pipeline_Leak_Detection_2022.pdf ("Advancement in pipeline leak detection may arise from combining more "traditional" legacy methods (such as mass-balance systems) with emerging technologies (as outlined below), in order to maximize methane detection and emission mitigation. It was recommended in several expert interviews that combining different technology types will result in more leak detection events than any one technology alone.") [hereinafter "Highwood 2022"].

[295] *Id.*

[296] *Id.*

[297] *See, e.g.*, Jevan Yu et al., *Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin*, 11 ENV. SCI. TECH. LETT. 969 (2022), https://pubs.acs.org/doi/10.1021/acs.estlett.2c00380; Zachary D. Weller et al., *A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems*, 54 ENV. SCI. TECH. 8958 (2020), https://pubs.acs.org/doi/full/10.1021/acs.est.0c00437.

[298] *See, e.g.*, 87 Fed. Reg. 74742-43; Nini Gu, Colorado's methane pollution verification rule is a game-changer: here are three reasons why, EDF (July 31, 2023), https://blogs.edf.org/energyexchange/2023/07/31/colorados-methane-pollution-verification-rule-is-a-game-changer-here-are-three-reasons-why/.

80-90% mitigation can be achieved.[299] Advanced technologies are also being deployed by leading operators, and found to be highly effective, on local gas distribution systems.[300] We urge PHMSA to finalize protective monitoring requirements based on the use of handheld instruments in combination with advanced mobile technologies. Below, we describe technologies, their commercial availability, and an analysis of their effectiveness using a pipeline-specific version of the Fugitive Emissions Abatement Simulation Toolkit (FEAST), which supports and informs the technology specification and frequency recommendations in this comment.[301] In general, mobile approaches should be paired with handheld technologies, in particular for pin-pointing leaks and for verifying repair. We therefore urge PHMSA to finalize a layered approach incorporating both types of technologies.

A. Advanced leak detection technologies and analytics are widely commercially available and are effective tools to identify natural gas pipeline leaks.

Costs and Availability. Advanced monitoring technologies are already widely available and in use by leading operators.[302] Many of these technologies are highly effective and cost effective. And many companies providing advanced methane mitigation services are domestic and provide well-paying jobs in geographies across the country. Some of these technologies are particularly capable and efficient at quickly screening large areas for emissions, while others may be more sensitive and better suited for finding and fixing smaller (but collectively significant) leaks. Operator experience, scientific use and testing, and simulation modeling provide estimates of the cost and effectiveness of different approaches that can inform the development of PHMSA's regulatory approach.

A 2022 report from Highwood Emissions Management examined advanced methane detection technologies and their applicability to distribution, transmission, and gathering pipelines.[303] The report is based on a comprehensive literature review supplemented with targeted, semi-structured interviews with industry experts, including pipeline operators, researchers, innovators, and technology solution providers. Key findings include:

- **Considerable innovation over the past decade has led to a growing number of advanced leak detection methods.** Dozens of systems have been developed to detect methane leaks in the oil and gas industry, including new handheld devices,

[299] Jiayang Wang et al., *Large-Scale Controlled Experiment Demonstrates Effectiveness of Methane Leak Detection and Repair Programs at Oil and Gas Facilities*, EarthArvXiv (2021) (non-peer reviewed preprint), https://eartharxiv.org/repository/view/2935/; Arvind P. Ravikumar et al., Repeated leak detection and repair surveys reduce methane emissions over scale of years, 15 Env. Research Letters 034029 (2020), https://iopscience.iop.org/article/10.1088/1748-9326/ab6ae1/pdf.
[300] *See* Weller et al., Vehicle-Based Methane Surveys for Finding Natural Gas Leaks and Estimating Their Size: Validation and Uncertainty, Environ. Sci. Technol. 52, 20, 11922–11930 (2018), https://doi.org/10.1021/acs.est.8b03135.
[301] ARVIND RAVIKUMAR, *Fugitive Emissions Abatement Simulation Toolkit*, https://www.arvindravikumar.com/feast.
[302] *See* Mary Lowe & Robin Lowe-Skillern, *Find, Measure, Fix: Jobs in the U.S. Methane Emissions Mitigation Industry*, DATU RSCH. (2021), https://www.edf.org/sites/default/files/content/FindMeasureFixReport2021.pdf; EPA, *Methane Detection Technology Workshops – August 23 and 24, 2021*, https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/epa-methane-detection-technology-workshop (last accessed August 14, 2023).
[303] Highwood 2022.

drones, mobile ground labs, aircraft, satellites, and continuous measurement. Significant innovation is expected to continue over the next decade.

- **Advanced methods are commercially available today and adoption rates are accelerating.** A growing number of operators in all segments of the supply chain are using advanced solutions to detect, localize, and quantify methane emissions.
- **Growing adoption of advanced solutions in the absence of regulation signals their value and cost-effectiveness.** Many operators are moving to adopt advanced solutions for detecting methane emissions from pipelines despite a general lack of regulations in North America requiring their use. This is a strong indicator of their value to industry.
- **The effectiveness of legacy detection methods remains unclear, despite forming the basis of most regulations.**[304]

Similarly, a comprehensive survey from Datu Research shows that advanced leak detection services are widely available. Datu's survey of service firms offering advanced methane monitoring reveals their abilities and plans to scale up in response to new federal regulations.[305] The report shows that this is a rapidly growing industry—it finds a 90% increase in services firms over the 2017 report,[306] and deems these numbers "almost certainly an undercount in all manufacturing and service categories."[307] Key findings include:

- The industry comprises dozens of job types, with annual salaries ranging from $37,150 to $140,960.
- Most of the firms (70%) are small businesses.
- Nearly 25% of the manufacturing firms and over 40% of the services firms were founded in the past 12 years.
- Firms are adding new U.S. employee locations. In 2021, Datu identified a total of 748 employee locations for manufacturing and service firms, an increase of 26% over the number previously identified.
- Firms anticipate growing jobs. Of 57 firms that responded to Datu's survey, 75% of the manufacturing firms and 88% of the service firms reported that if future state or federal methane emission rules were put in place, they would anticipate hiring more employees.
- These jobs appear poised to grow soon, in light of recent proposed federal regulations and at least eight states preparing to either introduce new methane rules or expand the scope of existing ones.[308]

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[304] *Id.* at 5, 32.
[305] Marcy Lowe, *Advanced Methane Monitoring: Gauging the Ability of U.S. Service Firms to Scale Up*, DATU RSCH. (July 22, 2021), http://blogs.edf.org/energyexchange/files/2021/08/Advanced-Methane-Monitoring-Survey_Datu-Research_8-10-2021.pdf.
[306] Marie Veyrier et al., *Find and Fix: Job Creation in the Emerging Methane Leak Detection and Repair Industry*, DATU RSCH. (2017), https://www.edf.org/sites/default/files/find-and-fix-datu-research.pdf.
[307] *See* Mary Lowe & Robin Lowe-Skillern, *Find, Measure, Fix: Jobs in the U.S. Methane Emissions Mitigation Industry*, DATU RSCH., at appx. A (2021), https://www.edf.org/sites/default/files/content/FindMeasureFixReport2021.pdf.
[308] Mary Lowe & Robin Lowe-Skillern, *Find, Measure, Fix: Jobs in the U.S. Methane Emissions Mitigation Industry*, DATU RSCH., at 3 (2021), https://www.edf.org/sites/default/files/content/FindMeasureFixReport2021.pdf.

An updated 2023 report from Datu on the methane measurement industries' commercial capabilities shows that growth and technological improvements in recent years have allowed for improved detection sensitivities at lower costs.[309] The report is based on a survey conducted in May 2023 via video conference with 15 methane mitigation companies and an accompanying optional written comment submission.[310] Eleven companies reported achieving a Minimum Detection Level (MDL) of 3.8 kg/hr or lower.[311] These companies have worked with a variety of entities to conduct controlled release testing and third-party validation to improve their performance.[312] Companies also provided industry-wide cost estimates, which include: $75-$360/hr for handheld, truck, and drone monitoring; and $20-$1,000/upstream site for drone.[313] This survey underscores that detection capabilities are rapidly advancing, and at the same time, costs are falling.

EPA held a Methane Detection Technology Workshop in August 2021 that highlighted the availability of advanced technologies and included valuable information on their effectiveness, including cost estimates.[314] While the focus of the workshop was on upstream leak monitoring, many of the insights are useful for understanding these technologies and their application to the pipeline sector. Below we summarize key takeaways from this workshop that are relevant to PHMSA's efforts:

- **A layered approach using a combination of technologies may be most effective to achieve high levels of mitigation.**[315] Advanced technologies can quickly and cost-effectively detect larger emitters, achieving significant reductions. Handheld technologies with lower detection limits, like Optical Gas Imaging (OGI) or Method 21, are more effective at finding smaller leaks and may be needed to pinpoint leaks detected during mobile screening.

- **Advanced technologies are cost-effective and significantly reduce emissions.**[316] Advanced technologies are widely used by upstream operators and some leading pipeline operators, small and large, to improve operations and reduce emissions to achieve company-set goals, even without regulatory requirements. Operators described conducting advanced monitoring voluntarily on top of existing regulatory requirements based on the cost-effective improvements secured in operations. For example, Triple Crown Resources, a mid-size Permian operator, said that it "saw a 90% decrease in

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309 DATU RSCH., *Measuring Methane Emissions in the U.S. Oil & Gas Industry: Commercial Capabilities* (2023), https://acrobat.adobe.com/id/urn:aaid:sc:VA6C2:31ec26d5-65fa-4023-944c-6d0e820781a2 [hereinafter "Datu 2023"].
310 *Id.* at 7.
311 *Id.* at 17.
312 *Id.* at 18-19.
313 *Id.* at 23.
314 EPA, Docket No. EPA-HQ-OAR-2021-0317, Methane Detection Technology Workshops (Aug. 23 & 24, 2021) (audio: https://www.regulations.gov/document/EPA-HQ-OAR-2021-0317-0183) (transcripts:https://www.regulations.gov/document/EPA-HQ-OAR-2021-0317-0181) (video: https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/epa-methane-detection-technology-workshop).
315 *See id.* (presentations by: David Lyon, Erin Tullos, Matt Johnson, Triple Crown, Jonah, Project Astra, Project Falcon, BPX, Conoco, and Exxon).
316 *See id.* (presentations by: Triple Crown, TRP, Jonah, BPX, Conoco, and Exxon).

emission volumes in comparison to the first [aerial] survey after just eight months and three surveys."[317] Triple Crown also found that the "first survey paid for itself in approximately five days. Over the next four months, detecting and repairing those emission sources generated $400,000 of profit."[318] Further, "fly[ing] over all of Triple Crown's 23,000 acres, survey[ing] over 200 assets *including pipelines*, deploy[ing] a follow-up OGI camera crew, and roustabout crew to verify and repair every leak that was detected by Kairos" cost Triple Crown "less than $25,000."[319]

- **Comprehensive coverage is already deployed by leading operators.**[320] Triple Crown indicated that it was able to survey across its facilities, not just those subject to EPA requirements, using advanced screening approaches.[321] Jonah Energy stated that increasing the frequency of its surveys to monthly and using continuous monitoring significantly reduced emissions and led Jonah to conduct monthly surveys at all its sites.[322] BPX stated that it has established a goal to install measurement technologies at all major oil and gas processing sites by 2023[323] and that it began using drones across all its operations in 2019.[324] Exxon said it can survey 30-65 facilities per day using aerial surveys,[325] which allow for near pinpointing of sources and immediate deployment of repair technicians.[326]

- **Upstream cost estimates:** OGI – $600/site/inspection[327]
Aerial – $100-300/site, quarterly for $1,600/facility[328]
Drone – $2,700-3,500/annually[329]
Continuous – $1,000-5,000 annually[330]

Types of Advanced Methane Monitoring Technologies. A broad range of advanced methane monitoring technologies are available and can be utilized by operators to detect, pinpoint, and quantify fugitive emissions. Over the past decade, rapid innovation has led to a diverse array of advanced methods: there are now at least 100 distinct methane measurement technologies that are commercially available for leak monitoring in the oil and gas industry.[331] Widespread adoption and deployment of emerging technologies—even in the absence of regulatory

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[317] EPA, Docket No. EPA-HQ-OAR-2021-0317, *Methane Tech Workshop Transcript Day One - Part 1*, at 39 (Aug. 23, 2021), https://www.regulations.gov/document/EPA-HQ-OAR-2021-0317-0181 .
[318] *Id.* at 40.
[319] *Id.*
[320] *See* presentations by: Triple Crown, Jonah, BPX, Conoco, and Exxon.
[321] EPA, Docket No. EPA-HQ-OAR-2021-0317, *Methane Tech Workshop Transcript Day One - Part 1*, at 40 (Aug. 23, 2021), https://www.regulations.gov/document/EPA-HQ-OAR-2021-0317-0181.
[322] *Id*. at 62.
[323] EPA, Docket No. EPA-HQ-OAR-2021-0317, *Methane Tech Workshop Transcript Day Two*, at 38, https://www.regulations.gov/document/EPA-HQ-OAR-2021-0317-0181.
[324] *Id.* at 41.
[325] *Id.* at 59.
[326] *Id.* at 50.
[327] *Id.* (Erin Tullos and Arvind Ravikumar).
[328] *Id.* (Erin Tullos, Arvind Ravikumar, and Matt Johnson (TRP $1,600/facility/quarterly)).
[329] *Id.* (TRP).
[330] *Id.* (Erin Tullos and TRP.)
[331] Mary Lowe & Robin Lowe-Skillern, *Find, Measure, Fix: Jobs in the U.S. Methane Emissions Mitigation Industry*, DATU RSCH., at 3 (2021), https://www.edf.org/sites/default/files/content/FindMeasureFixReport2021.pdf.

requirements—demonstrates their cost-effectiveness and the opportunity to incorporate these methods into regulations.

Methane monitoring technologies can be classified in several ways. Generally, technologies can be grouped into screening or mobile (i.e., aerial or vehicle-based) and close-range or handheld (i.e., OGI and Method 21). Most close-range methods are handheld instruments that can diagnose individual leaks at the component scale. Screening technologies, including those mounted on planes and vehicles, can quickly find abnormally emitting facilities for follow-up with close-range methods. Detection capabilities vary greatly and typically increase with proximity to the emission source. However, technologies that monitor from farther away, like aircraft and satellites, are usually much faster and can cover broad geographic areas frequently.[332] Many mobile screening technologies may require use of close-range methods for directed follow-up to pinpoint emission sources detected during screening. The use of mobile screening technologies has grown rapidly across the oil and gas sector in the last few years, especially in the upstream sector.[333] Screening frequently for large leaks can be more effective than less frequent, close-range inspections.[334]

In general, detection sensitivity declines with spatial scale of measurement, meaning those farthest from the source will be less able to detect smaller emissions. However, there is typically a trade-off between sensitivity and survey speed, and the cost of deployment tends to decline as speed increases. For example, aerial surveys with high detection limits are low cost and can quickly cover broad areas but will only detect the largest emission events, missing smaller leaks. By contrast, close range handheld methods can detect smaller emission sources, but may be time consuming to deploy across large mileage pipeline systems.

Methane detection methods differ not only in performance but also in the types of sources that can be identified and how these sources are characterized. For example, a recent study using aerial surveys identified far fewer–but much larger–sources than handheld surveys performed at the same time (39 vs 357 sources, respectively).[335] Many of the leaks found during the handheld survey were too small to be seen by aircraft. This indicates that full coverage of a system is most effective with multiple technologies. Simulation studies have shown that a combination of technologies can be effective under the right circumstances.[336]

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[332] *Id.*

[333] *See* Highwood 2022; Mary Lowe & Robin Lowe-Skillern, *Find, Measure, Fix: Jobs in the U.S. Methane Emissions Mitigation Industry*, DATU RSCH., at 3 (2021), https://www.edf.org/sites/default/files/content/FindMeasureFixReport2021.pdf;; *see also* Press Release, Scientific Aviation, Major Energy Companies Join Forces to Battle Methane Emissions, Launching Project Falcon (Mar. 1, 2021), http://www.scientificaviation.com/major-energy-companies-join-forces-to-battle-methane-emissions/.

[334] Docket No. EPA-HQ-OAR-2021-0317, Attachment L (FEAST National Slides), https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0317-0844.

[335] David R. Tyner & Matthew R. Johnson, *Where the Methane Is—Insights from Novel Airborne LiDAR Measurements Combined with Ground Survey Data*, 55 ENV. SCI. TECH. 9773 (2021), https://pubs.acs.org/doi/10.1021/acs.est.1c01572

[336] Thomas Fox et al., *A review of close-range and screening technologies for mitigating fugitive methane emissions in upstream oil and gas*, 14 ENV. RES. LETT. 053002 (2019), https://iopscience.iop.org/article/10.1088/1748-9326/ab0cc3/pdf.

When considering the performance of a monitoring approach, it is important to distinguish between technologies and methods. Technologies include deployment platforms and sensor types, while methods include work practices and follow up procedures that are followed when deploying the technology. Understanding the methods in combination with the technology is critical when evaluating performance.[337] Evaluation of the emission reductions achieved requires consideration of the inspection/screening frequency, detection limits, mass/volumetric flow rate of the leak, and repair timelines. For example, substantial reductions can be achieved when shorter repair timelines are required for sources with larger emissions detected during screening. This is consistent with PHMSA's current regulations which require faster repair times for larger leaks. Another element of a leak detection work practice that can greatly influence the effectiveness of the program is the time frame and threshold for which follow-up through a close range inspection is required. For example, if follow-up and repair is only required for the largest leaks, overall mitigation effectiveness will be lower than a work practice requiring follow-up on all leaks or a larger subset of leaks because the universe of small leaks not addressed can collectively represent significant emissions.

Technologies typically consist of sensors and deployment platforms. Sensing modes include point measurement of ambient mixing ratios, path integrated laser-based measurements (active imaging), and column-integrated passive imaging. Sensors can be broadly categorized as:

- **Point sensing** (in plume sensing) – Point sensors range from simple solid-state metal oxide detectors to complex cavity ringdown spectrometers (CRDS) and gas chromatographs. Point sensors can be deployed on any platform that passes through methane plumes.

- **Active imaging** (remote sensing) – Active imaging systems generate sources of light that traverse methane plumes, reflect off a remote surface, and return to a detector. Changes in the reflected light are used to infer methane concentrations along the path. A common example is Light Detection and Ranging (LiDAR).

- **Passive imaging** (remote sensing) – Passive imaging systems use natural light to measure methane concentration in the atmosphere. They are used in all types of platforms, ranging from infrared (IR) cameras to satellite imagery.

- **Non-methane** – Many sensors infer the presence of leaks by measuring variability in pressure, temperature, vegetation growth, physical disturbance of equipment or the areas nearby, and other proxies.[338]

Deployment platforms can be broadly classified into the following categories:

- **Handheld[339] -** Handheld instruments are among the most widely used approach – especially for distribution lines. Handheld technologies may be used on their own in an exhaustive search for leaks or as a follow up method in combination with mobile

[337] *See id.*
[338] Highwood 2022.
[339] *Id.* at 23.

screening technologies. Most handheld instruments are point sensors, which means they must be in close proximity to the leaking component. Optical gas imaging (OGI) cameras are a specialized version of infrared (IR) or thermal imaging cameras that allow users to visualize methane leaks. The primary limiting factors for both sniffers and OGIs are weather and the highly labor-intensive nature of operation. Depending on the size of the facility or number of miles, full surveys could take days to months to complete.

- **Aircraft**[340] – Passenger aircraft, both planes and helicopters, can be equipped with various sensor technologies and used at different elevations and frequencies. These factors, along with the methodologies used, affect survey speed and detection capabilities. Some aerial technologies or methods may use remote sensing and fly higher and faster to achieve broad coverage more rapidly.[341] Other aerial technologies and methodologies may call for lower and slower flights or use a technology with a higher sensitivity that detects more emission events but achieves less coverage in the same time period. Aircraft detection limits range from a few kilograms of methane per hour to tens of kilograms per hour. This technology is readily available for deployment and has undergone multiple third-party controlled release tests to verify performance metrics for aboveground infrastructure. Specifically, for the pipeline use case, the main advantage of aircraft technologies is the more significant spatial scale, providing the ability to survey hundreds of miles of pipeline per day or, depending on the infrastructure density, hundreds of sites per day. An industry expert estimates that aircraft can monitor pipelines at a cost of $20-100/mile The primary limiting factors for aerial methods are weather (high winds, precipitation, cloud cover), variable reflectivity from uneven snow cover, and flight permits.

- **Unmanned Aerial Vehicles (UAVs)**[342] – Also called drones, can fly very close to the source of plumes. They can be equipped with IR cameras and other relatively small, lightweight sensor devices and, like aircraft, can operate in three-dimensional space. Some UAV systems use point measurement technologies that directly measure methane concentrations. These point measurement UAVs are often more sensitive than aircraft techniques because of their ability to fly closer to the methane source. For pipeline leak surveys, UAVs present some unique advantages, especially when combined with close-range follow-up surveys. However, additional work is needed to properly benchmark critical performance metrics for buried infrastructure, such as minimum detection limits under different conditions. Drone systems may show promise for surveying hard to access pipeline right of ways (e.g., steep terrain, wetlands, or water bodies). The primary limitations for this technology are weather, the distance from the operator, and the relatively short flight times of a few hours (at most).

- **Mobile Ground Labs (MGLs)**[343] – Consisting of a vehicle with a global positioning system and a methane sensor, MGLs enable an operator to generate a map of methane

[340] *Id.* at 24.
[341] *See, e.g.*, EDF, *MethaneSAT Adds Jet Aircraft to Methane Measurement Arsenal* (June 26, 2023), https://www.edf.org/media/methanesat-adds-jet-aircraft-methane-measurement-arsenal.
[342] Highwood 2022.
[343] *Id.*

concentrations along the vehicle's path. Because it is limited to the path (usually a road), this method collects data in a two-dimensional space. Typically, MGLs will also measure environmental conditions, especially wind speed, wind direction, temperature, and humidity. MGLs can take an active or passive approach to surveying. The active approach entails MGLs driving a predetermined route along the infrastructure to be monitored, while the passive approach entails mounting sensing equipment on vehicles performing unrelated tasks, like delivery trucks. The passive approach could prove beneficial for identifying leaks on distribution pipeline networks that are heavily trafficked, but would not appropriately replace safety and environmental compliance surveys. However, gathering and transmission pipelines require an active approach due to their remoteness.[344]

- **Continuous Monitoring[345]** – These systems are unique in that they are stationary. Fixed sensors are installed at a facility—typically in high-risk areas—to provide continuous, real-time readings of methane concentration and will trigger an alarm if concentrations exceed certain limits. Fixed and continuous monitoring technologies can be divided into active and passive categories. Active continuous monitors regularly scan an entire site or use a laser detector to monitor a large area of the site for emissions. Tower-based systems provide even greater coverage and can scan broadly from a single location. Passive continuous monitors use point sensors to monitor a single location at the site. For passive sensors to detect a leak, the emission plume must be carried via the wind to the location of the sensor; therefore, these kinds of sensors must be deployed in larger numbers to achieve coverage comparable to that of an active continuous monitor. To our knowledge, there have been no deployments of aboveground continuous measurement systems to monitor pipeline emissions due to the vast distances involved.

- **Satellites[346]** – Satellites equipped to measure methane concentrations can be combined with other data to identify large sources of emissions.[347] Many methane-sensing satellites currently exist, and still more are in development.[348] These systems are diverse in form and function; some have very high minimum detection limits and therefore are better suited to detect large plumes, while others with improved sensitivity are capable of detecting smaller sources.[349] Minimum detection limits of satellites have been estimated to be between 1,000 and 7,100 kg CH_4/hr, meaning they are not suitable for detecting emissions other than large super-emitters.[350]

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[344] *Id.*
[345] *Id.*
[346] *Id.*
[347] Marcy Lowe & Robin Lowe-Skillern, *Find, Measure, Fix: Jobs in the U.S. Methane*, DATU RSCH. (2021); Highwood 2022.
[348] *See, e.g.*, EDF, *MethaneSAT Adds Jet Aircraft to Methane Measurement Arsenal* (June 26, 2023), https://www.edf.org/media/methanesat-adds-jet-aircraft-methane-measurement-arsenal.
[349] *See, e.g.*, EDF, *MethaneSAT*, https://www.methanesat.org/; Daniel J. Jacob et al., *Quantifying Methane Emissions from the Global Scale Down to Point Sources Using Satellite Observations of Atmospheric Methane*, 22 ATMOS. CHEM. & PHYS. 14 (2022), https://acp.copernicus.org/articles/22/9617/2022/acp-22-9617-2022-assets.html.
[350] Highwood 2022.

Over the past decade, there has been considerable innovation in advanced methane detection strategies. Significant advancements have occurred in technologies and deployment platforms, but also in the most effective methodologies and work practices. These advancements, which have largely occurred as the result of voluntary action by leading operators as well as researchers, can inform effective and forward-looking regulations.

B. Fugitive Emissions Abatement Simulation Tool (FEAST) for Pipeline Systems

Emissions simulation models such as the Fugitive Emissions Abatement Simulation Tool (FEAST) or LDAR-Sim can be used to estimate the efficacy of different leak monitoring technologies and work practices in different emissions scenarios and at varying frequencies. The open source version of FEAST combines a stochastic model of methane emissions at upstream oil and gas facilities with a model of leak detection and repair (LDAR) programs to estimate the efficacy and cost of methane mitigation. Probabilistic models like FEAST simulate the generation, detection, and mitigation of emissions to compare the effectiveness of LDAR programs with different technologies and work practices. For scientifically rigorous comparisons, models simulate emissions detection based on independent, controlled-release testing under diverse environmental conditions such as wind speed. These models are sensitive to assumptions such as leak rate distributions and repair effectiveness, so it is critical that models use accurate assumptions that are nationally representative and also test results against different likely emission distributions.

EPA recently relied on the FEAST model to determine the proposed frequency and detection thresholds for advanced technologies that would be used for compliance with regulatory LDAR requirements at upstream production sites.[351] Specifically, EPA's proposal provided two compliance pathways for LDAR, both of which EPA proposed would achieve equivalent emission reductions based on the results of the FEAST model.[352] First, EPA proposed a pathway based on OGI and AVO LDAR at frequencies varying across four categories of site types. Second, EPA proposed an advanced technology pathway based on two matrices of options, one of which would apply to sites that would otherwise be subject to quarterly OGI and the other which would apply to sites subject to semiannual OGI or AVO. Each proposed matrix provides multiple technology options based on median detection threshold at varying frequencies. In general, the more sensitive technologies can be used less frequently, while less sensitive technologies must be used more frequently, up to monthly. Based on the results of the FEAST model, EPA proposed that each option would lead to equivalent emission reductions and would therefore be permissible alternatives. After finalizing the regulations, EPA would review applications for alternative test methods to vet and approve technologies for use, ensuring that they can achieve the detection threshold claimed. Once approved those technologies can then be deployed at the appropriate frequency set forth in the matrices.

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[351] *See* EPA, Regulatory Impact Analysis of the Supplemental Proposal for the Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review, Appendix D, https://www.regulations.gov/document/EPA-HQ-OAR-2021-0317-1566.
[352] 87 Fed. Reg. 74742-43, https://www.regulations.gov/document/EPA-HQ-OAR-2021-0317-1460.

Like EPA, PHMSA can and should rely on results from these simulation models to estimate the potential reductions achievable from the use of different technologies at different frequencies for pipeline LDAR programs. These results can then inform the parameters that PHMSA promulgates under the final regulatory approaches. Similarly, PHMSA should coordinate with EPA during the alternative test method approval process, which could include relying on EPA approvals, with appropriate review and vetting as it relates to pipeline LDAR programs, to allow the use of some of the same technologies for compliance with this final regulation.

FEAST and LDAR-Sim have not traditionally been used to evaluate pipeline leak detection and repair programs, and the open source versions are not able to simulate the pipeline sector. We worked with Dr. Arvind Ravikumar who has developed a pipeline-specific version of the FEAST model that we used to estimate the effectiveness of various technologies across the distribution, transmission, and gathering segments. The entirety of the FEAST modeling results, and a detailed methodology are included as Attachment A. Here, we describe how the model was built for each segment and the input assumptions. The following section provides an explanation of the results and the implications for PHMSA's rulemaking.

Distribution. To develop a model representative of the distribution segment, we relied on pipeline miles by age and material taken from Weller et. al., 2020 for the 2017 PHMSA reporting year. We then simulated a network of 100 miles of distribution pipelines with composition similar to Weller et al., 2020. The model was then calibrated to the mileage weighted average leaks per mile derived by material and age specific activity factors determined by Weller et. al., 2020. Specifically, the baseline leakage was calibrated based on Weller et. al., of 0.69 Tg CH4/year, or 16 Tons CO_2e mile^{-1} y^{-1}.

Transmission. To build and calibrate a model representative of the transmission segment, where data is scarce, we again relied on activity factors for the transmission sector based on the Weller et. al., 2020 activity factor estimates for material and age. We assumed, in the absence of empirical data, that the mileage weighted average activity factor for the transmission sector is approximately double the distribution sector. Emissions information across transmission pipelines are not available. We therefore assumed an emissions distribution similar to the gathering and boosting sector. It includes two distributions – a normal emitter distribution (Weller et al. 2020) and a super-emitter distribution (Yu et al. 2022). Pipeline material and age data for the transmission sector was collected from PHMSA reported mileage, where pipeline age is reported by the decade in which it was installed. We assumed that pipeline materials other than coated-steel are negligible as most transmission pipeline miles are reported as coated-steel.

Gathering. To build a model representative of pipelines in the gathering segment, we developed an emissions distribution based on both normal fugitives (Weller et al. 2020) and super-emitters (Yu et al. 2022), resulting in a skewed emissions distribution consistent with the published literature. This means that emissions reductions in gathering depend more on effectiveness in detecting and repairing large emitters than in other segments. To calibrate the model, we used activity factors for the gathering sector based on the Weller et. al., 2020 activity factor estimates for material and age. We assumed, in the absence of empirical data, that the mileage weighted average activity factor for the gathering segment is approximately double the distribution sector. Super-emitters were also included as part of the emissions distribution based on data from the

Permian basin (Yu et al. 2022). Pipeline material and age data was collected from PHMSA reported mileage when available.

C. FEAST results demonstrate the efficacy of implementing advanced detection technologies, increased survey frequency, and faster leak repair times to mitigate additional methane emissions.

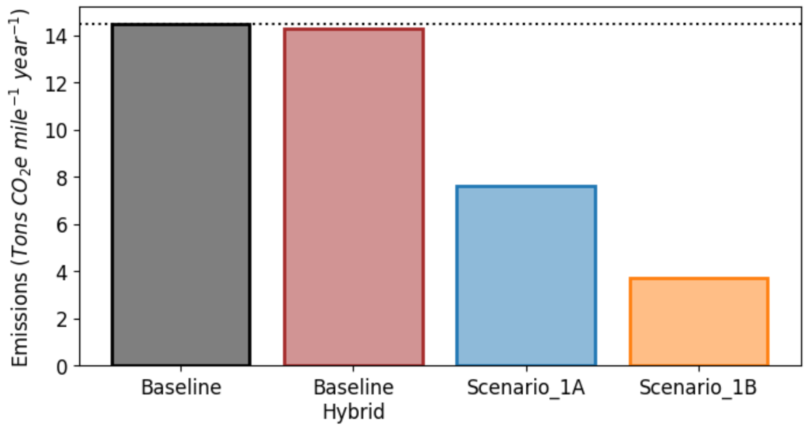
In this section, we explain the results of the FEAST pipeline modeling as well as the implications of these results for PHMSA's rulemaking. As a general matter, the modeling results show that advanced technologies are highly effective when deployed at the appropriate frequency and can achieve greater emission reductions than legacy methods. Within each segment, we modeled a variety of technologies at various frequencies to estimate their effectiveness in finding leaks, which, along with the corresponding repair requirements, show the mitigation effectiveness. The modeling results are presented in bar charts that compare a baseline approach, representing existing regulatory requirements, to improved approaches, which include improved technology requirements, survey frequencies, and repair timelines. The bars represent residual emissions, meaning the remaining methane emissions from leakage that are not mitigated by the modeled approach. A smaller bar therefore represents a *more effective* approach that mitigates more emissions and leaves fewer residual emissions. Below is a segment-by-segment description of the results.

Distribution

In the distribution segment, which is characterized by many smaller leaks, the results show that more sensitive technologies are more effective. Technologies with higher detection thresholds do not perform as well because they miss the majority of emissions that are comprised of leaks they cannot detect. For this segment we modeled: a handheld technology, corresponding to performance of OGI or Method 21; advanced mobile technologies with detection thresholds of 1, 3, 10, and 30 kg/hr; and a CRDS with a 0.2 kg/hr detection threshold. We also modeled legacy and improved repair timelines. The improved repair timelines used include: Grade-1: 10 days; Grade-2: 180 days; Grade-3: 720 days; and super-emitter (any grade): 30 days. We examined different leak survey frequencies, including: once every 5 years; once every 3 years; annual; semiannual; and quarterly. Note that some scenarios applied different survey frequencies based on whether pipelines are inside or outside a business district – these scenarios assumed that 5% of pipes are inside and 95% of pipes are outside a business district, based on PHMSA's own assumptions.

Overall, handhelds demonstrate high performance due to high sensitivity, and the most sensitivity mobile survey option also demonstrated high performance. The results in Figure 2 below show that increasing survey frequency with high-sensitivity handheld technologies can achieve significant emissions mitigation (>50%), especially when deployed annually at all distribution lines with implementation of the improved repair timelines proposed in the Proposed Rule (scenario 1B in Figure 2 below).

Figure 2: Comparing Varying Frequencies and Repair Requirements, Using Handheld Technologies



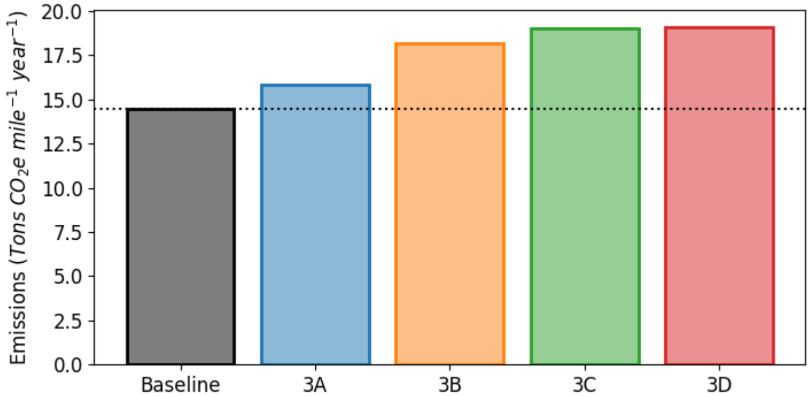
Key
Baseline: handheld, once/5 years (all lines), legacy repair rules
Baseline Hybrid: handheld, once/5 years (95% lines), annual (business districts), legacy repair rules
Scenario 1A: handheld, once/3 years (all lines), new repair rules
Scenario 1B: handheld, annual (all lines), new repair rules

We also found that a requirement to repair the top 20% of leaks within 30 days could increase emissions reduction by about 2 t CO2e/mi/yr, equivalent to an additional 12%.

When examining less-sensitive technologies, we found that they did not perform as well because a significant portion of total emissions were below their detection thresholds. Methane detection technologies with detection thresholds of 1 kg/hr – 30 kg/hr may be deployed on various mobile pathways (plane, drone, vehicle), and this modeling scenario does not explicitly assume which mobile pathway is used, but rather compares mitigation by detection threshold. For distribution systems, the FEAST model demonstrates that while aerial systems can detect distribution system emissions at a regional scale—which can be useful to evaluate methane levels for an urban area as a whole[353]—they cannot detect individual point sources of similar volumes as found in Weller et al. 2020. This was true even when they were deployed at an identical frequency and with the same repair timelines. As demonstrated below in Figure 3, aerial systems even performed worse than the baseline scenario of handheld technology, suggesting that these technologies are not well suited for maximizing leak identification in the distribution segment.

[353] Plant et al., Large Fugitive Methane Emissions from Urban Centers Along the U.S. East Coast, Geophysical Research Letters, 46, 8500–8507 (2019), https://doi.org/10.1029/2019GL082635.

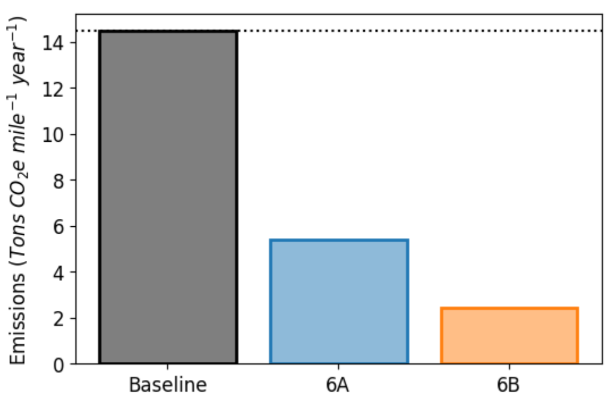
Figure 3: Comparing Mobile Systems (1, 3, 10, 30 kg/hr) at 3 Year Frequency



Key
Baseline: handheld, once/5 years (all lines), legacy repair rules
Scenario 3A: 1 kg/hr, once/3 years (95% lines), annual (business districts), new repair rules
Scenario 3B: 3 kg/hr, once/3 years (95% lines), annual (business districts), new repair rules
Scenario 3C: 10 kg/hr, once/3 years (95% lines), annual (business districts), new repair rules
Scenario 3D: 30 kg/hr, once/3 years (95% lines), annual (business districts), new repair rules

Last, mobile cavity ring down spectroscopy ("CRDS") survey technology can achieve significant mitigation compared to the baseline when deployed at the 3 year and annual frequency--emissions mitigation of 62% and 83%, respectively, compared to baseline, as shown below. CRDS measures methane concentration at parts per billion (ppb) levels of precision, combined with high-precision GPS and other inputs to generate leak flow rate, or emission rate, leak indications. CRDS pairs with data analytics software to consider variation in background methane concentration, identify significant and actionable elevated readings that may be from a leak, and screen out false positives.

Figure 4: Mobile CRDS Compared to Baseline at Varied Frequencies



Key
Baseline: handheld, once/5 years (all lines), legacy repair rules
Scenario 6A: Mobile CRDS, once/3 years (all lines), new repair rules
Scenario 6B: Mobile CRDS, annual (all lines), new repair rules

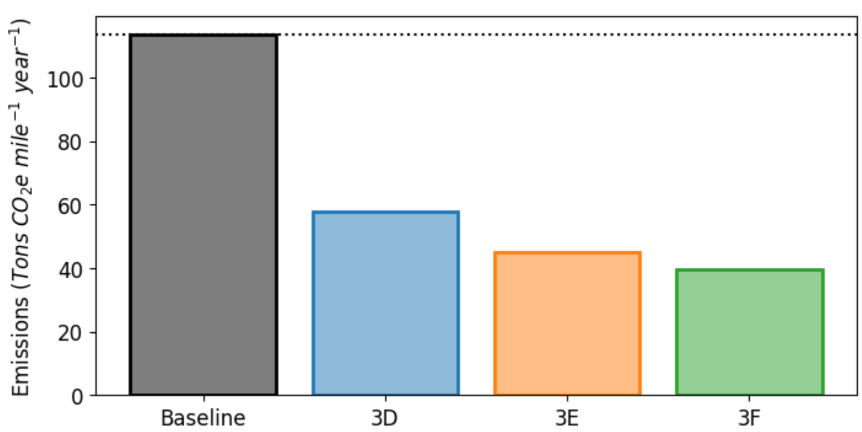
Because emissions in the distribution system are dominated by many leaks on a smaller scale than upstream systems, it is critical that only very sensitive technologies be permitted for leak detection purposes. The FEAST results suggest that sensitive handheld technologies and sensitive mobile CRDS technologies are likely to be effective in the distribution segment, while technologies with detection thresholds of 1 kg/hr and above are not effective.

Transmission

The results for transmission and gathering are significantly different than distribution, with the advanced aerial technologies demonstrating high effectiveness over the baseline. In the model, this is primarily attributed to the emissions distribution and the fact that advanced technologies can rapidly and effectively detect large emitters for mitigation. In transmission and gathering, large emitters make up a much greater portion of the total emissions than in distribution. For this segment we modeled: a handheld technology, corresponding to performance of OGI or Method 21; and advanced mobile technologies with detection thresholds of 1, 3, 10, and 30 kg/hr. We also modeled legacy and improved repair timelines. The improved repair timelines used include: Grade-1: 10 days; Grade-2: 180 days; Grade-3: 720 days; and super-emitter (any grade): 30 days. We examined different frequencies, including: annual; semiannual; and quarterly.

The modeling shows handheld technologies being effective when deployed frequently; however, deploying a sensitive handheld technology across the large geographic range of transmission lines would be labor intensive and likely cost prohibitive at a regular frequency, particularly considering the potential remote location of transmission lines (compared with distribution pipes that run along roads), and challenges with accessibility to walk along pipeline rights of way. As expected, the results show greater mitigation with increasing frequencies and with better detection thresholds.

Figure 5: Comparing Survey Frequencies (Annual, Semiannual, Quarterly) Using 3 kg/hr Mobile Technology



Key
Baseline: handheld, annual, legacy repair rules
Scenario 3D: 3 kg/hr, annual, new repair rules
Scenario 3E: 3 kg/hr, semiannual, new repair rules
Scenario 3F: 3 kg/hr, quarterly, new repair rules

Both the 1kg/hr and 10kg/hr technologies show similar results, with 1kg/hr achieving slightly better mitigation and 10kg/hr achieving lower mitigation. The results suggest a detection threshold of 3 kg/hr or less would be appropriate for the transmission segment. This is particularly true given that such technologies are known to be effective and there is significant uncertainty around the presence or lack of large emitters in this segment. One general challenge with evaluating options for transmission pipelines is the lack of public datasets on leaks,[354] which could potentially be remediated through improved reporting standards in this rulemaking.

Gathering

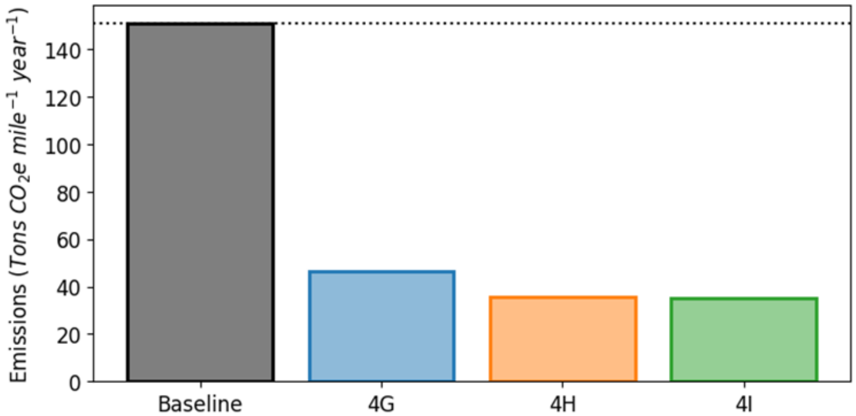
The gathering segment is thought to have a heavy-tailed distribution (at least in certain basins), similar to production, meaning that large emitters make up a significant portion of total emissions. Because of this, technologies that can detect those large emitters may perform well. This is borne out in the modeling results, which show that most mobile technologies with detection thresholds between 1 – 30 kg/h are effective in emissions mitigation. Unlike the production segment, where emissions are highly intermittent, the results for gathering show limited additional reductions from increasing survey frequency because most super-emitters are detected in the initial survey. However, given the limited data characterizing intermittency in gathering, we urge PHMSA to take a more protective approach when determining the appropriate frequency. We also note that earlier detection of super-emitters will lead to earlier mitigation, improving health and environmental outcomes. Importantly, the uncertainty in emissions reductions estimated by the model are also significantly higher than the distribution segment because of the presence of super-emitters, which occur randomly within the simulation.

For this segment, we again modeled the baseline technology against advanced mobile methods at 1, 3, 10, and 30 kg/hr detection thresholds. We also modeled the legacy leak repair timing requirements and improved requirements which are: grade-1: 10 days; grade-2: 180 days; grade-3: 720 days; super-emitter (any grade): 30 days. The results look only at a representative segment of gathering lines, and therefore do not draw any conclusions related to the coverage of regulated or unregulated lines.

The results show greatly improved (and similar) performance of all advanced mobile technologies compared to the baseline. They also show high-performing handheld technologies mitigating significantly more emissions than the baseline. Below are results for a 10kg/hr technology at an annual, semiannual, and quarterly frequency.

[354] *See* Attachment B, Renee McVay, Methane Emissions from U.S. Gas Pipeline Leaks, Env't Def. Fund (Aug. 2023), https://www.edf.org/sites/default/files/documents/Pipeline%20Methane%20Leaks%20Report.pdf.

Figure 6: Comparing Multiple Frequencies Using 10kg/hr, Compared to Baseline



Key
Baseline: handheld, once/2 years, legacy repair rules
Scenario 4G: 10 kg/hr, annual, new repair rules
Scenario 4H: 10 kg/hr, semiannual, new repair rules
Scenario 4I: 10 kg/hr, quarterly, new repair rules

As shown, increasing survey frequency increases mitigation, but not substantially beyond the semiannual frequency. Results for the 1, 3, and 30 kg/hr technologies are all similar because the super-emitters making up the majority of the total emissions can be detected by any of these options. However, this is based on limited data gathered from the Permian basin, and there are likely greater emissions in the <10 kg/hr range than assumed by the model, especially in basins with less heavy-tailed distributions. The results therefore support requiring a detection threshold of 10 kg/hr or lower to ensure appropriate mitigation occurs nationwide. We likewise urge PHMSA to finalize improved repair timelines to ensure large climate-damaging and dangerous leaks are rapidly mitigated.

V. Advanced Leak Detection Programs

A. Leak Detection Equipment

We support PHMSA's proposal to require the use of leak detection equipment during surveys for all distribution pipelines.[355] The current leak survey requirements do not clearly specify the use of leak detection equipment for leak surveys. By clearly requiring leak detection equipment, PHMSA has strengthened the leak survey standards to ensure leaks not readily detectable by non-equipment methods, such as human senses, can be detected and ultimately repaired - improving safety and reducing methane pollution.

We also support PHMSA's proposal to require the use of leak detection equipment during onshore gas transmission and gathering pipeline surveys.[356] However, we oppose the exception

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[355] Proposed Rule at 31933.
[356] Proposed Rule at 31933.

provided for Class 1 and Class 2 gas transmission and gathering pipelines as this creates an inappropriate loophole. Specifically, we oppose any exception that would allow operators to conduct leak surveys solely based on the use of human/animal senses as this exception is counter to PHMSA's obligation to prioritize both environmental and public safety benefits.[357]

As proposed, this exception would allow onshore gas transmission and gathering pipeline operators to "determine that a survey using human senses would be sufficient."[358] Methane detection technology is vastly more effective than human/animal senses and this exception would wrongly allow operators to avoid deploying advanced leak detection technology, as Congress intended.

It is not appropriate to exempt rural transmission and gathering pipelines from the use of leak detection equipment when performing leak surveys. PHMSA's proposed standards are designed to protect public safety and the environment, but the proposed exception ignores the fact that methane leak environmental impacts are not dependent on the geographic location of the leak. Specifically, an exception for these rural pipelines implies there is a less significant environmental impact or safety implication simply because the pipeline is located away from populated areas. On the contrary, the results of various aerial surveys indicate that rural pipelines do experience significant leaks that not only contribute to methane's impact on climate change, but that also put operator employees and contractors at risk when working near the pipeline.[359] Furthermore, widespread commercial availability of aerial methane survey technologies demonstrates that it is unnecessary and inappropriate to allow operators to rely solely on human senses for leak surveys. If an operator can access their infrastructure via flyover patrol without technology, that infrastructure can also be flown over with aerial leak detection technology.

B. Leak Detection Technology Standards & Advanced Leak Detection Performance Standard

We are generally supportive of PHMSA's proposal to strengthen the leak detection requirements for distribution, transmission, and gathering pipelines as this will result in providing both public safety protections but also reduce environmental impacts. However, to ensure wider use of commercially available advanced leak detection technologies and simplify implementation of an Advanced Leak Detection Program (ALDP), PHMSA should adopt clearer final standards for ALD performance.

Performance Standards

PHMSA proposes two performance standards: (1) a minimum detection sensitivity of 5 parts per million (ppm) for each gas surveyed[360] and (2) an ALDP capable of "detecting all leaks that

[357] Proposed Rule at 31891.
[358] Proposed Rule at 31933.
[359] See Jevan Yu et al., *Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin*, 9 Evn't Sci & Tech. Letters 969 (2022); Daniel H. Cusworth et al., *Strong methane point sources contribute a disproportionate fraction of total emissions across multiple basins in the United States*, 119 PNAS e2202338119 (2022), https://doi.org/10.1073/pnas.2202338119; EDF, *Permian Methane Analysis Project*, https://www.permianmap.org/.
[360] Proposed Rule at 31977.

produce a reading of 5 ppm or greater…from a distance of 5 feet from the pipeline."[361] While these proposed performance standards are consistent with each other and reflect the capabilities of some commonly used handheld leak detection devices, these performance standards potentially exclude the use of advanced remote sensing technologies. We recommend adding to the proposed performance standards to allow and require the use of advanced leak detection technologies.

Many advanced leak detection technologies measure the flow rate of emissions rather than providing a gas concentration reading. In fact, the concentration of any emissions plume can vary considerably based on the distance away from the leak source and wind speed and direction. When looking at handheld technologies, such as a flame ionization detector commonly used for EPA Method 21 leak surveys, a common problem with failure to detect leaks is due to the probe placement. The EPA LDAR Best Practices Guide states that, "placing the probe even 1 centimeter from the interface can result in a false reading, indicating that the component is not leaking, when in fact it is leaking."[362] Other technologies have similar limitations when utilizing concentration-based standards.

The proposed concentration-based standards may unintentionally omit many of the commercially advanced detection technologies for which evaluation is required in the proposed ALDP. Specifically, PHMSA proposes to require operators to analyze the appropriateness of the following technologies, some of which were referenced in the PIPES Act of 2020: "leakage surveys with optical, infrared, or laser-based handheld devices; continuous monitoring via stationary gas sensors, pressure monitoring, or other means; mobile surveys from vehicle, satellite, or aerial platforms; and systemic use of other technologies capable of detecting and locating leaks consistent with the proposed ALDP performance standard at § 192.763."[363] First, the concentration-based standards appear to not allow the use of OGI, in any deployment platform (handheld, drone-mounted, or fixed) because OGI does not provide a concentration reading of any gas but instead provides a visual image when the flow rate of a gas is above its minimum detection threshold. Similarly, the proposal appears to intend to allow the use of open path infrared tunable diode laser absorption spectroscopy, however this technology may not meet the proposed concentration-based standard when mounted on an aircraft - which is a common deployment platform currently utilized by the oil and gas industry.

Therefore, we strongly recommend that PHMSA adopt an additional leak equipment and ALDP performance standard that better reflects the detection capabilities of commercially available advanced detection technologies. As discussed in section IV.C of these comments, FEAST simulation modeling permits evaluation of appropriate minimum detection sensitivities and survey frequencies for advanced leak detection technologies for inclusion in the ALDP. Our specific recommendations by industry segment are presented below, and include the use of a layered leak detection program utilizing both handheld and remote/mobile advanced technologies.

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[361] Proposed Rule at 31936.

[362] EPA, *Leak Detection and Repair: A Best Practices Guide*, at 16, https://www.epa.gov/sites/default/files/2014-02/documents/ldarguide.pdf.

[363] Proposed Rule at 31935.

For distribution pipelines, PHMSA should require annual mobile surveys using leak detection equipment with a minimum detection sensitivity of 0.5 kg/hr or less in addition to handheld surveys conducted at least once every 3 years with leak detection equipment meeting the proposed 5 ppm within 5 feet of the pipeline performance standard. Technologies such as CRDS have been used for distribution pipeline leak surveys and have successfully detected leaks that were missed by ground crews using handheld devices.[364] Additionally, the leak distribution data for distribution pipelines indicates that large leaks are not as prevalent as small leaks, therefore, higher thresholds would be much less effective for this industry segment. Annual mobile surveys using technologies at this threshold are recommended as they are estimated to achieve approximately 80% emission reduction when compared to the baseline. This reduction is higher than the 50% reductions expected from handheld equipment surveys conducted annually. Handheld surveys should be simplified to a frequency of once every 3 years for all distribution pipelines because of the effectiveness of the annual mobile surveys and for ease of implementation and compliance. Finally, where the mobile survey indicates the presence of a leak, PHMSA should require the use of handheld leak detection equipment (that satisfies the 5ppm concentration-based threshold) to locate and confirm the specific leak source and verify successful repairs.

For transmission pipelines PHMSA should require aerial screening surveys using leak detection equipment with a minimum detection sensitivity of 3 kg/hr or less . Technologies mounted on airplanes, helicopters, and drones have been used for transmission and gathering pipeline leak surveys and provide a more efficient method of detecting leaks along these pipelines than have ground crews using handheld devices. The simulation results discussed in section IV.C of these comments indicate that higher minimum detection sensitivities may be effective at identifying leaks, however, there is considerable uncertainty in the leak distribution and leak persistence for this segment, which could result in less effective leak surveys if a higher threshold were used. Therefore, we are recommending a minimum detection sensitivity to provide for the greatest protection. Finally, where the remote survey indicates the presence of a leak, PHMSA should require the use of handheld leak detection equipment (with the same concentration-based threshold) to locate the specific leak source and verify successful repairs.

For gathering pipelines PHMSA should require mobile screening surveys using leak detection equipment with a minimum detection sensitivity of 10 kg/hr or less. Technologies mounted on airplanes, helicopters, vehicles, and drones have also been used for gathering pipeline leak surveys and provide a more efficient method of detecting leaks along these pipelines than have ground crews using handheld devices. The simulation results discussed in section IV.C of these comments indicate that a higher minimum detection sensitivity of 30 kg/hr may also be effective at identifying leaks from gathering pipelines, however, these results rely specifically on the presence of large emissions (super-emitters) based on a study from a single basin (Permian).[365] Therefore, we are recommending a minimum detection sensitivity to provide for better protection and to recognize that the presence of super-emitters is expected to decrease as leak surveys continue. Finally, where the remote survey indicates the presence of a leak, PHMSA

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[364] Zachary D. Weller et al., *Vehicle-Based Methane Surveys for Finding Natural Gas Leaks and Estimating Their Size: Validation and Uncertainty*, 52 ENV'T SCI. TECH. 11922 (2018), https://doi.org/10.1021/acs.est.8b03135.
[365] Jevan Yu et. al., *Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin*, 11 ENV. SCI. TECH. LETT. 969 (2022), https://pubs.acs.org/doi/10.1021/acs.estlett.2c00380.

should require the use of handheld leak detection equipment (with the same concentration-based threshold) to locate the specific leak source and verify successful repairs.

These revisions to the ALDP will simplify the requirements, ensure commercially available advanced leak detection technologies are utilized, and achieve improvements to public safety from current leak survey requirements and achieve significant emission reductions.

Leak Detection Equipment

We support PHMSA's proposal to require operators to analyze the appropriateness of advanced leak detection technologies and methods and recognize this as an improvement over the current leak survey requirements. However, this requirement to analyze the appropriateness of these technologies is not sufficient to ensure that operators incorporate the use of these advanced technologies in their ALDP and maximize the mitigation potential of their program. As explained in the comments above related to performance standards, we strongly recommend that PHMSA finalize an ALDP standard hat includes leak surveys utilizing both advanced screening technologies and handheld leak detection equipment. There are distinct advantages of both types of equipment that, when combined, will ensure a robust leak detection program that provides both public safety and environmental protections.

Leak Repairs and Post-Repair Inspections

We support PHMSA's proposed repair requirements, including the prescribed deadline for post-repair inspections to verify repair. We believe that the post-repair inspection is critical to ensuring the success of the repair. However, we recommend requiring the same detection thresholds for post-repair inspections as those used to identify the leak. As proposed, a leak would not be considered repaired unless a gas concentration of 0% gas by volume is detected.[366] This is more stringent than the minimum detection sensitivity that PHMSA proposes for detecting a leak. We believe this more stringent repair threshold will disincentivize the use of more sensitive technologies. PHMSA should adopt the same leak threshold for confirming repair as that used to detect the leak.

C. Alternative ALD Performance Standard

PHMSA has proposed to allow operators to propose and implement an alternative ALDP performance standard for gathering and transmission pipelines in Class 1 and Class 2 areas and part 192-regulated gas pipelines transporting flammable, toxic, or corrosive gases other than natural gas. PHMSA has not provided appropriate justification for allowing alternative performance standards. Further, this alternative ALDP performance standard would not require approval from PHMSA before it is implemented, rather, operators would be allowed to use the alternative if PHMSA does not provide any modifications or disapproval within 90 days of notification of the alternative from the operator. This approval in the absence of action creates a potential loophole where a less effective ALDP could be implemented without clear justification or PHMSA review.

[366] Proposed Rule at 31943.

The basis for allowing an alternative performance standard is not supported with the data available on pipeline leaks. PHMSA states the exemption is proposed "because of the comparatively low emissions from natural gas transmission pipeline leaks (relative to other gas transmission pipeline facilities such as compressor stations), comparatively lower potential safety risks to persons or property in remote areas, and the continued development of methane leak detection technologies."[367] There is little information available on the extent of transmission pipeline leaks.[368] While it may be true that compressor stations have more emissions than transmission pipelines themselves, that alone does not support allowing a different performance standard for transmission pipelines, even those located in remote areas. Similar to the discussion in Section V.A of these comments, it is not appropriate to allow an alternative performance standard (especially one allowed without PHMSA review and approval) for rural transmission and gathering pipelines. PHMSA's proposed standards are designed to protect public safety and the environment, but the proposed justification for this alternative ignores the fact that methane leak environmental impacts are not dependent on the geographic location of the leak. Specifically, an exception for these rural pipelines implies there is a less significant environmental impact or safety implication simply because the pipeline is located away from populated areas. On the contrary, the results of various aerial surveys indicate that rural pipelines do experience significant leaks that not only contribute to methane's impact on climate change, but that also put operator employees (and contractors) at risk when working near the pipeline.[369]

If PHMSA maintains the allowance for operators to request an alternative ALDP performance standard, that standard must be subject to formal review and approval by PHMSA before the standard is implemented. It is inappropriate for default approval of an alternative simply because a self-imposed response deadline has passed. Instead, PHMSA must establish an alternative approval process that clearly states the application and review criteria for any alternative. Implementation would then only occur after PHMSA has determined the operator has demonstrated the alternative is "consistent with pipeline safety and equivalent to the performance standard in §192.763(b)."[370]

See Section XIII(E) of this comment for recommendations regarding the Alternative ALDP proposal's application to hydrogen pipelines.

VI. Leak Survey and Patrol Frequencies

The proposed standards to enhance frequency of leak surveys and patrols are a significant improvement that will improve community safety, protect the environment, and reduce economic losses associated with lost gas. See Attachment D to these comments for a table that delineates the proposed standards in comparison to the existing federal baseline. PHMSA should at

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[367] Proposed Rule at 31937.

[368] *See* Attachment B, Renee McVay, Methane Emissions from U.S. Gas Pipeline Leaks, Env't Def. Fund (Aug. 2023), https://www.edf.org/sites/default/files/documents/Pipeline%20Methane%20Leaks%20Report.pdf.

[369] *See* Jevan Yu et al., *Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin,* 9 ENV'T SCI & TECH. LETTERS 969 (2022); Daniel H. Cusworth et al., *Strong methane point sources contribute a disproportionate fraction of total emissions across multiple basins in the United States,* 119 PNAS e2202338119 (2022), https://doi.org/10.1073/pnas.2202338119; EDF, *Permian Methane Analysis Project*, https://www.permianmap.org/.

[370] Proposed Rule at 31937.

minimum finalize these elements of its proposal; but PHMSA should consider adopting a simplified version of the proposed standards, to raise the bar across the board and facilitate ease of compliance for operators and ease of enforcement for inspectors and regulators. Additionally, PHMSA should further expand leak survey and repair requirements to all gas gathering pipelines.

A. Distribution Pipelines

The proposal states that "leakage surveys be incorporated within operator ALDPs meeting the minimum performance standards proposed in this NPRM," that "any detected leaks be graded and repaired consistent with the grading framework in this NPRM," and the proposal for "more frequent leakage surveys to promote earlier detection and repair of leaks" are beneficial and should be adopted in a final rule.[371] In particular, the following components of the Proposed Rule should be adopted for distribution pipelines:[372]

- Increase survey frequency from every 5 years to every 3 years for areas outside business districts.
- Increase survey frequency from every 3 years to every 1 year for cathodically unprotected pipes subject to 192.465(e) outside business districts.
- Increase survey frequency from every 5 years to every 1 year for pipelines known to leak based on their materials (including, but not limited to, cast iron, unprotected steel, wrought iron, and historic plastics with known issues), design, or past operating and maintenance history, outside business districts.
- Increase survey frequency from every 5 years to every 1 year for distribution pipelines protected by a distributed anode system where the cathodic protection survey under § 195.463 showed a deficient reading, outside business districts.
- Require leak survey within 72 hours of cessation of extreme weather events or land movement that could damage the pipe segment.
- Require "operators to investigate existing leaks when ground freezing and other changes in environmental conditions (such as heavy rain or flooding-inducing ground subsidence, erosion, or the installation of new pavement) has occurred that could affect gas venting or migration to nearby buildings."

These proposed standards will ensure that more leaks are detected—and subsequently repaired—on gas distribution systems, improving the safety of these pipeline systems and reducing harmful methane emissions. Operators have long been required to conduct annual leak surveys on certain parts of their systems, in business districts, and extending that standard to additional distribution pipelines is feasible for operators and beneficial for safety and the environment.

Plastic Pipes. Plastic distribution pipes should not be surveyed any less frequently than other pipeline materials. In the Preliminary RIA, "PHMSA considers an alternative where the 5-year survey interval outside of business districts is maintained for plastic pipe distribution pipelines without known leak issues," Proposed Rule at 31928-29. The agency decided correctly not to propose this provision. It is appropriate and beneficial to increase survey frequencies for plastic pipe along with all other materials. Peer-reviewed research has documented the incidence of

[371] *See* Proposed Rule at 31926-27.
[372] *See* Proposed Rule at 31927-28.

methane leaks on plastic distribution pipes and estimated that the number of leaks per mile on plastic pipelines is approximately 8.5 times greater than estimates used by U.S. EPA.[373]

Business District Definition. PHMSA requires that distribution pipelines within "business districts" be surveyed once per year, while the baseline for pipelines outside a business district is once every 5 years under current standards and once every 3 years under the proposed standards.[374] But PHMSA has not previously defined the term business district. The Proposed Rule invites comment on "potential criteria for defining the boundaries of a business district for potential inclusion within a final rule in this proceeding."[375] We recommend the following criteria for consideration:

- The title "business district" should be reconsidered and updated. The areas where distribution pipelines should be surveyed most frequently from a safety perspective are the areas where people are congregating at greater densities, either in places people reside or congregate. This is not only about the conduct of "business," but rather about the concentration of people. Therefore, it would be appropriate to define the areas subject to annual surveys as "human occupied district."
- Human occupied districts should account for residences, workplaces, recreational facilities, schools, public transit, etc. – not only the presence of "business" or commerce activities.
- PHMSA should consider input provided through comments by industry and operators about their current understanding of the scope of "business district." PHMSA should not adopt a regulatory definition of "human frequented district" or "business district" that is narrower than the current industry approach.

Simplified Survey Frequency Standard. The Proposed Rule increases survey frequency for most distribution pipelines in a manner that will enhance safety and environmental protection, but PHMSA proposes to continue its preexisting practice of establishing various frequency requirements for various subcategories of distribution pipelines, depending on location and pipe material. To promote efficient deployment of operator resources, it is worth considering whether the time required to differentiate between subcategories of pipeline and manage differing survey schedules for different pipe segments is beneficial. PHMSA should require higher survey frequencies across all distribution pipelines and require that all distribution pipelines be surveyed once per year. This would (1) improve safety and environmental protection by increasing survey frequencies to find more leaks, (2) make compliance easier for operators by eliminating more complex requirements to implement varying survey frequencies depending on pipe location and other characteristics, and (3) facilitate more effective oversight and enforcement by PHMSA and state inspectors. In the Preliminary RIA, PHMSA considered as an alternative that "distribution mains would be required to be surveyed annually; typically, mains are likely to be more accessible to pipeline operators than service lines crossing private property and may therefore be

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[373] *See* Zachary D. Weller et al., *A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems*, 54 ENV'T. SCI. TECH. 8958, 8964 (2020), https://doi.org/10.1021/acs.est.0c00437.
[374] 49 C.F.R. § 192.723.
[375] Proposed Rule at 31926.

more convenient to survey."[376] The agency invites comment on this option, *see* Proposed Rule at 31929.

Annual Super-Emitter Surveys. Even if PHMSA does not adopt the recommendation above to require annual compliance surveys across all distribution pipelines, the agency should require annual super-emitter surveys on all distribution main pipelines. Distribution pipeline operators already successfully implement this practice, which allows an operator to identify super-emitting leaks above 10 scf/hr across their entire system.[377] In the Preliminary RIA, PHMSA considered as an alternative that "distribution mains would be required to be surveyed annually; typically, mains are likely to be more accessible to pipeline operators than service lines crossing private property and may therefore be more convenient to survey." 31929.

B. Transmission Pipelines

The provisions of the Proposed Rule to increase survey and patrol frequencies on transmission pipelines will increase safety, reduce pipeline methane emissions, and help to reduce economic losses associated with lost gas.[378] PHMSA should adopt these proposed standards. In particular, the following components of the Proposed Rule should be adopted for transmission pipelines:

- Increase survey frequency from 1x/year to 4x/year for Class 4 odorized lines in High Consequence Areas ("HCAs")[379]
- Increase survey frequency from 1x/year to 2x/year for Class 3 odorized lines and all Class 1 and 2 lines in HCAs
- Increase survey frequency from 1x/year to 2x/year for complex pipeline facilities (i.e., valve sites, in-line instrument launchers and receivers, and tanks) in Class 1, 2, and 3 locations
    - As stated in the Proposed Rule, this proposal would establish the same survey frequency requirement for these complex facilities as the U.S. EPA has proposed for compressor stations along pipelines. This consistency will help facilitate ease of compliance for operators. *See* Proposed Rule at 31930.
- Increase survey frequency from 1x/year to 4x/year for complex pipeline facilities (i.e., valve sites, in-line instrument launchers and receivers, and tanks) in Class 4 locations
- Increase patrol frequencies from 1x, 2x, or 4x/year to 12x/year—once per month—for all transmission lines

Simplified Survey Frequency Standard. The Proposed Rule increases survey frequency for many transmission pipelines in a manner that will enhance safety and environmental protection, but PHMSA proposes to continue establishing differentiated frequency requirements for various

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[376] U.S. DOT PHMSA Office of Pipeline Safety, Preliminary Regulatory Impact Analysis, Pipeline Safety: Gas Leak Detection and Repair Proposed Rule at p20, Docket No. PHMSA-2021-0039 (Apr. 2023).
[377] *See, e.g.,* PG&E, 2020 Gas Safety Plan (Mar. 16, 2020); PG&E, 2020 Leak Abatement Compliance Plan.
[378] *See generally* Proposed Rule 31974-75.
[379] HCAs are established in two ways: (1) An area defined as— (i) a Class 3 location; (ii) a Class 4 location; (iii) Any area in a Class 1 or Class 2 location where the potential impact radius is greater than 660 feet (200 meters), and the area within a potential impact circle contains 20 or more buildings intended for human occupancy; or (iv) Any area in a Class 1 or Class 2 location where the potential impact circle contains an identified site; OR (2) The area within a potential impact circle containing— (i) 20 or more buildings intended for human occupancy; or (ii) An identified site. 49 C.F.R. § 192.903.

subcategories of transmission pipelines depending on location. In fact, the proposed standards appear to create an even more complicated structure than the existing standards. It is worth considering whether the resources required to differentiate between subcategories of pipeline and manage differing survey schedules for different pipe segments is beneficial.

To promote efficient deployment of operator and regulator resources, PHMSA should require higher survey frequencies across all transmission pipelines in a structure that is clearer for operators, regulators, and the public to understand. This would (1) improve safety and environmental protection by increasing survey frequencies to find more leaks, (2) make compliance easier for operators by eliminating more complex requirements to implement varying survey frequencies depending on pipe location and other characteristics, and (3) facilitate more effective oversight and enforcement by PHMSA and state inspectors. The Environmental Organizations recommend a simplified structure, presented below, whereby all Class 4 transmission pipelines must be surveyed at least 4x/year, and all Class 1-3 lines must be surveyed at least 2x/year.

<table>
<tr><th colspan="8">Transmission Pipeline Survey Frequencies</th></tr>
<tr><th rowspan="3">Location</th><th colspan="2">Current Regulations[380]</th><th colspan="4">Proposed Rule[381]</th><th rowspan="3">Environmental Commenters' Proposal</th></tr>
<tr><th rowspan="2">Non-odorized lines</th><th rowspan="2">All other lines</th><th colspan="2">Odorized</th><th colspan="2">Non-odorized</th></tr>
<tr><th>In HCAs</th><th>Outside HCAs</th><th>In HCAs</th><th>Outside HCAs</th></tr>
<tr><td>Class 4 (most populated)</td><td>4x/year</td><td rowspan="3">1x a year</td><td>4x/year</td><td rowspan="3">1x a year</td><td colspan="2">4x/year</td><td>4x/year</td></tr>
<tr><td>Class 3</td><td>2x/year</td><td>2x/year</td><td colspan="2">2x /year</td><td rowspan="2">2x/year</td></tr>
<tr><td>Class 1 & 2</td><td>1x/year</td><td>2x/year</td><td>2x/year</td><td>1x/year</td></tr>
</table>

Transmission Pipeline Leakage. The NPRM states that "leaks from natural gas transmission line pipe are not as significant a source of methane emissions compared with venting, blowdowns, and leaks from compressor stations and other aboveground equipment."[382] While operational releases are significant sources of methane emissions on transmission pipelines, leaks can also be an important source of climate pollution and should be treated as such. There is significant uncertainty around the extent of transmission pipeline leakage because methane leakage from transmission pipelines has not been measured and reported in peer-reviewed studies. While it is commonly assumed that leaks on transmission lines are much less of an issue than other pipeline types, transmission leakage cannot be assumed to be de minimis when in fact it has not been quantified. PHMSA should explore opportunities to support research to measure and quantify transmission pipeline leaks and continue to improve reporting requirements for operators, to address this knowledge gap.

[380] 49 C.F.R. § 192.706.
[381] Proposed Rule at 31974-75.
[382] Proposed Rule at 31929.

C. Gathering Lines

PHMSA's proposal to extend leak survey and repair requirements to all Type C gathering lines is a beneficial standard that should be commended and adopted into the final rule. Additionally, PHMSA should extend leak survey and repair requirements to all gas gathering pipelines to maximize safety, environmental, and economic benefits.

Application of Leak Survey Frequency & Repair Standards to U.S. Gas Gathering Pipelines (Onshore)			
Type/Location	**Current Regulations**[383]	**Proposed Rule**[384]	**Environmental Commenters' Recommendation**
Type A (~8,000 miles)	Yes	Yes	Yes
Type B (~3,000 miles)	Yes	Yes	Yes
Type C, diameter ≥ 8.625 in. w/PIR exception & all diameter >16 in. (~20,000 miles)	Yes	Yes	Yes
Type C, diameter < 16 in. and no PIR exception (~70,000 miles)	No	Yes	Yes
Type R (Unregulated) (~340,000 miles)	No	No	Yes

There are over 430,000 miles of onshore gathering pipelines across the country,[385] designed to transport unprocessed natural gas from well sites and other facilities to processing plants. Historically, only a fraction of the these gathering pipelines—around 11,000 miles—have been subject to federal pipeline safety standards.[386] After concerns were raised by Congress, the Government Accountability Office, and other stakeholders, and after initiating a rulemaking in 2011, PHMSA issued a final rule in November 2021 to expand oversight of gathering pipelines.[387] Although the rule was an important step forward in documenting the importance of

[383] *See* 49 C.F.R. § 192.9(c), (d)(8) (extending requirements applicable to transmission lines to Type A and B regulated gathering lines); 49 C.F.R. § 192.9(e)(1)(vii) (extending requirements applicable to transmission lines to Type C gathering lines with a diameter greater than 8.625 inches); 49 C.F.R. § 192.9(f)(1) (exempting Type C lines with diameters less than 16 inches that are not located in areas intended for human occupancy from leak survey frequency requirements).

[384] *See* Proposed Rule at 31972-75.

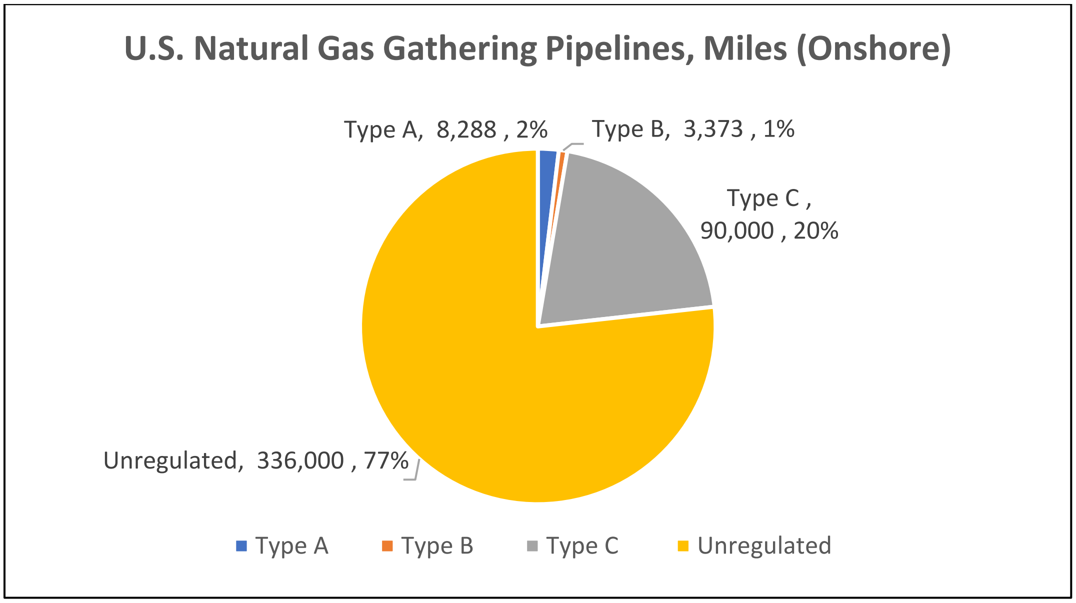
[385] *See* PHMSA, Regulatory Impact Analysis, Pipeline Safety: Expansion of Gas Gathering Regulation Final Rule (Nov. 2021), https://www.regulations.gov/document/PHMSA-2011-0023-0488.

[386] *See id.* at 13; PHMSA, Annual Report Mileage for Natural Gas Transmission & Gathering Systems (last updated July 10, 2023), https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-natural-gas-transmission-gathering-systems.

[387] *See* U.S. GOV'T ACCOUNTABILITY OFF., *Pipeline Safety: Collecting Data and Sharing Information on Federally Unregulated Gathering Pipelines Could Help Enhance Safety*, Report No. GAO-12-388, at 9 (Mar. 2012); U.S. GOV'T ACCOUNTABILITY OFF., *Dept. of Transportation is Taking Actions to Address Rail Safety, but Additional Actions are Needed to Improve Pipeline Safety*, Report No. GAO-14-667, at 47-48 (Aug. 2014); PHMSA, Advance

protective standards for gathering infrastructure and implementing such standards for some additional pipelines, the rule left a significant proportion of gathering lines unregulated. Out of the approximately 424,000 miles of previously unregulated gathering pipelines, the November 2021 rule applied basic safety standards of damage prevention and emergency planning to about 90,000 miles; and the rule applied leak survey and repair standards to about 20,000 miles.[388] Over 400,000 miles of gathering pipelines carrying unprocessed natural gas have gone untouched by federal survey and repair requirements—until now.

Figure 7.[389]



Regulated gathering pipelines are classified into three categories based on location, size, and pressure—Type A, B, or C. The remaining gathering lines, referred to as Type R, are unregulated and not subject to safety standards, but must submit annual and incident reporting to PHMSA. Under current regulations, most Type C gathering lines are not subject to the same leak survey requirements as Type A and B gathering lines. Instead, only about 20,000 miles of Type C gathering lines—those with diameter greater than 16 inches or diameter between 8.625-16 inches with PIR exception—are subject to survey and repair requirements. In the 2021 Gas Gathering Rule, PHMSA determined that this subset of Type C lines posed "the most significant potential hazard to people and the environment."[390] Since PHMSA issued the final Gas Gathering Rule,

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Notice of Proposed Rulemaking: *Pipeline Safety: Safety of Gas Transmission Pipelines*, 76 Fed. Reg. 53086 (Dec. 2, 2011); PHMSA, Notice of Proposed Rulemaking: *Pipeline Safety: Safety of Gas Transmission and Gathering Pipelines*, 81 Fed. Reg. 20721 (Apr. 8, 2016); U.S. Department of Transportation, PHMSA, Final Rule: *Pipeline Safety: Safety of Gas Gathering Pipelines: Extension of Reporting Requirements, Regulation of Large, High-Pressure Lines, and Other Related Amendments*, 86 Fed. Reg. 63266 (Nov. 15, 2021).

[388] PHMSA, *Gas Gathering Fact Sheet*, https://www.phmsa.dot.gov/pipeline/gas-gathering/gas-gathering-fact-sheet (last accessed Aug. 13, 2023).

[389] Data source: PHMSA, Pipeline Safety: Expansion of Gas Gathering Regulation Final Rule, 86 Fed. Reg. 63266 (Nov. 2021), Regulatory Impact Analysis, at 13 (Nov. 2021).

[390] PHMSA, Pipeline Safety: Expansion of Gas Gathering Regulation Final Rule, 86 Fed. Reg. 63266, 63286 (Nov. 2021).

additional data has demonstrated the extent of methane emissions associated with gathering lines. This information, discussed below, supports the importance of expanding leak survey and repair standards to all gas gathering lines.

The Proposed Rule addresses part of this regulatory gap by proposing that all Type A, B, and C gathering lines be subject to the same leak survey and patrol requirements as transmission pipelines, and by establishing clear standards for leak grading, timelines for leak repair, and leak detection technology standards. The agency accurately concluded that more frequent surveys and stricter repair requirements will lead to fewer greenhouse gas emissions, accidents, and negative health impacts of natural gas pipeline infrastructure.[391] Though extending survey requirements to all Type C pipelines is an important step, the agency should maximize the positive climate, safety, and health impacts of this rulemaking by extending the proposed survey and repair requirements to Type R gathering lines.

1. *Expanded Leak Survey and Patrol Requirements Could Reduce Methane Emissions*

Gathering pipelines are leaking significant volumes of methane that contribute to near-term warming and worsen the climate crisis. Increased survey and repair requirements for gathering pipeline operators could substantially accelerate the pace at which unintentional methane emissions are found and eliminated along the natural gas supply chain.

Recent research reveals that the climate impact of gathering pipelines is greater than previously understood. A peer-reviewed study conducted by scientists from EDF, Stanford University, and University of Arizona revealed that onshore gas gathering pipelines in the Permian Basin are leaking orders of magnitude more methane than the U.S. Environmental Protection Agency inventory estimates.[392] The study analyzed results from a series of aircraft measurement campaigns conducted from 2019-2021 alongside datasets of pipeline location and mileage throughout the Permian Basin, finding emission factors ranging from 2.7 to 10 metric tons of methane per year per kilometer of pipeline.[393] These emission factors are 14-52 times greater than those used for the U.S. EPA national inventory estimates.[394] Using the study's emission factors, total emissions from gathering lines in the Permian Basin are estimated to be at least 213,000 metric tons per year.[395] This quantity of emissions is equivalent to the annual climate impact of 3.91 million gas-powered passenger vehicles and represents enough natural gas to heat over 187,000 US households.[396]

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[391] Proposed Rule at 31910.
[392] Jevan Yu et al., *Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin,* ENV'T SCI. TECH. LETTERS (Oct. 4, 2022), https://pubs.acs.org/doi/10.1021/acs.estlett.2c00380.
[393] *Id.*
[394] *Compare id.*; U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, Chapter 3, Energy, at Tbl. 3-86, https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-chapter-3-energy.pdf.
[395] Jevan Yu et al., *Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin,* ENV'T SCI. TECH. LETTERS (Oct. 4, 2022), https://pubs.acs.org/doi/10.1021/acs.estlett.2c00380.
[396] EDF, Internal Resource, Oil and Gas Conversion and Equivalencies Tool (2023) (modeled using a 20-year GWP and 84% methane content).

Other recent studies have also identified gathering pipelines as a significant source of methane emissions. One study by Cusworth *et al.* found that, across several basins, pipelines comprised on average about one quarter (23%) of all observed super-emitting oil and gas methane emissions.[397] A 2022 study quantifying methane emissions in the New Mexico portion of the Permian Basin estimated that pipelines, including underground gas gathering lines, emitted approximately 29 metric tons per hour of methane.[398] Environmental Defense Fund crossed publicly available survey data with known characteristics of the U.S. pipeline system to determine the system's methane leakage rate. The study found gathering pipelines to emit between 482,000 and 1.89 million metric tons of methane—whereas the EPA greenhouse gas inventory accounted for only 127,000 metric tons of methane.[399] EDF's figure for methane emissions from gathering lines represents the annual climate impact of 8.85 to 34.7 million passenger vehicles, or the annual natural gas usage of 425,200 to 1.67 million U.S. households.[400]

The location and function of a pipeline does not affect the environmental impact of its leaks. Pipelines of any diameter can leak and emit significant methane emissions, particularly if leaks are left unabated over long periods of time. Improving leak survey frequency, leak repair timelines, and leak detection technology standards for Type A, B, and C gathering lines will reduce methane emissions; and PHMSA should extend leak surveys and repair standards to Type R pipelines, to fulfill its obligation to establish pipeline standards that "protect[] the environment."[401]

2. *Expanded Leak Survey and Patrol Requirements on Gathering Lines Could Reduce Negative Health Impacts*

The agency acknowledges the significant health risks that those in close proximity to pipeline infrastructure face in the proposed rule.[402] Gathering lines pose unique health risks because they transport unprocessed gas.[403] Unprocessed gas contains volatile organic compounds (VOCs) and hazardous air pollutant (HAPs), putting those nearby at increased risk of cancer, respiratory distress, and neurological problems.[404] VOCs also contribute to the formation of ground-level

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[397] Daniel H. Cusworth et al., *Strong Methane Point Sources Contribute a Disproportionate Fraction of Total Emissions Across Multiple Basins in the United States*, NAT'L ACAD. SCI. (Sept. 13, 2022), https://doi.org/10.1073/pnas.2202338119.

[398] Yuanlei Chen et al., *Quantifying Regional Methane Emissions in the New Mexico Permian Basin with a Comprehensive Aerial Survey*, ENV'T SCI. TECH. LETTERS (Mar. 23, 2022), https://pubs.acs.org/doi/10.1021/acs.est.1c06458.

[399] Renee McVay, *Methane Emissions from U.S. Gas Pipeline Leaks*, ENV'T DEF. FUND (Aug. 2023), https://www.edf.org/sites/default/files/documents/Pipeline%20Methane%20Leaks%20Report.pdf.

[400] EDF, Internal Resource, *Oil and Gas Conversion and Equivalencies Tool* (2023) (modeled using a 20-year GWP and 84% methane content).

[401] 49 U.S.C. § 60102.

[402] Proposed Rule at 31931.

[403] U.S. EPA, Final Rule: Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Review, 85 Fed. Reg. 57,018, 57,028 (Sept 14, 2020) (citing EPA, Analysis of Average Methane Concentrations in the Oil and Gas Industry Using Data Reported Under 40 CFR part 98 Subpart W (Apr. 9, 2020), https://www.regulations.gov/document/EPA-HQ-OAR-2017-0757-2682).

[404] *Id.*

ozone, which can lead to a host of respiratory issues.[405] The threat radius for HAPs is approximately a half mile—putting anyone in close proximity to leaking gathering infrastructure at greater risk to these toxins.[406] Additionally, the positive correlation between the location of socioeconomically vulnerable communities and density of gathering pipelines make the negative health and safety impacts of gathering line leaks an environmental justice issue.[407] Leak survey and repair requirements for Type R gathering lines could lead to faster identification and elimination of source points of unprocessed gas in rural communities, improving air quality and decreasing exposure to these harmful pollutants.

3. *Expanded Leak Survey and Repair Requirements on Gathering Lines Could Increase Safety*

Leaks on gas gathering pipelines pose safety risks of rupture and explosion. Pipeline safety experts, including the Pipeline Safety Trust and the National Association of Pipeline Safety Representatives, have urged PHMSA at various times to impose various safety standards on a greater mileage, or all, gathering pipelines.[408] Gathering pipelines are under-discussed in the context of pipeline safety because of the misleading notion that rural areas are less densely populated and can therefore shoulder bigger safety risks. This belief overlooks the inherent dangers of unchecked, sprawling, and explosive infrastructure in rural communities and the threat posed to the environment. Imposing survey and repair requirements on Type R gathering lines could decrease the risk of explosions due to pipeline malfunction or degradation. More responsible regulatory oversight of this infrastructure could also include positive impacts on property values, land use restrictions, and personal security.

4. *Expanding Leak Survey and Repair Requirements on Gathering Lines is Feasible – A Majority of Operators Must Already Comply with PHMSA Requirements for Other Assets*

Of the over 460 companies that reported operation of unregulated gathering pipelines to PHMSA, 351 also operate regulated gathering lines. Therefore, 75% of the operators that would be impacted by expanding the rule to unregulated gathering lines already have transferable procedures in place to comply with such requirements. The majority of operators will therefore

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[405] See supra Section II.J.
[406] Jane C.S. Long et al., An Independent Scientific Assessment of Well Stimulation in California, Volume III, CAL. COUNCIL SCI. & TECH. (July 2015), at 14, https://ccst.us/wp-content/uploads/160708-sb4-vol-III.pdf.
[407] *See* Ryan E. Emanuel et al., *Natural Gas Gathering and Transmission Pipelines and Social Vulnerability in the United States*, GEOHEALTH, at 6 (2021), https://doi.org/10.1029/2021GH000442.
[408] Comment of Pipeline Safety Trust Opposing Petition for Reconsideration of Pipeline Safety Rule (Docket No. PHMSA-2011-0023), Submitted by Interstate Natural Gas Association of America and the American Petroleum Institute (Dec. 19, 2018), https://www.regulations.gov/comment/PHMSA-2011-0023-0455; Nat'l Asso. Pipeline Safety Reps., *Urging PHMSA to Establish Regulatory Requirements for Gas Gathering Lines in Class 1 Areas*, Resolution 2010-2 AC-2, (Sept. 30, 2010), http://nebula.wsimg.com/b4dc9f247c35c707f0ceda7992adc664?AccessKeyId=8C483A6DA79FB79FC7FA&disposition=0&alloworigin=1

have lower compliance costs for a final rule that extends requirements to Type R gathering lines than if they had to comply with federal requirements for the first time.[409]

In fact, some operators are already voluntarily finding and reporting leaks to PHMSA on unregulated gathering pipelines. Last year, 87 Type R pipeline operators reported a total of 4,303 leaks to PHMSA, including both leaks eliminated and leaks scheduled for repair. Type R pipelines are not subject to requirements to conduct leak survey and repair, so the number of reported leaks to PHMSA is almost certainly a fraction of the actual number of leaks. The assertion that this figure is a massive undercount is further evidenced by the fact that it represents the catalog of leaks from less than 20% of the Type R operators. That operators are reporting this data demonstrates operators' existing ability to find and report leaks.

The FEAST modeling results demonstrate that extended coverage of gathering lines would lead to significant emission reductions. The results show that 70-80% reductions can be achieved compared to baseline monitoring requirements for gathering lines. These reductions would be even greater in comparison to lines that have not previously been covered and therefore likely have even higher baseline emissions. FEAST, along with the Datu and Highwood reports and publicly available information about the efficacy and cost of monitoring solutions, indicate that extended leak survey requirements would be low cost for operators and would lead to significant mitigation of emissions.

5. *At Minimum, PHMSA Should Require Survey & Repair of Identified Super-Emitters on Type R Gathering Lines*

PHMSA should expand leak survey and repair requirements to Type R (currently unregulated) gathering lines for the reasons presented above. But even if the agency does not take this step, it should, at minimum, apply the Super-Emitter Reporting Program to Type R gathering lines, discussed infra at Part VIII(E). Under this program, third parties can identify large methane leaks on infrastructure and report the information to U.S. EPA and PHMSA. PHMSA should then inform the operator - or its best guess of who operates infrastructure in the area - about the identified leak. The operator should be required to check for the leak, repair it, and report on the event as a large-release incident and as a repaired leak in its annual report. This recommendation will facilitate mitigation of identified super-emitter leaks, improving the safety of Type R gathering lines and reducing harmful methane emissions. Furthermore, this recommendation underscores the importance of adding Type R gathering lines into the National Pipeline Mapping System, and of making NPMS information readily available to the public, so that PHMSA and third parties can better identify the operator of a given gathering line. Additionally, PHMSA could consider requiring any otherwise unregulated Type R line for which there is a detection under the super-emitter program to comply with leak survey and repair requirements going forward.

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[409] Proposed Rule at 31944-45 ("PHMSA understands that some affected operators may already have adopted (either voluntarily or in response to State or Federal requirements) compliant training and personnel practices, or would be able to adapt existing practices with minimal effort—particularly as ensuring personnel employed in conducting leakage surveys, inspection, and repair activities is a practice that reasonably prudent operators would adopt in ordinary course to protect public safety and the environment from release of pressurized (natural, flammable, corrosive, and toxic) gases transported in their pipelines and minimize loss of commercially valuable commodity.").

D. LNG Facilities

PHMSA proposes "to require a quarterly methane leakage survey using leak detection equipment and remediation of any methane leaks discovered in accordance with the operator's maintenance or abnormal operations procedures." Proposed Rule at 31932. Requiring natural gas leak detection and repair practices in areas of LNG facilities where no such standards apply is a positive step forward that will improve safety and reduce methane emissions. PHMSA should adopt its proposed requirement to conduct quarterly methane leakage surveys. PHMSA should also strengthen this proposal to provide more clarity - since operator maintenance procedures may vary and may not deploy the most effective technologies and practices, operators should be required to satisfy the Advanced Leak Detection Program technology standards.

E. Underground Natural Gas Storage Facilities

PHMSA does not currently require Underground Natural Gas Storage Facilities (UNGSF) to perform periodic leakage surveys with leak detection equipment – this is an oversight that should be corrected. Surface leak detection surveys are an essential component of a safety monitoring program to ensure that the nation's 400 UNGSFs have mechanical integrity and are not leaking natural gas.

Following the Aliso Canyon UNGSF disaster of 2015, an Interagency Task Force comprising the Department of Energy and PHMSA recommended that "[g]as storage operators should deploy continuous monitoring systems at the ground surface and through the multiple casing strings for wells and critical gas handling infrastructure. This includes monitoring of annular and tubing pressure, as well as surface leak detection."[410]

The Joint Environmental Commenters agree, and would commend PHMSA to consult the Ground Water Protection Council and Interstate Oil and Gas Compact Commission's 2017 report, "Underground Gas Storage Regulatory Considerations: A Guide for State and Federal Regulatory Agencies," which provided a snapshot of technology options for surface leak detection at UNGSFs including OGI, aerial surveys, handheld and stationary point measurement, and open path infrared to facilitate period and continuous surveys as warranted.[411]

In section XII of these comments, the Joint Environmental Commenters strongly recommend that PHMSA conduct a comprehensive rulemaking on UNGSF, while in the meantime adopting the updated 2022 versions (second editions) of API Recommended Practices 1170 and 1171 – preventing leaks at UNGSFs starts with proper well integrity, and these underlying rules need to be updated to the latest standards to lower risks of leaks and explosions. Nevertheless, because the API RPs do not comprehensively address surface leak detection, PHMSA will need to adopt

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[410] *Ensuring Safe and Reliable Underground Natural Gas Storage: Final Report of the Interagency Task Force on Natural Gas Storage Safety* at 58 (Oct. 2016), https://www.energy.gov/sites/prod/files/2016/10/f33/Ensuring%20Safe%20and%20Reliable%20Underground%20Natural%20Gas%20Storage%20-%20Final%20Report.pdf

[411] Ground Water Protection Council and Interstate Oil and Gas Compact Commission, *Underground Gas Storage Regulatory Considerations: A Guide for State and Federal Regulatory Agencies*, at 92-97 (May 2017), https://iogcc.ok.gov//Websites/iogcc/images/FINAL_UGS_report_2017-05.pdf.

special rules to cover this activity, whether as a standalone exercise or as part of broader regulatory reform on UNGSF operations.

F. State policies and operator practices indicate that increased leak survey frequencies are cost effective and beneficial.

Some states and operators already require more frequent leak surveys than federal regulations mandate, indicating that increased leak survey frequency is both cost-effective and beneficial.

1. *Numerous states require that leak surveys be performed more frequently than federal regulations require.*

In the proposed rule, PHMSA notes that some states already require more frequent leak surveys than current federal regulations mandate.[412] Current federal regulations require that operators conduct leak surveys on pipelines located in "business districts" at least once each calendar year.[413] For pipelines located outside business districts, operators must conduct leak surveys at least once every five calendar years and at intervals not exceeding 63 months. However, the regulations do not define the term "business district."[414] For distribution lines which are not cathodically protected, leak surveys must be conducted at least once every three calendar years and at intervals not exceeding 39 months.[415]

According to data provided by the National Association of Pipeline Safety Representatives (NAPSR), at least thirteen states plus the District of Columbia require that, in certain situations, leak surveys be conducted with more frequency than the federal baselines require.[416]

Since the federal regulations do not provide a definition for "business district," some states provide their own. Massachusetts defines business districts as "areas with pavement from building wall to building wall and/or where the principal commercial activity of the city or town takes place."[417] Washington State defines a business district as "an area where the public regularly congregates or where the majority of the buildings on either side of the street are regularly utilized, for financial, commercial, industrial, religious, educational, health, or recreational purposes."[418]

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412 Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890, 31918–19 (proposed May 18, 2023) (to be codified at 49 C.F.R. 191–93).
413 49 C.F.R. 192.723(b)(1).
414 *See* Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890, 31918–19 (proposed May 18, 2023) (to be codified at 49 C.F.R. 191–93) (stating that some states "provide a definition of the term 'business district' subject to more frequent leakage surveys in § 192.723 but not defined in part 192").
415 49 C.F.R. 192.723(b)(2).
416 *See* NAT'L ASS'N OF PIPELINE SAFETY REPS., *Compendium of State Pipeline Safety Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations* (3rd ed. 2022), http://nebula.wsimg.com/77f8f2a14d467fbe1e56cbafaf9e8a8b?AccessKeyId=8C483A6DA79FB79FC7FA&disposition=0&alloworigin=1. States with more stringent requirements than the federal baseline with respect to leak survey frequency include California, Indiana, Kansas, Maine, Maryland, Massachusetts, Missouri, New Hampshire, Pennsylvania, South Carolina, Texas, Washington, and Wisconsin.
417 220 C.M.R. § 101.06(21)(a).
418 W.A.C. 480-93-005(3).

A number of states require more frequent leak surveys of pipelines based on their location inside or outside of business districts or in high-occupation areas.[419] For instance, California extends the federal requirements for leak survey frequency in business districts to distribution and transmission systems "in the vicinity of schools, hospitals and churches. . . and at other locations providing an opportunity for finding gas leaks."[420] Indiana similarly extends the federal survey requirements for business districts to "high occupancy buildings," including schools, churches, hospitals, apartment buildings, and commercial buildings.[421] Maine requires leak surveys at buildings used for "public assembly" each year between March 1 and December 1.[422] Maryland requires "[s]ervice lines to places of public assembly" to be surveyed with the same frequency as those in business districts.[423] Massachusetts requires surveys in its locally-defined "business districts" to be conducted every 12 months, rather than 15, and requires surveys in distribution areas outside of business districts to be conducted every 24 months, instead of every five years.[424] Massachusetts also requires annual surveys of "schools, churches, hospitals, theatres, and arenas."[425] All pipelines in Missouri must be inspected every 39 months and at least once every third calendar year, aside from those made of unprotected steel or unprotected steel yard (to which more stringent requirements apply).[426] Washington State extends the federal survey requirements for business districts to "high occupancy structure[s] or area[s]," which it defines as any "building or an outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least five days a week for 10 weeks in any 12-month period."[427] Wisconsin requires a second leakage survey of "street openings in business districts" in some circumstances.[428] Wisconsin also extends the federal business district survey requirement to "all buildings used for public gatherings" and all mains in incorporated cities and villages, and requires mains in unincorporated areas to be inspected "at least once every 2 calendar years at intervals not exceeding 27 months."[429]

Some states also require more frequent leak surveys for pipelines made of certain materials, pipelines that are part of certain infrastructures, or certain segments of the gas system. California requires surveys of transmission pipelines to be conducted "at least twice each year and at intervals not exceeding 7 ½ months."[430] Kansas's system comprehensively imposes more stringent inspection requirements based on pipeline materials. For mains located outside business districts, surveys must be conducted annually at intervals not exceeding 15 months for "[c]athodically unprotected steel mains and ductile iron mains located in class 2, 3, and 4 areas," and every three years at intervals not exceeding 39 months for "[c]athodically unprotected steel

[419] Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890, 31919 (proposed May 18, 2023) (to be codified at 49 C.F.R. 191–93).
[420] Cal. Pub. Utils. Comm'n, General Order No. 112-F, § 143.1(a) (Jun. 25, 2015), https://www.sdge.com/sites/default/files/regulatory/General%20Order%20112-F.PDF.
[421] 170 I.A.C. 5-3-2 § 2(r).
[422] C.M.R. 65-407-420 § 6(D)(1)(c).
[423] C.O.M.A.R. 20.55.09.05(B)(2).
[424] 220 C.M.R. § 101.06(21)(a)–(b).
[425] 220 C.M.R. § 101.06(21)(d).
[426] 20 C.S.R. 4240-40.030(13)(M)(2)(B).
[427] W.A.C. 480-93-188(3)(b); W.A.C. 480-93-005(14).
[428] Wis. Adm. Code PSC 135.723(cw)(1).
[429] Wis. Adm. Code PSC 135.723(cw)(3)–(5).
[430] Cal. Pub. Utils. Comm'n, General Order No. 112-F, § 143.1(b) (Jun. 25, 2015), https://www.sdge.com/sites/default/files/regulatory/General%20Order%20112-F.PDF.

mains and ductile iron mains located in class 1 areas, cathodically protected bare steel mains, cast iron mains, and mains constructed of PVC plastic."[431] Maryland requires leak surveys every three years for pipelines that are located outside of buildings and are made of "[c]ast iron, ductile iron, [or] cathodically unprotected steel."[432] Missouri requires leak surveys at intervals not exceeding 15 months for "unprotected steel pipelines and unprotected steel yard lines."[433] South Carolina requires leak surveys at least every 12 months for buried pipelines "not protected against corrosion" in accordance with federal regulations.[434] Washington State requires twice-annual inspections where the "gas system has cast iron, wrought iron, copper, or noncathodically protected steel," and requires monthly inspections for non-odorized gas pipelines.[435]

A few states require leak surveys to be conducted with increased frequency in response to certain conditions. Maryland requires that, any time a "utility service person enters a customer's premises for the purpose of inspecting or servicing any gas equipment" besides meter readings, a survey should be conducted at "appropriate locations, including atmosphere samples, and at all utility service entrances."[436] Some states that experience particularly cold winters require surveys to be conducted with increased frequency during the winter months, including Maine,[437] New Hampshire,[438] and Pennsylvania.[439] Washington State requires surveys prior to and following certain construction projects.[440] Texas has a unique risk-based leak survey program that supplements federal requirements by directing operators to conduct surveys "more frequently [than required by federal regulations] in those areas with the greatest potential for leakage and where leakage could be expected to create a hazard," and provides direction to operators on how risks should be prioritized.[441]

2. *Some operators perform leak surveys more frequently than federal regulations require.*

PHMSA notes in the proposed rule that "publicly available information regarding [voluntary industry initiatives] does not confirm that leaks on gas transmission, distribution, and regulated gathering are detected and repaired in a timely manner."[442] There are, however, a few operators that perform leak surveys more frequently than required by federal regulations, indicating that more frequent surveys are cost-effective.

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[431] K.A.R. § 82-11-4(b)(34)(b)(2).
[432] C.O.M.A.R. 20.55.09.05(B)(3).
[433] 20 C.S.R. 4240-40.030(13)(M)(2)(B)(I).
[434] S.C. Code Regs. 103-493(3).
[435] W.A.C. 480-93-188(3)(d)–(e).
[436] C.O.M.A.R. 20.55.09.05(C)(2).
[437] *See* C.M.R. 65-407-420(6)(D)(1)(b).
[438] *See* N.H. Admin. Rules, P.U.C. 508.04(d).
[439] *See* Penn. Pub. Util. Comm'n. Docket No. M-2011-2271982, Final Order (Dec. 22, 2011) (discussing survey requirements during "frost" conditions throughout); *see also* Nat'l Ass'n of Pipeline Safety Representatives, *Compendium of State Pipeline Safety Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations*, 284, (3rd ed. 2022), http://nebula.wsimg.com/77f8f2a14d467fbe1e56cbafaf9e8a8b?AccessKeyId=8C483A6DA79FB79FC7FA&disposition=0&alloworigin=1.
[440] W.A.C. 480-93-188(4)(a)–(b), (e).
[441] 16 T.A.C. § 8.206.
[442] Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890, 31920 (proposed May 18, 2023) (to be codified at 49 C.F.R. 191–93).

Although voluntary industry standards and programs such as the EPA Methane Challenge[443] and the Environmental Partnership[444] do not rigorously address or document leak survey frequency,[445] a group of gas associations states in their comment in response to PHMSA's May 2021 public meeting that "[s]ome operators are currently using both conventional and advanced leak detection technologies to identify larger emitters and prioritize their repairs" and provides as an example that Pacific Gas & Electric (PG&E) has performed "supplemental leak surveys to identify larger emissions since 2018."[446]

PG&E indicates elsewhere that it "moved to a three-year leak survey cycle for 2018." [447] In the California Public Utilities Commission's most recent finalized general rate case for PG&E, the Commission notes that PG&E's forecast for leak management expenses was about $0.5 million higher than recent recorded expenses, mainly because of "PG&E's transition from a four-year to a three-year compliance survey for leaks," which would mean "more leak surveys are scheduled to be performed annually."[448] The Commission approved this forecast and the related capital projects, finding them to be "reasonable."[449] PG&E has also "continued to make improvements to [its] distribution leak management practices with the Super Emitter leak abatement program." This program identifies larger leaks by conducting annual surveys, and the threshold for the Super Emitter program was lowered from 10 standard cubic feet per hour to 7 standard cubic feet per hour in 2023. [450]

Two subsidiaries of Consolidated Edison, Inc. have significantly more proactive leak survey programs than are required by federal regulations. Consolidated Edison Company of New York (CECONY) performs "monthly leak surveys of the entire distribution system to detect methane emissions and make associated repairs to the gas system," and Orange and Rockland Utilities, Inc. performs surveys of the entire distribution system annually.[451] The New York Public Service

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[443] EPA, *Methane Challenge Partner Commitments*, https://www.epa.gov/natural-gas-star-program/methane-challenge-partner-commitments (last visited Aug. 14, 2023).
[444] ENVIRONMENTAL PARTNERSHIP, *Leak Detection and Repair Programs for Oil and Gas production sources*, https://theenvironmentalpartnership.org/what-were-doing/leak-program/ (last visited Aug. 14, 2023).
[445] *See* Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890, 31920 (proposed May 18, 2023) (to be codified at 49 C.F.R. 191–93).
[446] American Gas Association et al., Comments in Response to the PHMSA Public Meeting (May 24, 2021), https://www.regulations.gov/comment/PHMSA-2021-0039-0008.
[447] PG&E CORP., *CDP Climate Change Questionnaire 2023* (Jul. 27, 2023), https://www.pgecorp.com/corp_responsibility/reports/2023/downloads/PGE_Corporation_CDP_Climate_Change_Questionnaire_2023.pdf.
[448] Cal. Pub. Utils. Comm'n, Decision 20-12-005, Decision Addressing the Test Year 2020 General Rate Case of Pac. Gas & Elec. Co., 36 (Dec. 11, 2020), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M354/K486/354486687.PDF.
[449] Cal. Pub. Utils. Comm'n, Decision 20-12-005, Decision Addressing the Test Year 2020 General Rate Case of Pac. Gas & Elec. Co., 345–46 (Dec. 11, 2020), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M354/K486/354486687.PDF.
[450] PG&E CORP., *CDP Climate Change Questionnaire 2023*, 27 (Jul. 27, 2023), https://www.pgecorp.com/corp_responsibility/reports/2023/downloads/PGE_Corporation_CDP_Climate_Change_Questionnaire_2023.pdf.
[451] CON EDISON, INC., *Managing Our Emissions*, https://lite.conedison.com/ehs/2022-sustainability-report/environment/managing-our-emissions/ (last visited Aug. 14, 2023).

Commission also requires CECONY to survey "at least one-third of its distribution system each calendar year" using advanced leak detection technology.[452]

Williams Companies, Inc. (Williams), which operates gas pipelines that span the country,[453] conducts "quarterly, semiannual or annual LDAR surveys on Williams' compressor stations and facilities," and in 2022 performed leak surveys at 43 compressor stations "that did not previously have LDAR required by state or federal regulations." Williams states that it "has developed separate LDAR Standards for our gathering, boosting and transmission segments and is developing a comprehensive requirement within our integrated management system that outlines roles and responsibilities for LDAR. Once completed, [Williams] will use these documents to communicate the roles and responsibilities of Williams employees for promoting an improved, efficient and effective LDAR program across the enterprise."[454] Williams also states that it performs "aerial patrols more frequently than PHMSA's minimum requirements as an added damage and leak prevention measure" throughout its "regulated pipeline systems."[455]

Avista Utilities' 2021 Electric and Natural Gas Sustainability Accounting Standards Board ESG Metrics report states that Avista inspected 100% of gas transmission pipelines in each of the years 2019–2021, while inspecting 40%, 44%, and 39% of the gas distribution pipelines in each of those years successively.[456]

Numerous states require more frequent leak surveys than federal regulations mandate, and a number of operators exceed federal leak survey requirements, indicating that more frequent leak surveys are both cost-effective and beneficial.

VII. Leak Grading and Repair

The Proposed Rule establishes clear standards and timelines for leak grading and repair that incorporate consideration of both public safety and environmental protection. These proposals are key to reducing gas pipeline leaks and PHMSA should adopt its proposed standards, with certain improvements. PHMSA states that "gas pipeline operator leak grading and repair practices are currently insufficient to meet the threats to the environment and public safety from leaks on their systems," in part because current federal standards "lack meaningful requirements

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[452] NYPSC, Docket Nos. 22-E-0064 and 22-G-0065, *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulation of Consolidated Edison Company of New York, Inc. for Electric & Gas Service*, Order Adopting Terms of Joint Proposal and Establishing Electric and Gas Rate Plans with Additional Requirements, 97 (Jul. 20, 2023), https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=22-G-0065&CaseSearch=Search.

[453] WILLIAMS COS., INC., *Operations*, https://www.williams.com/our-company/operations/ (last visited Aug. 14, 2023).

[454] WILLIAMS COS., INC., *2022 Sustainability Report*, 54, https://www.williams.com/wp-content/uploads/sites/8/2023/07/Williams_2022SustainabilityReport-2.pdf (last visited Aug. 14, 2023).

[455] WILLIAMS COS., INC., *2022 Sustainability Report*, 35, https://www.williams.com/wp-content/uploads/sites/8/2023/07/Williams_2022SustainabilityReport-2.pdf (last visited Aug. 14, 2023).

[456] AVISTA UTILITIES, 2021 Avista Electric and Natural Gas SASB ESG Metrics (Dec. 9, 2022), https://investor.avistacorp.com/static-files/6ff8007b-022d-4ae8-8793-ae4f96ed5345.

for timely grading and repair of leaks."[457] This proposal, summarized in the table below, will help to remediate those inadequacies.

PROPOSED LEAK GRADES			
Grade	**Definition (Relevant Excerpts)**	**Applicability**	**Repair Timeline**
1	"[A]ny leak that constitutes an existing or probable hazard to persons or property or a grave hazard to the environment." Proposed § 192.760(b). Includes leak with any of these characteristics: "(i) Any leak that, in the judgment of operating personnel at the scene is regarded as an existing or probable hazard to public safety or a grave hazard to the environment."	All Grade 1 leaks	Immediate and continuous action
2	"A grade 2 leak constitutes a probable future hazard to persons or property or a significant hazard to the environment." Proposed § 192.760(c). Includes any leak with these characteristics: "(vi) Any reading of gas that does not qualify as a grade 1 leak that occurs on a transmission pipeline or a Type A or Type C regulated gas gathering line; (vii) Any leak with a leakage rate of 10 cubic feet per hour (CFH) or more that does not qualify as a grade 1 leak."	Transmission and Type A gathering lines in HCAs, or Class 3/4 locations	Within 30 days of detection
		All other Grade 2 leaks	Within 6 months of detection
		Leaks detected before/on date of final rule publication	Within 1 year of final rule publication date
3	"Any leak that does not meet the criteria of a grade 1 or 2 leak." Proposed § 192.760(d).	General rule*	Within 24 months of detection; with reevaluations every 6 months
		Leaks detected before/on date of final rule publication	Within 3 years of final rule publication date
		* Repair may be postponed if the segment containing the leak is scheduled for replacement, and is replaced, within 5 years of detection	

A. Leak Grade Framework

At present, federal standards do not clearly define how operators should evaluate and prioritize identified leaks. PHMSA regulations state that "[h]azardous leaks must be repaired promptly," 40 C.F.R. § 192.703(c), but the term "hazardous" is not defined and the time frame for

[457] Proposed Rule at 31937.

"promptly" is not clarified.[458] The Gas Piping Technology Committee ("GPTC"), a committee accredited by the American National Standards Institute, maintains and publishes the GPTC Guide as "an implementation tool facilitating compliance by gas pipeline operators with PHMSA regulatory requirements."[459] The GPTC Guide details a leak grading system, in which leaks are defined as Grade 1, 2, or 3 depending on their relative safety risk. A number of states have adopted versions of these leak grading criteria, but often with local variations. Thus, there is no nationwide standard for leak grading and prioritization, and the voluntary standard in the GPTC Guide does not incorporate environmental considerations.

The Proposed Rule will remediate this gap by adopting into federal regulation clear definitions for Grade 1, 2, and 3 leaks. The proposed definitions of Grade 1, 2, and 3 leaks bring clarity and structure to leak management protocols, which will improve safety and environmental protection by facilitating more effective leak repair prioritization by operators. The criteria resemble the GPTC Guide, which has long been utilized by operators and states as a reference point—therefore, the proposed leak grade definitions should be familiar to operators and state regulators and be straightforward to incorporate into operational practice.

PHMSA's proposal takes a monumental step forward by incorporating environmental considerations, as well as safety, into the leak grading framework. Safety and environmental protection are mutually reinforcing objectives in the context of leak management, but when leaks are only defined in the context of near-term safety risks, leaks that have significant environmental impacts can be overlooked. Large-volume leaks, sometimes referred to as super emitters, are responsible for a high proportion of methane emissions from pipeline leakage. Fixing these leaks more quickly can help to cost-effectively mitigate the climate impact of gas pipelines. One peer-reviewed study estimated that on distribution pipeline systems with higher proportions of leak-prone pipe, "repairs of the largest 8% of leaks would reduce [natural gas] distribution pipeline emissions by 30%, and cutting emissions in half could be accomplished by repairing the largest 20% of leaks."[460] Another study, also focused on gas distribution systems, estimated that 20% of emissions come from the largest 2.5% of leaks, and 50% of emissions come from the largest 16% of leaks – indicating the high environmental value of repairing the largest leaks.[461]

Additionally, finding and fixing even smaller leaks on pipelines can further improve the safety of the infrastructure and minimize harmful methane emissions. As the proposal states, "Any leak of methane from a gas pipeline system necessarily entails environmental harm proportional to the total release volume by contributing to climate change," and "even a small leak can result in significant emissions and harm to the environment and public safety if it is allowed to release

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[458] Note that there is a description of "hazardous leak" at 49 C.F.R. § 192.1001, but the definition is vague, does not address environmental considerations, and applies only to distribution system integrity management requirements. *See* Proposed Rule at 31906-907.
[459] Proposed Rule at 31917.
[460] Von Fischer et al., *Rapid, Vehicle-Based Identification of Location and Magnitude of Urban Natural Gas Pipeline Leaks*, 51 ENV'T SCI. TECH., 4091, 4097 (2017) https://doi.org/10.1021/acs.est.6b06095.
[461] *See* Zachary D. Weller et al., *An open source algorithm to detect natural gas leaks from mobile methane survey data*, PLoS ONE 14(2): e0212287 (2019), https://doi.org/10.1371/journal.pone.0212287.

indefinitely without repair."[462] This is particularly worthy of consideration when leaks are allowed to remain on gas pipeline systems without remediation. Under current federal standards, unless a pipeline leak is deemed imminently hazardous to people or property, the operator may *never* have to repair the leak. The Proposed Rule will appropriately remedy this oversight gap by establishing clear timelines, such that all leaks

From the perspective of climate impacts, under the proposed leak grading framework, leaks that pose a "grave hazard to the environment" are Grade 1, the highest priority leaks; leaks that pose a "significant hazard to the environment," including any leak with "a leakage rate of 10 cubic feet per hour (CFH) or more" are Grade 2 leaks, also with expedited repair schedules; and all other identified leaks are Grade 3.[463] PHMSA may want to consider explaining more clearly the distinction between a "grave" and a "significant" hazard to the environment, so that operators have more guidance to ensure compliance with the rapid timeline for repairing a Grade 1 versus a Grade 2 leak.

PHMSA states that the 10 CFH leakage rate criterion for Grade 2 leaks "would ensure prioritized repair of such environmentally damaging leaks even if other grade 1 or grade 2 criteria are not met."[464] The inclusion of leak flow rate as part of the criteria in the leak grading framework is meaningful and should be adopted as proposed. Leak flow rate is a valuable metric that allows operators, regulators, and the public to assess the environmental impact of a pipeline leak by quantifying the associated methane emissions.[465] Operators using advanced leak detection are already using leak flow rate information to inform leak repair prioritization. For instance, in its most recent general rate case, Consolidated Edison Company of New York received state regulator approval to implement an advanced leak detection program through which it will survey one-third of its distribution system annually to identify methane leaks, with a particular focus on high-emitting leaks with an emission rate of 10 scfh or greater.[466] National Grid New York received regulator approval to use ALD in implementing an Enhanced High Emitter Methane Detection Program to identify, quantify, and target leaks of 10 scfh or greater for repair or replacement.[467] Pacific Gas & Electric has been implementing a "Super Emitter" program since 2018, which uses ALD technology in annual system wide surveys to detect large leaks. The threshold for these leaks was initially set at 10 scfh but was lowered to 7 scfh in 2023.[468]

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[462] Proposed Rule at 31940.
[463] *See* Proposed Rule at 31939-41.
[464] Proposed Rule at 31941.
[465] *See* Virginia Palacios et al., *Integrating Leak Quantification into Natural Gas Utility Operations*, PUB. UTILS. FORTNIGHTLY (May 2017) https://www.fortnightly.com/sites/default/files/whitepapers/2017_Palacios%20et%20al_Integrating%20Leak%20Quantification%20into%20Natural%20Gas%20Utility%20Operations.pdf; Zachary D. Weller et al., *An open source algorithm to detect natural gas leaks from mobile methane survey data*, 14 PLoS ONE e0212287 (2019), https://doi.org/10.1371/journal.pone.0212287.
[466] NYPSC, Docket Nos. 22-E-0064 and 22-G-0065, *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulation of Consolidated Edison Company of New York, Inc. for Electric & Gas Service*, Joint Proposal, 97–98 (Feb. 16, 2023).
[467] NYPSC Docket Nos. 19-G-0309 and 19-G-0310, *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of The Brooklyn Union Gas Company d/b/a National Grid NY for Gas Service & KeySpan Gas East Corp. d/b/a National Grid for Gas Service*, Joint Proposal, 58 (May 14, 2021).
[468] PG&E CORP., *CDP Climate Change Questionnaire 2023*, 27 (Jul. 27, 2023), https://www.pgecorp.com/corp_responsibility/reports/2023/downloads/PGE_Corporation_CDP_Climate_Change_Q

Some state regulators have also incorporated relative leak size information into requirements and guidance for leak management. As discussed in further detail in Section VII(C)(1) below, a number of states' regulations distinguish between Grade 1, Grade 2, and Grade 3 leaks and impose different repair timing requirements based on leak grade. Although many states do not require that Grade 3 leaks be repaired in any particular timeframe, Massachusetts requires that Grade 3 leaks that are "environmentally significant" based on certain criteria for gas-in-air reading or leak extent in square feet be repaired within specified timeframes.[469] New Jersey requires that gas utilities report information about Grades 1, 2, and 3 leaks to the state Department of Environmental Protection, including "[i]f known, the volume of methane emissions released, per unit of time."[470] And the California Public Utilities Commission approvingly discussed PG&E's leak survey program in 2015 while discussing "best practices" for leak abatement, stating that PG&E's mobile technology allows PG&E to "find more leaks in a shorter amount of time" and repair them, resulting in "the benefit of a more rapid reduction in methane escaping to the environment," as well as "leak survey labor cost savings and . . . methane cost savings."[471]

The Proposed Rule would designate all leaks on transmission and Type A and C gathering pipelines as minimum of Grade 2 due to higher risk of rupture on higher stress level lines.[472] This is appropriate to ensure safety on this higher-stress infrastructure, and will also help to reduce methane emissions by facilitating faster leak repair in these areas—particularly in HCAs and Class 3 and 4 locations where the agency proposes a 30-day repair time.

The proposal would require that operator leak grading and repair procedures must include a methodology for prioritizing grade 2 repairs, and the "operator's methodology must also include an analysis of the estimated volume of leakage since detection or the date of the last survey (whichever is earlier)." Proposed Rule at 31942. This will help to improve repair prioritization from an environmental and climate perspective.

B. Leak Repair Threshold and Timing

PHMSA proposes to eliminate the current standard that only "hazardous" leaks are subject to explicit repair timelines. This standard was vague since the term "hazardous" was not defined in regulation and has commonly been understood to only address safety—not environmental protection. The proposal would expand leak repair standards, such that operators must prioritize and eventually repair all identified and graded leaks pursuant to the grading framework detailed in the table above.

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uestionnaire_2023.pdf; *see also PG&E Deploys Advanced Methane Detection Technology for Gas Distribution Safety Survey*, BUSINESSWIRE, Feb. 3, 2022, https://www.businesswire.com/news/home/20220203005751/en/PGE-Deploys-Advanced-Methane-Detection-Technology-for-Gas-Distribution-Safety-Survey.

[469] 220 C.M.R. 114.07.

[470] N.J.A.C. 7:27E-3.1.

[471] Cal. Pub. Utils. Comm'n, Safety and Enforcement Division Staff Report, Survey of Natural Gas Leakage Abatement Best Practices (Mar. 17, 2015), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/safety-policy-division/reports/ra-doc-3-sedsb1371lenonaturalgasleakageabatementbestpracticesfinal.pdf.

[472] Proposed Rule at 31942, 31976.

PHMSA proposes a tiered timeline for leak repairs based on the grade, such that Grade 1 leaks must be repaired via "immediate and continuous action"; Grade 2 leaks must be repaired within 6 months of detection; and Grade 3 leaks must be repaired within 2 years of detection. This framework is appropriate to ensure timely leak repair and minimization of environmental harm and safety risks, and PHMSA should adopt the framework as proposed. PHMSA also proposes that for leaks detected prior to the publication of a final rule, Grade 2 leaks must be repaired within 1 year and Grade 3 leak must be repaired within 3 years. Operators can be expected to have many existing, already identified Grade 2 and 3 leaks on their systems, since in many states there are generous timelines for repairing Grade 2 leaks and no mandated timelines at all for repairing Grade 3 leaks.[473] It is important that PHMSA set a standard to ensure that operators address these existing, identified leaks promptly and the agency should adopt the proposed framework to ensure that existing leaks are repaired within 3 years. This provision could help to remediate inequities in leak distribution, as peer-reviewed research found that neighborhoods with more people of color and lower household income tended to have greater densities of gas leaks.[474]

1. *PHMSA Should Remove the Proposed 5-Year Replacement Loophole*

PHMSA should narrow the proposed exception for pipe replacement. The proposal would allow leak repair to be postponed if the pipe segment containing the leak is scheduled for replacement, and is replaced, within 5 years of detection: "To accommodate pipe replacement programs, particularly on leak prone facilities, PHMSA proposes to allow that a grade 3 leak may be monitored rather than repaired if the leaking pipeline is scheduled for replacement or abandonment, and is in fact replaced or abandoned, within five years from the date of detection of the leak."[475] This proposed provision would create a loophole that would allow leaks to persist, posing a safety and environmental threat. The proposal's tiered leak repair framework—under which no graded leak is allowed to persist for more than 2 years—would be significantly undermined by a loophole that allows known leaks to persist for as long as 5 years. B ecause pipe segments planned for replacement tend to be older and more leak-prone, it is particularly important that leaks be repaired on these segments. PHMSA should remove this 5-year loophole from the final rule. Instead, PHMSA should adopt a more limited exception, to allow a Grade 3 leak to be monitored rather than repaired if the leaking pipeline is scheduled for replacement or abandonment in the next 1 year. This would ensure that no graded leaks are allowed to endure on a pipeline for more than 3 years. If PHMSA does adopt a provision allowing operators to avoid leak repair on segments planned for replacement, either as PHMSA proposed or modified as this comment recommends, the exception must remain limited to Grade 3 leaks.

In addition to the concerns identified above, this loophole could potentially incentivize pipeline replacement that may be able to be avoided. Pipe replacement must be carefully evaluated and

[473] *See* Proposed Rule at 31942-43.
[474] Zachary D. Weller et al., *Environmental Injustices of Leaks from Urban Natural Gas Distribution Systems: Patterns among and within 13 U.S. Metro Areas*, 56 Env't Sci. Tech. 8599 (2022), https://doi.org/10.1021/acs.est.2c00097.
[475] Proposed Rule at 31943.

should not be viewed as the ultimate solution to address older infrastructure, see discussion below at Part VII(C).

2. *PHMSA Should Modify the Proposed Leak Repair Extension Provision*

The proposed extension of leak repair, under which an operator could notify PHMSA of its intent to extend leak repair deadline requirements, should be revised. Because PHMSA's notification procedures in § 192.18 do not require affirmative approval by the agency before an operator may proceed, it is essential that any opportunity to extend compliance deadlines through the notification process be structured in a clear, limited manner.

PHMSA proposes that, to extend the timeline for repair of a leak, an operator must demonstrate that "remediation within the specified time frame would result in the release of more gas to the environment than would otherwise occur if the leak were allowed to continue," for example, "if remediation within the timeframe proposed in this NPRM would result in the release of more gas to the environment from blowdown."[476] The proposal would require that "notification to PHMSA would need to include a description of the leak, the leaking pipeline, the leak environment, any proposed monitoring and extended repair schedule, the justification for an extended repair schedule, and proposed emissions mitigation methods."[477]

PHMSA should modify the proposed extension to require that the operator's demonstration (that remediation would release more gas than would otherwise occur) must account for maximum blowdown abatement practices, to ensure that operators are not delaying leak repair on the basis of assumed unmitigated blowdown emissions. Thus, in the notification, the operator should be required to detail the maximum deployment of blowdown mitigation—combining the greatest number of practices and technologies possible—and estimate the associated methane emissions. Finally, this provision is appropriately limited to Grade 3 leaks.

3. *PHMSA Should Modify the Proposed Post-Repair Inspection Standard*

The Proposed Rule would require "that a leak repair may only be classified as complete if the operator obtains during a post-repair inspection a gas concentration reading of 0% gas by volume at the leak location. The equipment used in leak investigations, including this post-repair inspection, must meet the proposed 5 ppm sensitivity standards in § 192.763(a)(1)(ii)."[478] While it is important that operators conduct timely follow-up inspections to ensure that leak repairs have been successfully completed, the standard applied to post-repair inspection should not be so severe that it discourages operators from using more sensitive methane detection technologies. Thus, whatever threshold is defined for the *detection* of a leak should also be the threshold that is defined for concluding the successful *repair* of a leak, rather than requiring a 0% concentration reading.

The FEAST modeling results likewise show the importance of faster leak repair timelines. For example, the results for the gathering and transmission segments show that repairing grade 2

[476] Proposed Rule at 31944.
[477] *Id.*
[478] Proposed Rule at 31943.

leaks in 180 days instead of 365 days, and repairing grade 3 leaks in 720 days, could triple the emission reductions compared to the legacy repair rules.[479] The results for distribution also show nearly double the emission reductions in scenarios relying on the improved repair timelines.[480]

C. State policies and operator practices indicate that more rapid leak repair practices, and leak prioritization based on climate impact, are in use and feasible.

Several states and operators already require faster response to and repair of detected leaks than federal regulations require, indicating that fast leak repair programs are cost-effective and beneficial.

1. *Numerous states have leak grading and repair requirements that supplement or exceed federal requirements.*

A number of states have supplemented federal requirements for leak grading and repair. According to data provided by NAPSR, at least 22 states have requirements for prioritizing leak repairs that add to or exceed federal requirements.[481]

Many of these states flesh out federal requirements by creating a classification system for prioritizing leaks, often accompanied by required timeframes for repair. As PHMSA notes in the proposed rule, many states use a grading system similar or identical to the system proposed by the GPTC, with leaks classified as grade 1, grade 2, or grade 3 depending on how hazardous they are.[482] States generally provide information on what factors the operator should consider when classifying a leak.

Some states impose leak repair timeframe requirements for all grades of leaks. California imposes one of the most protective standards for leak repair: all leaks "of any consequence in gas pipeline, valves and equipment in the vicinity of a [pipe-type and bottle-type] holder must be promptly repaired upon discovery, or as soon as practicable," while "[a]ll hazardous leaks must be remedied at once."[483] California also uses a three-grade system for classifying leaks, with extensive guidance on what issues should be considered in the process.[484] Kansas requires that class 1 leaks receive "immediate repair or continuous action," that class 2 leaks be repaired

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[479] FEAST Pipeline Modeling Results at 29, 44.
[480] *Id.* at 13.
[481] *See* NAT'L ASS'N OF PIPELINE SAFETY REPS., *Compendium of State Pipeline Safety Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations* (3rd ed. 2022), http://nebula.wsimg.com/77f8f2a14d467fbe1e56cbafaf9e8a8b?AccessKeyId=8C483A6DA79FB79FC7FA&disposition=0&alloworigin=1. States with more stringent requirements than the federal baseline with respect to leak response and repair timing include Arkansas, California, Connecticut, Delaware, Georgia, Indiana, Iowa, Kansas, Maine, Michigan, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Rhode Island, South Carolina, Tennessee, Texas, and Washington.
[482] Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890, 31919 (proposed May 18, 2023) (to be codified at 49 C.F.R. 191–93).
[483] Cal. Pub. Utils. Comm'n, General Order No. 112-F, § 183.1 (Jun. 25, 2015), https://www.sdge.com/sites/default/files/regulatory/General%20Order%20112-F.PDF.
[484] Cal. Pub. Utils. Comm'n, General Order No. 112-F, § 143.2 (Jun. 25, 2015), https://www.sdge.com/sites/default/files/regulatory/General%20Order%20112-F.PDF.

within six months and be monitored weekly during periods when the ground is frozen, and that class 3 leaks be inspected every six months and be repaired or replaced within 30 months.[485] Maine similarly requires "prompt action, immediate repair, or continuous action" for Grade 1 leaks, repair "within 30 days of detection" for Grade 2 leaks given the sub-grade "Priority 1," reevaluation of all Grade 2 leaks every 30 days until repair is completed, and reevaluation of Grade 3 leaks every 180 days with repair generally required to be completed within 24 months.[486] Texas requires that Grade 1 leaks receive prompt action, that Grade 2 leaks be repaired within six months of detection with shorter timeframes depending on the situation, and that Grade 3 leaks be repaired within 36 months.[487]

Other states impose leak repair timeframe requirements for some grades of leaks. Arkansas requires that Class 1 leaks be repaired immediately, that Class 2 leaks be repaired "as soon as possible, but within a period not to exceed five months," and that Class 3 leaks be reevaluated at the next scheduled survey.[488] Georgia similarly uses a three-grade system for classifying leaks, with Grade 1 leaks requiring "prompt action," Grade 2 leaks requiring repair within 15 months after they are reported, and Grade 3 leaks generally requiring reevaluation at the next scheduled survey or within 15 months of the date reported, whichever comes first.[489] Michigan requires that hazardous or potentially hazardous leaks receive "immediate corrective action," that non-hazardous leaks which require scheduled repair be repaired within 1 year, and that other leaks be surveyed at least once a year at intervals not exceeding 15 months.[490] Missouri's classification system has four levels, with Class 1 leaks requiring immediate action, Class 2 leaks requiring repair within 45 days or, in some situations, within 15 days, Class 3 leaks requiring repair within five years with inspections twice a year, and Class 4 leaks requiring no further action.[491] New Hampshire requires repair within 24 hours or continuous action for Class I leaks, repair within six months or before the end of the calendar year for Class II leaks, and annual reevaluation of Class III leaks until they are repaired.[492] New Mexico uses a three-grade system for prioritizing repair, although it does not impose explicit requirements for the timeframe within which leaks must be repaired.[493] New York requires that type 1 leaks be addressed immediately, that type "2A" leaks be repaired within six months, that type 2 leaks be generally repaired within one year, and that type 3 leaks "be reevaluated during the next required leakage survey or annually, whichever is less."[494] North Carolina states simply that a "report of a gas leak shall be considered as an emergency requiring immediate attention."[495] Ohio requires immediate repair or continuous action for grade-one leaks, repair of grade-two leaks within 15 months of discovery unless the pipeline is replaced within 24 months, and reevaluation of grade-three leaks during the next

[485] K.A.R. § 82-11-4(b)(32)(c).
[486] C.M.R. 65-407-420 § 6(E)(1).
[487] 16 T.A.C. § 8.207.
[488] Ark. Pub. Serv. Comm'n Docket No. 16-093-R, Order No. 4 Adopting Arkansas Gas Pipeline Code, § 192.723(d)–(e) (May 19, 2017), https://www.sos.arkansas.gov/uploads/rulesRegs/Arkansas%20Register/2017/june2017/126.01.17-001.pdf.
[489] Ga. Comp. R. & Regs. r. 515-9-1-.05.
[490] Mich. Admin. Code R 460.20237.
[491] 20 C.S.R. 4240-40.030(14)(C).
[492] N.H. Admin. Rules, Puc 508.04(m).
[493] N.M.A.C. 18.60.2.12.
[494] 16 NYCRR §§ 255.811, 255.813, 255.815, 255.817.
[495] N.C. Utils. Comm'n Rules and Reguls. Ch. 6, Art. 8, R6-41(a), https://www.ncuc.gov/ncrules/Chapter06.pdf.

scheduled survey or within 15 months of the date of the last inspection, whichever is sooner.[496] South Carolina directs operators to classify leaks into three grades, although it does not impose explicit timeframe requirements for repairs.[497] Tennessee requires that Grade 1 leaks receive immediate and continuous action, that Grade 2 leaks be scheduled for repair within 12 months of discovery (although Grade 2 leaks may be "rechecked" and "rescheduled for repair if they are not in a hazardous location and the repair would be difficult or expensive"), and that Grade 3 leaks be reevaluated at the next scheduled survey.[498] Washington State uses a three-grade classification system, although it does not impose explicit timeframe requirements for repairs.[499] However, "Grade 1 and 2 leaks can only be downgraded once to a Grade 3 leak without a physical repair. After a leak has been downgraded once, the maximum repair time for that leak is twenty-one months."[500]

Like Washington State, other states also have restrictions on the practice of "downgrading" a leak. Maine does not allow operators to downgrade a leak unless it is repaired,[501] while Missouri only allows leaks to be downgraded if certain criteria are met.[502] New Hampshire only allows operators to downgrade a limited number of leaks from Class II to Class III each year (six leaks total or five percent "of all outstanding leaks in a given class, whichever is less").[503]

2. *Some operators perform leak repairs more promptly than required by federal regulations.*

Consolidated Edison NY ("CECONY") demonstrates the feasibility of rapid leak repair timing. According to data released by CECONY, in 2022, it repaired Type 1 leaks in an average of 4 days, Type 2A leaks in an average of 17 days (compared to the timeframe of six months required by state regulation), Type 2 leaks in an average of 16 days (compared to the timeframe of one year required by state regulation), and Type 3 leaks in an average of 35 days (whereas state regulations do not require that Type 3 leaks be repaired at all). As CECONY notes, this "proactive leak identification and rapid repair program significantly reduces the amount of natural gas emissions that would have occurred had CECONY simply adhered to code repair requirements." Specifically, assuming that Type 3 leaks would be repaired within 12 months of discovery, CECONY's program reduces annual natural gas emissions from leaks by about 87% compared to the emissions that would occur under the state's required timelines.[504]

As described above in Section VI(F)(2), some operators perform more frequent leak surveys than federal regulations require, which enables operators to promptly identify and repair leaks. PG&E's Super Emitter leak abatement program, through which PG&E identifies and responds to

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[496] O.A.C. Ann. 4901:1-16-04(E).
[497] S.C. Code Regs. 103-493(2).
[498] Tenn. Comp. R. & Regs. R. 1220-04-05-.44.
[499] W.A.C. § 480-93-186.
[500] W.A.C. § 480-93-186(4).
[501] C.M.R. 65-407-420 § 6(E)(8).
[502] *See* 20 C.S.R. 4240-40-030(14)(C).
[503] N.H. Admin. Rules, Puc 508.04(q).
[504] CON EDISON, INC., *Managing Our Emissions*, https://lite.conedison.com/ehs/2022-sustainability-report/environment/managing-our-emissions/ (last visited Aug. 14, 2023).

large leaks, enabled PG&E to identify and repair over 900 super emitter leaks by 2022.[505] Similarly, Williams' and Avista's leak inspection programs allow them to identify leaks early, enabling faster response and repair times.

CenterPoint Energy states that as of 2018, it had "the world's largest fleet of state-of-the-art leak survey technology," which was able to perform "[n]ear real-time tracking of the leak survey results and natural gas system assets surveyed in the geographic information system, replacing manual tracking of completed leak surveys."[506] In 2021, CenterPoint began deploying Zero Emission Vacuum and Compressor technology to reduce methane emissions.[507]

Operators point to the climate benefits of their leak detection and repair programs. PG&E discusses its leak detection and repair programs as part of its "2030 Climate Goals" for Scope 1 and Scope 2 Emissions, with a 2030 goal of reducing methane emissions by 45% from 2015.[508] CECONY describes how its programs to address leaks quickly reduce methane emissions, and states that it is "looking into several initiatives to meet the requirement under New York's Climate Leadership and Community Protection Act of 85% reduction in greenhouse gas emissions from 1990 levels by 2050."[509] Williams discusses its leak detection and repair programs as part of identifying its "operational GHG emissions" and states that Williams "strives to incorporate and implement environmental considerations into our decision-making processes at all stages of our operations" in order to "mitigate our GHG emissions."[510]

D. Pipeline Retirement Opportunities Should be Evaluated Alongside Replacement

PHMSA should not adopt regulatory provisions that support or motivate pipeline replacement without also requiring consideration of the safety and emissions benefits associated with pipeline retirement.

1. Research Demonstrates that Urban Methane Emissions Continue Despite Pipe Replacement

The Proposed Rule states that EPA "GHGI data demonstrates that replacing leak-prone pipe, such as aging cast iron, can have a significant effect in reducing methane emissions from gas

[505] PG&E CORP., *CDP Climate Change Questionnaire 2023*, 27 (Jul. 27, 2023), https://www.pgecorp.com/corp_responsibility/reports/2023/downloads/PGE_Corporation_CDP_Climate_Change_Questionnaire_2023.pdf.
[506] CENTERPOINT ENERGY, *2018 Corporate Responsibility Report*, 26 https://investors.centerpointenergy.com/static-files/82c57a89-1fc3-43af-ac9e-9cabfb21f070?_ga=2.174743842.1087997689.1692195545-396968575.1692195545 (last visited Aug. 16, 2023).
[507] CENTERPOINT ENERGY, *2022 Corporate Responsibility Report*, "Net Zero by 2035 and Scope 3 Goals," https://sustainability.centerpointenergy.com/wp-content/uploads/2022/08/CenterPoint-Energy-2022-Corporate-Sustainability-Report.pdf (last visited Aug. 16, 2023).
[508] PG&E Corp., *Climate Strategy Report*, at 9 (Jun. 2022), https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/pge-climate-goals/PGE-Climate-Strategy-Report.pdf.
[509] Con Edison, Inc., *Managing Our Emissions*, https://lite.conedison.com/ehs/2022-sustainability-report/environment/managing-our-emissions/ (last visited Aug. 14, 2023).
[510] WILLIAMS COS., INC., *2022 Sustainability Report*, 32–35, https://www.williams.com/wp-content/uploads/sites/8/2023/07/Williams_2022SustainabilityReport-2.pdf (last visited Aug. 14, 2023).

distribution systems," and that a documented "reduction in methane emissions" from distribution systems during 1990 to 2019 "corresponds to a decline in cast-iron and cathodically unprotected steel pipe mileage over the same period."[511] The proposal further states that "GHGI and PHMSA data, therefore, demonstrates that replacing leak-prone materials on gas distribution pipelines can reduce fugitive emissions and incidents and suggest that similar environmental and public safety benefits could be achieved by upgrading gas transmission and gas gathering pipelines made from materials known to leak."[512]

While it is well recognized that certain pipe materials are more prone to leakage,[513] particularly as they age, conclusions that pipe replacement guarantees a certain numeric reduction in methane emissions should be approached with caution. The estimates referenced in the Proposed Rule from PHMSA and the EPA GHGI are based on emissions factor-based quantification, which relies on emission and activity factors based on small data samples that are fairly outdated.[514] Importantly, this approach to estimating methane emissions means that when an operator sees changes in the material of its pipe infrastructure due to replacement, the operator will report decreased leaked methane from its overall system. And while this may be a reasonable directional indicator, it is not a precise quantification of leaked emissions from that pipeline system.

Research has found that urban methane emissions are greater than previously estimated, from gas pipelines, buildings, and other infrastructure. Peer-reviewed research concluded that methane emissions from natural gas infrastructure and buildings in the Boston area remained consistently high over an 8-year period, 2012-2020, despite multiple programs aimed at reducing methane pipeline leakage.[515] Using sensors and a high-resolution transport model to track the methane, researchers found that Boston-area methane concentrations were 3 times higher than state inventories had previously estimated, and remained elevated throughout the study period. Meanwhile, Massachusetts gas utilities spent $2.3 billion in ratepayer funds replacing older leak-prone distribution pipes during the study period. In the context of this research, Environmental Defense Fund recommended to Massachusetts regulators that methane reduction policies should not be tied solely to pipe replacement programs—rather, regulators should facilitate measurement-based emissions reduction programs, including super-emitter leak repair programs.[516]

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[511] Proposed Rule at 31902.
[512] Proposed Rule at 31902.
[513] *See, e.g.,* Virginia Palacios et al., *Integrating Leak Quantification into Natural Gas Utility Operations*, PUB. UTILS. FORTNIGHTLY (May 2017) https://www.fortnightly.com/white-papers/integrating-leakquantification-natural-gas-utility-operations; Zachary D. Weller et al., *A calibration-capture-recapture model for inferring natural gas leak population characteristics using data from Google Street View cars*, 29 ENVIRONMETRICS e2519 (2018), https://doi.org/10.1002/env.2519.
[514] *See* Renee McVay, *Methane Emissions from U.S. Gas Pipeline Leaks*, ENVTL. DEF. FUND (Aug. 2023), https://www.edf.org/sites/default/files/documents/Pipeline%20Methane%20Leaks%20Report.pdf.
[515] Sargent et al, *Majority of US urban natural gas emissions unaccounted for in inventories*, Proceedings of the National Academy of Sciences, 118 (44) e2105804118 (2021), https://doi.org/10.1073/pnas.2105804118.
[516] Comment of Environmental Defense Fund on the Massachusetts Department of Environmental Protection's Program Review, Emergency Regulation, and Proposed Amendments to 310 CMR 7.73, Reducing Methane Emissions from Natural Gas Distribution Mains and Services (submitted Jan. 29, 2021), https://www.edf.org/sites/default/files/2023-08/EDF%20Comment%20MassDEP%20Prog%20Review%20310%20CMR%20773%201.29.21.pdf.

A study surveying Washington, D.C., Philadelphia, New York, Baltimore, and Boston also found urban and gas system methane emissions were 2 to 6 times greater than inventories reported.[517] "These results highlight that current urban inventory estimates of natural gas emissions are substantially low, either due to underestimates of leakage, lack of inclusion of end-use emissions, or some combination thereof."[518]

2. *Other Considerations May Limit the Benefits of Pipe Replacement*

Existing PHMSA regulations state that "[e]ach segment of pipeline that becomes unsafe must be replaced, repaired, or *removed* from service." 49 C.F.R. § 192.703(b) (emphasis added). But in the Proposed Rule, referencing the requirement in Section 114 of the PIPES Act of 2020 that operators update procedures to provide for "the replacement or remediation of pipelines known to leak," PHMSA states that operators may update "their operating, maintenance, and emergency procedures to contain protocols guiding decision-making on whether replacement or remediation of a particular pipeline or its components would be a more durable and effective solution for remediating or preventing leaks that entail public safety and the environmental harms."[519] The retirement of leak-prone pipe segments, when appropriate, can also address the safety and environmental harms presented. PHMSA should revise its proposal to require that operator protocols evaluate whether replacement, remediation, *or retirement* of a particular pipeline or its components would be a more durable and effective solution for remediating or preventing leaks, consistent with the agency's existing standard at 49 C.F.R. § 192.703(b).

Addressing leak-prone pipe is critical to ensuring safety, but like the development of new gas infrastructure, it is often predicated on an assumption that the replaced pipe will continue to be useful and necessary well into the future. Leak-prone pipe replacement is also expensive — Central Hudson Gas & Electric estimates an average cost of $1.9 million per mile,[520] and an analysis for the Maryland Office of People's Counsel found that the state's three gas utilities are projected to spend $4.7 billion on replacing aging gas infrastructure over the next 20 years.[521]

Pipeline replacement may not necessarily be a "durable" or advisable solution to address leak-prone pipe. In the face of national, state, and local policies to address climate change by reducing reliance on fossil fuels, there is a need to reduce overall reliance on natural gas. As natural gas demand declines over time, particularly in homes and buildings, strategic decommissioning of segments of the gas distribution system may be appropriate. If the pipe is primarily serving

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[517] Genevieve Plant et al., *Large Fugitive Methane Emissions from Urban Centers Along the U.S. East Coast*, 46 GEO. RSCH. LETTERS 8500 (2019), https://doi.org/10.1029/2019GL082635.
[518] *Id.* at 8500.
[519] Proposed Rule at 31938.
[520] NYPSC Case Nos. 17-E-0459 and 17-G-0460, Proceeding on Motion of the Commission as to the Rates, Charges, Rules, and Regulations of Central Hudson Gas & Electric Corporation for Electric and Gas Service, Central Hudson Gas & Electric Corporation's Non-Tariff Implementation Plan & Compliance Filing for Non-Pipe Alternatives: Three Transportation Mode Alternatives (June 21, 2019), http://documents.dps.ny.gov/public/MatterManagement/MatterFilingItem.aspx?FilingSeq=228704&MatterSeq=54152.
[521] Maryland Office of People's Counsel, Maryland Gas Utility Spending Projections & Analysis (Oct. 2022), https://opc.maryland.gov/Gas-Utility-Spending-Report.

residential or other distribution level assets, it may be more cost-effective to deploy a Non-Pipeline Alternative and take the asset out of service. Alternatively, if the leak-prone pipe services backbone or transmission level uses, then prioritizing its replacement to eliminate these leaks should be a top priority.

This recommendation is consistent with state policies. The New York Public Service Commission has directed gas utilities to identify in annual reports "the locations of specific segments of LPP [leak-prone pipe] that could be abandoned in favor of NPAs [Non-Pipe Alternatives] and where infrastructure projects may be needed in the near future to maintain reliability." The Commission further stated that utilities should develop "a comprehensive program that simultaneously removes leaking or leak-prone infrastructure and employs programs such as weatherization and demand response along with electrification."[522] In California, Public Utility Commission Staff have proposed a Gas Distribution Infrastructure Decommissioning Framework in which pipeline segments would be prioritized for strategic retirement based on safety risk, environmental harm, cost, and other factors.[523]

PHMSA standards should identify pipe retirement, in addition to replacement or remediation, as another pathway that should be evaluated and considered by operators to address leaks that pose safety and environmental concerns.

VIII. Reporting

Comprehensive and transparent reporting by operators is important to ensure that PHMSA and the public have access to information about pipeline leaks, operator pipeline management, and the extent of methane emissions from leaks, blowdowns, and other aspects of infrastructure operations.

A. Annual Reporting

Current PHMSA annual reporting forms collect limited data from operators on leak management. Operators report the number of leaks repaired in the prior year and planned for repair in the coming year–but since operators are only required to repair "hazardous" leaks, this dataset may not represent all of the known leaks on an operator's system.[524] Thus, the current leak reporting framework presents an incomplete picture of gas pipeline leaks. PHMSA identifies further information gaps in current reporting: "While existing annual report forms

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[522] NYPSC, Case 20-G-0131, Proceeding on Motion of the Commission in Regard to Gas Planning Procedures, Order Adopting Gas System Planning Process at 39 (May 12, 2022), https://documents.dps.ny.gov/public/MatterManagement/MatterFilingItem.aspx?FilingSeq=286895&MatterSeq=62227.

[523] *See* California Public Utilities Commission Staff, Staff Proposal on Gas Distribution Infrastructure Decommissioning Framework in Support of Climate Goals, Proceeding R.20-01-007 (Dec. 21, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M500/K158/500158371.PDF.

[524] *See* Gas Distribution Annual Report Form PHMSA F 7100.1-1 (CY 2021 & Beyond), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2021-05/Current_GD_Annual_Report_Form_PHMSA%20F%207100.1-1_CY%202021%20and%20Beyond.pdf; Natural and Other Gas Transmission and Gathering Pipeline Systems Annual Report Form PHMSA F 7100.2-1 (CY2022 & Beyond), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2022-03/Current_GT_GG_Annual%20Form%20-%20PHMSA%20F%207100%202-1%20CY%202022%20and%20Beyond.pdf.

include limited data on leaks repaired in the preceding year, they lack other data—including the number and grade of leaks detected in the preceding year, the grade of leaks repaired in the preceding year, and estimated release volumes from those leaks—important for PHMSA and State regulators to understand the frequency of leaks, the significance for public safety and the environment from those leaks, and adequacy of operator leak detection and repair programs."[525]

The agency's proposal to improve annual reporting requirements for gas transmission, offshore gathering, and Types A, B, and C gathering, and distribution pipeline operators is beneficial and should be further strengthened and adopted.

As proposed, PHMSA should require operators to report "the number of leaks detected and repaired by grade." Proposed Rule at 31945. PHMSA should collect additional granular information about leaks, including:

- For each leak, to be reported in spreadsheet form: leak location, leak grade, leak flow rate (if known), date of leak identification, date of repair, and last date the leak location was surveyed prior to date of leak identification.
    - Note that these dates, combined with leak flow rate, would allow an operator to calculate the estimated total methane emissions associated with the leak, by multiplying the leak flow rate (or emission rate) by the duration of the leak. Operators should be required to conservatively date back to 1 day after the last date the leak location was surveyed as an estimated start date for the leak– this calculation method will incentivize operators to strive for greater leak frequency to reduce leak duration.
- Annual report should include a list of all notifications submitted by the operator to extend leak repair deadlines pursuant to proposed § 192.760(h) for Grade 3 leaks (if that component of the proposal is retained).
- Annual report should include a list of all Grade 3 leaks being monitored rather than repaired pursuant to proposed §192.760(d) (if that component of the proposal is retained).

More granular reporting, in a usable format (i.e., spreadsheet) will enhance accountability and transparency around leak management practices of operators. Better reporting will also facilitate understanding of equity considerations in leak management. For example, peer-reviewed research found that neighborhoods with more people of color and lower household income tended to have more gas leaks. The study found that average leak density increased by 37% for these populations compared to predominantly white neighborhoods.[526] This analysis was only possible because researchers conducted independent leak surveys and collected their own leak data. Access to the detailed leak information that utilities possess should be made available in a way that is useful and actionable for the public. As discussed below in Part VIII(D), leading states and operators are normalizing transparency around leak location information. PHMSA should adopt these requirements on a nationwide basis.

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[525] Proposed Rule at 31946.
[526] Zachary D. Weller et al., *Environmental Injustices of Leaks from Urban Natural Gas Distribution Systems: Patterns among and within 13 U.S. Metro Areas*, 56 ENV'T SCI. TECH. 8599 (2022), https://doi.org/10.1021/acs.est.2c00097.

As proposed, PHMSA should require operators to report "the estimated aggregate emissions from all existing leaks (whether detected in the reporting year or not) by grade, and estimated emissions from other sources by source categories." Proposed Rule at 31946. However, PHMSA should ensure that its instructions for this reporting are detailed and clear, to ensure consistency across operators and usability of the reported data. Furthermore, PHMSA should seek to ensure maximum consistency with EPA, including the recently proposed updates to EPA Greenhouse Gas Reporting Program (GHGRP) in its emission calculation instructions.

PHMSA's proposed expanded annual reporting, as well as the additional reporting recommendations presented above, should also be required for Type R gathering pipelines. As discussed elsewhere in this comment, PHMSA should expand leak survey and repair requirements to all Type R gathering lines, and reporting should be similarly expanded. Even if PHMSA declines to expand full leak survey and repair standards to Type R gathering lines, PHMSA should still incorporate all of the components of the regulated Transmission and Gathering Annual Report Form into the Type R report form on a voluntary basis. Doing so will allow operators to show leadership by voluntarily reporting leak management practices on Type R gathering pipelines, and will potentially help PHMSA gather useful information about that subset of pipelines.

B. Large-Volume Gas Report

The proposal would improve reporting of large-volume natural gas release events "at § 191.19 to require a new report for intentional and unintentional releases with a volume of 1 MMCF or greater, excluding certain events that had been reported as incidents under §§ 191.9 or 191.15." Proposed Rule at 31945. Currently, PHMSA requires operators to report as incidents only the "unintentional release of 3 MMCF or more of gas" (or events involving death, serious injury, or property damage of $122,000 or more). 49 C.F.R. § 191.3. But existing requirements do not adequately address the importance of tracking and quantifying large releases of natural gas methane. As PHMSA states, "[t]hese new, large-volume gas release reports would provide valuable information on the primary sources and causes of vented emissions and the causes of large-volume leaks that do not qualify as incidents, addressing information gaps in the current incident reporting requirements." Proposed Rule 31945.

Media coverage of major pipeline blowdowns indicates the scale of these events, and the value of understanding them through improved reporting. Bloomberg reported on a Kinder Morgan blowdown event in Texas in 2021, finding that "[g]eoanalytics company Kayrros SAS, which analyzed data from the European Space Agency, estimated release rates of 89 and 53 tons an hour and said they probably occurred within a 10-kilometer radius from Kinder Morgan's pipelines."[527] Bloomberg also reported on a methane plume detected via satellite that was tied to "routine work"--likely a blowdown–on Energy Transfer LP's Panhandle Eastern pipeline.[528]

[527] Naureen Malik & Aaron Clark, *How a Rural Texas Road Project Triggered a Cloud of Methane*, BLOOMBERG (Dec. 1, 2021), https://www.bloomberg.com/news/articles/2021-12-01/this-rural-texas-road-project-triggered-a-cloud-of-methane#xj4y7vzkg.

[528] Naureen Malik & Aaron Clark, *Satellites Spot Methane Plumes Over U.S. Caused by 'Routine Work,'* BLOOMBERG (Sept. 2, 2021), https://www.bloomberg.com/news/articles/2021-09-02/methane-plumes-detected-near-energy-transfer-s-natural-gas-pipeline.

While PHMSA's proposal is strong, it can be improved. In its Subpart W Greenhouse Gas Reporting Program proposed rule, U.S. EPA is proposing to require reporting of "large release events" at a threshold of 10 mtCH4, or approximately 500,000 standard cubic feet of pipeline natural gas.[529]

PHMSA should modify its proposal to set a threshold for reporting large-volume gas releases at 0.5 MMCF. This would ensure improved collection of large release event information and be consistent with the EPA proposal. Additionally, we support the inclusion of Type R unregulated gathering lines as proposed to facilitate additional information collection.

C. National Pipeline Mapping System

The National Pipeline Mapping System ("NPMS") is a key database of information on pipeline location information. PHMSA accurately explains that "stakeholders—including journalists, operators, emergency responders, excavators, elected officials, public interest advocates, and PHMSA and State regulators—use the NPMS to obtain important pipeline-safety related information, including the locations of pipelines and related infrastructure, the names and contact information of pipeline operators, and other attributes of pipelines such as commodities transported and diameter." Proposed Rule at 31947.

PHMSA's proposal to expand NPMS data collection to Type A, B, and C gathering lines and offshore gathering lines is appropriate and welcome. Collection of this information in a unified federal database will facilitate improved analysis and understanding of U.S. pipeline infrastructure. PHMSA should also require that Type R gathering pipelines report to NPMS, to facilitate improved understanding of U.S. pipeline infrastructure and to ensure a complete database that captures all gas pipelines. PHMSA has authority to collect information on gathering pipelines, including to inform "whether and how to provide regulatory oversight of those facilities." Proposed Rule 31946-47; 49 U.S.C. 60117(c).

D. Existing state policies and operator practices indicate the efficacy and benefits of improved reporting

State regulators have expanded leak reporting requirements, and leading operators have expanded voluntary leak reporting, beyond the current federal baseline. These practices demonstrate the feasibility of the improved reporting requirements proposed by PHMSA.

1. States have expanded reporting requirements

Several states require leaks to be regularly reported. According to the NAPSR data, at least eleven states have expanded leak reporting requirements beyond what is currently required by the federal regulations.[530]

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[529] U.S. EPA, Proposed Rule: Greenhouse Gas Reporting Rule: Revisions and Confidentiality Determinations for Petroleum and Natural Gas Systems, 88 Fed. Reg. 50282, 50298 (Aug. 1, 2023).

[530] *See* NAT'L ASS'N OF PIPELINE SAFETY REPS., *Compendium of State Pipeline Safety Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations* (3rd ed. 2022),

Maine[531] and New Hampshire[532] both require monthly reports from operators describing the status of any leaks on their system. Arkansas requires each operator to submit a report identifying the status of all known leaks twice a year.[533] California requires operators to submit annual reports documenting the number of leaks repaired, the time between when the leak was found and when it was repaired, and the response time to reports of leaks.[534] Connecticut requires operators to report "such leaks as are caused by broken mains, services, and defective joints which are of such a nature as might have resulted in serious consequences."[535] New Jersey requires operators to submit an annual report on the status of all unrepaired leaks.[536] In 2022, New Jersey's Department of Environmental Protection adopted regulations that require comprehensive reporting from gas public utilities, including annual reports identifying all known leaks, the dates that leaks were reported and repaired, and leak flow-rate information, if known.[537] Texas requires operators to submit biannual reports documenting all repaired and unrepaired leaks, although its definition of "leak" excludes non-hazardous above-ground leaks that can be "eliminated by lubrication, adjustment, or tightening."[538] According to NAPSR, Virginia's Corporation Commission instructed operators to report all repaired leaks every six months.[539] Washington State requires annual reports from operators documenting the total number of known leaks, the total number of hazardous and nonhazardous leaks eliminated or repaired in the previous year, and the total number of leaks scheduled for repair in the upcoming year.[540] The Washington Utilities and Transportation Commission is then required to, based on this data, estimate the total volume of leaked gas and associated emissions and publish its findings on its website for public access.[541]

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http://nebula.wsimg.com/77f8f2a14d467fbe1e56cbafaf9e8a8b?AccessKeyId=8C483A6DA79FB79FC7FA&disposition=0&alloworigin=1. States with enhanced leak reporting requirements include Arkansas, California, Connecticut, Maine, New Hampshire, New Jersey, New York, Rhode Island, Texas, Virginia, and Washington.

531 C.M.R. 65-407-420(G).

532 N.H. Admin. Rules, Puc 504.06(a)(2).

533 Arkansas Pub. Serv. Comm'n Docket No. 16-093-R, Order No. 4 Adopting Arkansas Gas Pipeline Code, § 191.27 (May 19, 2017), https://www.sos.arkansas.gov/uploads/rulesRegs/Arkansas%20Register/2017/june2017/126.01.17-001.pdf.

534 Cal. Pub. Utils. Comm'n, General Order No. 112-F, § 123.2(a)–(c) (Jun. 25, 2015), https://www.sdge.com/sites/default/files/regulatory/General%20Order%20112-F.PDF.

535 Regs., Conn. State Agencies § 16-11-12(c).

536 N.J.A.C. 14:7-1.26(d)(1).

537 N.J.A.C. 7:27E-3.1.

538 16 T.A.C. § 8.210(e).

539 NAT'L ASS'N OF PIPELINE SAFETY REPS., *Compendium of State Pipeline Safety Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations*, 323 (3rd ed. 2022), http://nebula.wsimg.com/77f8f2a14d467fbe1e56cbafaf9e8a8b?AccessKeyId=8C483A6DA79FB79FC7FA&disposition=0&alloworigin=1.

540 Rev. Code Wash. § 81.88.160(1).

541 Rev. Code Wash. § 81.88.160(4)–(5).

Some states also require reports of the response time between when the operator is notified of a leak and when it responds. These states include Maine,[542] New Hampshire,[543] New York,[544] and Rhode Island.[545]

2. *Some operators disclose information about leak detection and repair programs and emissions.*

In their response to PHMSA's May 2021 public meeting, a group of gas operators stated that they are committed to "report[ing] emissions transparently," and noted that the Interstate Natural Gas Association of America (INGAA) "and its members have made a series of Methane Emissions Commitments, including . . . transparent reporting."[546] INGAA's list of its methane emissions commitments includes a commitment to reporting "methane emissions transparently," noting that some INGAA member companies "voluntarily report emissions under the EPA Natural Gas STAR and Methane Challenge Programs."[547]

A few individual gas utilities voluntarily disclose information about gas leaks. As discussed above, CECONY's website provides data about the average time it took to repair various grades of leaks in 2022.[548] In their 2022 ESG Report, Algonquin Power & Utilities Corporation and its subsidiary Liberty Utilities disclosed their leakage rates in natural gas distribution infrastructure in the years 2019–2021.[549] Avista Corporation disclosed in its 2023 Natural Gas Integrated Resource Plan that methane leaks averaged about 0.51% of the total methane it delivered between July 2019 and June 2022.[550] PG&E disclosed the percentage of gas transmission and distribution pipelines it inspected in 2022, with a number of different tests applied to gas transmission pipelines.[551] PG&E also completes the CDP Climate Change Questionnaire, which

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[542] C.M.R. 65-407-420(F)(3).

[543] The New Hampshire Public Utility Commission has approved settlement agreements with response time reporting requirements for individual operators. *See* N.H. Pub. Utils. Comm'n Docket No. DG 08-048, Order No. 24,906 Approving Settlement Agreement, Art. VI.6.6 (Oct. 10, 2008), https://www.puc.nh.gov/regulatory/CASEFILE/2008/08-048/ORDERS/08-048%202008-10-10%20ORDER%2024906%20APPROVING%20SETTLEMENT%20AGREEMENT.PDF. *See also* NAT'L ASS'N OF PIPELINE SAFETY REPS., *Compendium of State Pipeline Safety Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations*, 203 (3rd ed. 2022), http://nebula.wsimg.com/77f8f2a14d467fbe1e56cbafaf9e8a8b?AccessKeyId=8C483A6DA79FB79FC7FA&disposition=0&alloworigin=1.

[544] 16 NYCRR § 255.825(d).

[545] The Rhode Island Public Utilities Commission ordered the New England Gas Company to submit quarterly reports on its proposed "service quality statistics," which include data on leak response timing. R.I. Pub. Utils. Comm'n Docket No. 3476, Report and Order, 5, 18, 30 (Nov. 21, 2003), https://ripuc.ri.gov/sites/g/files/xkgbur841/files/eventsactions/docket/3476-NEGasOrd17605%2811-21-03%29.pdf.

[546] American Gas Association et al., Comments in Response to the PHMSA Public Meeting, App. A (May 24, 2021), https://www.regulations.gov/comment/PHMSA-2021-0039-0008.

[547] *Id.*

[548] CON EDISON, INC., *Managing Our Emissions*, https://lite.conedison.com/ehs/2022-sustainability-report/environment/managing-our-emissions/ (last visited Aug. 14, 2023).

[549] ALGONQUIN POWER & UTILS. CORP., *2022 ESG Report*, E5 (Nov. 7, 2022), https://libertyutilities.com/uploads/AQN-ESG-Report-2022.pdf.

[550] AVISTA CORP., *2023 Natural Gas Integrated Resource Plan*, 5-3, https://investor.avistacorp.com/static-files/b07f68c6-03c2-4d8c-8213-518f5a527669 (last visited Aug. 14, 2023).

[551] PG&E CORP., *Sustainability Accounting Standards Board (SASB) Index*, https://www.pgecorp.com/corp_responsibility/reports/2023/esg/sasb/ (last visited Aug. 14, 2023).

provides data about leak survey and repair practices, including information about PG&E's Super Emitter program. In the questionnaire, PG&E states that in 2022, it "reduced methane emissions, compared to the 2016 baseline of the Million Ton Challenge, by 380,894 metric tons CO2e (MT CO2e)."[552] PG&E's Million Ton Challenge was a "voluntary five-year carbon reduction goal to avoid one million tons of cumulative greenhouse gas emissions from [PG&E's] operations from 2018 through 2022."[553] PG&E also reports that its methodology for emissions accounting changed in 2022, where it used a "leak-based emission methodology to calculate certain categories of natural gas process and fugitive emissions, following regulatory approval from the California Public Utilities Commission on the emission calculation methodology. This approach differed from prior years, where a population-based approach was used."[554] Williams Companies, Inc. disclosed data about its greenhouse gas emissions, including its Scope 1 and Scope 2 methane emissions, for the year 2022.[555] Enbridge Energy disclosed that it experienced "2 reportable leaks" in its natural gas pipelines in 2017.[556]

While only a handful of operators provide significant data to the public about detected leaks and repair status, the gas operators' comments indicate that it is feasible to report data about detected leaks and emissions, and CECONY's and PG&E's disclosures indicate that operators can make such information and data about leak repair programs easily accessible to the public.

E. Super-Emitter Response Program

Notably, EPA is currently poised to take action to mitigate super-emitter events. EPA, in its proposed standards of performance and emission guidelines for oil and gas sources[557] has outlined a super-emitter response program (SERP)[558] which would "allow the use of reliable and demonstrated remote sensing technology deployed by experienced, certified entities or regulatory authorities to find these large emissions sources."[559] EPA has also recently proposed revisions to subpart W of the greenhouse gas reporting program (GHGRP) that would require reporting of "large release events," including those detected through SERP.[560] The SERP proposed by EPA requires that operators take action to address large emission events detected by certified monitoring entities and, for those emissions that are subsequently

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[552] PG&E CORP., *CDP Climate Change Questionnaire 2023*, 74 (Jul. 27, 2023), https://www.pgecorp.com/corp_responsibility/reports/2023/downloads/PGE_Corporation_CDP_Climate_Change_Questionnaire_2023.pdf.

[553] PG&E CORP., *Climate Strategy Report*, 16 (Jun. 2022), https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/pge-climate-goals/PGE-Climate-Strategy-Report.pdf.

[554] PG&E CORP., *CDP Climate Change Questionnaire 2023*, 87 (Jul. 27, 2023), https://www.pgecorp.com/corp_responsibility/reports/2023/downloads/PGE_Corporation_CDP_Climate_Change_Questionnaire_2023.pdf.

[555] WILLIAMS COS., INC., *2022 Performance Data Table*, https://www.williams.com/wp-content/uploads/sites/8/2023/07/Williams_2022PerformanceDataTable-FINAL.pdf (last visited Aug. 14, 2023).

[556] ENBRIDGE INC., *Enbridge Safety Performance 2017*, https://www.enbridge.com/~/media/Enb/Documents/About-Us/2017_ENB_SafetyReporttoTheCommunity.pdf?rev=6b9036e538fe44298195cfbd61ef5a8d&hash=4B07C051166D618E81CEF98066EB6842f (last visited Aug. 14, 2023).

[557] 86 Fed. Reg. 63110 (Nov. 15, 2021).

[558] *See* PHMSA proposal at fn 266 (stating "PHMSA would also consider estimated emissions methodologies employed by EPA-qualified third-party notifiers in reporting leaks under EPA's super-emitter response program proposals within its supplemental notice of proposed rulemaking issued under").

[559] Proposed Standards of Performance for Oil and Gas Sources, Preamble at 153.

[560] 88 Fed. Reg. 50282 (Aug. 1, 2023).

verified, the operator must report the event to the GHGRP on an annual basis. Operators would also be required to report large release events they detect during regulatory LDAR and any other time they have credible information demonstrating a large release at their facilities.[561]

PHMSA should coordinate an information sharing effort with EPA to facilitate PHMSA's collection of super-emitter data relevant to PHMSA-regulated infrastructure that is reported through EPA's SERP.[562] Additionally, PHMSA should use this data and the EPA proposed framework to create a SERP for PHMSA-regulated natural gas infrastructure. Such a program should incorporate the components proposed in the EPA SERP. These components include a mechanism for independent monitoring entities to report large emission events directly to the Agency. EPA defines super-emitter events as emissions of methane exceeding 100 kg/hr and a "large release event" as emissions exceeding 100 kg/hr or emitting 500,000 scf or more. A PHMSA SERP should also outline a protocol for notifying operators of large emission events observed on their infrastructure and create requirements for those operators to investigate reported events to determine their source and, if necessary, subsequently repair any leaks. A SERP of this kind would create a needed pathway for mitigating emissions from large, intermittent events and also contribute to the overall efficacy of leak detection and repair efforts on the part of operators. The practice of responding to publicly-reported leaks is standard in the gas pipeline industry, since many pipelines are odorized and members of the public can call in to report a detected gas leak and ensure quick operator response. As the public and communities are able to identify gas leaks through other means, such as the use of methane detection equipment, it is appropriate for operators and regulators to develop pathways to respond to the public and improve safety and environmental protection for all. Moreover, PHMSA could use data produced by such a program to further expand oversight of regulated pipelines, prioritizing those with significant and verifiable emissions levels.

IX. Additional Gathering Line Components

The Proposed Rule recognizes and rectifies the current regulatory gap exempting Type B and C gathering lines from certain PHMSA safety requirements. The agency proposes to extend recordkeeping, pressure relief parameters, operations and maintenance, and emergency response procedures to Type B and C gathering lines.[563] A PHMSA rulemaking in November 2021, "Pipeline Safety: Safety of Gas Gathering Pipelines," expanded agency oversight of gathering lines.[564] The final rule applied § 192.615 emergency planning requirements to Type C gathering lines, leaving Type B gathering lines as the only category of regulated gathering lines exempted from this requirement. The Proposed Rule remedies this by expanding emergency planning requirements to Type B gathering lines.[565] This expansion is a step in the right direction—consistent rules across different types and sizes of gathering lines minimizes compliance confusion and maximizes safety.

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[561] *Id*. at 50299-300.
[562] *See id.* at 50299 (seeking comment on how to align EPA's "large release event" definition with PHMSA's "incident" definition).
[563] Proposed Rule at 31952.
[564] PHMSA, Pipeline Safety: Expansion of Gas Gathering Regulation Final Rule, 86 Fed. Reg. 63266 (Nov. 2021), Regulatory Impact Analysis, at 13 (Nov. 2021).
[565] Proposed Rule at 31952.

There are several other ways the agency can amend the Proposed Rule to simply its requirements and bolster its regulatory efficacy. First, PHMSA can eliminate the provision in § 192.9(f) exempting over 70,000 miles of Type C gathering lines from certain safety regulations. The November 2021 rulemaking bifurcated Type C gathering lines into two categories: 1) pipelines between 8.625 inches and 16 inches with a PIR exception and 2) pipelines greater than 16 inches. The agency applied safety requirements to the second group—pipelines with a diameter greater than 16 inches—in full, but exempted the first group from corrosion control, public awareness, line markers, leak survey and repair requirements.[566] The Proposed Rule rectifies this regulatory gap with regard to survey and repair requirements, making all pipelines greater than or equal to 8.625 inches subject to standardized survey and repair requirements.[567] However, the Proposed Rule maintains the other exemptions for pipelines between 8.625 and 16 inches subject to the PIR exemption.[568] PHMSA should eliminate the exception in § 192.9(f) and adopt consistent standards to ensure the maximum efficacy of its safety oversight.

In addition to broadening its oversight of Type C gathering lines, PHMSA should implement maximum coverage of safety requirements for all gathering lines. Type R gathering lines present the same fundamental dangers to human safety and the environment, yet do not have to comply with basic safety requirements like damage prevention, pressure testing, emergency planning or procedures, corrosion control, or design and construction testing for new pipelines.[569] The lack of regulatory oversight over 400,000+ miles of gathering pipelines leaves the infrastructure vulnerable to degradation and weather-related damage, exposes nearby communities to health and safety hazards, and emits atmospheric-warming methane. Consistent standards for all gathering lines would ensure clarity for operators, facilitate clearer enforcement pathways for federal and state inspectors and regulators, and promote safety and environmental protection.

X. Mitigating Operational Gas Releases – Venting, Blowdowns, Etc.

A. PHMSA's proposal to set protective standards to minimize operational releases is a positive step that can be improved

PHMSA proposes to incorporate into its standards for gas transmission, Type A gathering pipelines, and LNG facilities a requirement to mitigate methane releases during blowdowns, tank boil-offs, and other vented emissions. Establishing clear requirements and processes for operators to minimize gas releases during pipeline operations will reduce harmful methane pollution and wasteful product losses.

The agency states that these proposed standards are intended to "facilitate operator implementation of the self-executing mandate in section 114 of the PIPES Act of 2020," and further states that the "proposals described in this section are intended to codify section 114(a) and (b) of the PIPES Act of 2020 and address a subset of operations and maintenance-related emissions sources."[570] In addition to the clear language of Section 114 that operators should

[566] 49 CFR § 192.9(e)-(f).
[567] Proposed Rule at 31972-73.
[568] *Id.*
[569] 49 CFR § 192.8.
[570] Proposed Rule at 31947, 31949.

implement practices to mitigate operational releases in their Operations & Maintenance plans, PHMSA also has core statutory authority to set minimum pipeline safety standards, and those standards may—and do—include protective standards regarding blowdowns, venting, and other operational practices on pipelines.[571]

In the Proposed Rule, PHMSA standards would "identify a menu of proven options" to mitigate methane releases during blowdowns, tank boil-offs, and other venting. The standards would require that an "operator must prevent or minimize the release of gas to the environment through one or more of the following methods": (1) use of valves or control fittings to isolate a shorter segment of pipe for blowdowns; (2) routing gas for flaring instead of venting; (3) use a downstream compressor station to reduce pressure of the affected segment before a blowdown; (4) use a mobile compressor unit to reduce the pressure of the affected segment; or (5) transfer gas/LNG to a lower-pressure pipeline segment.[572] The proposed list identifies effective, feasible options to mitigate blowdowns and other natural gas or LNG releases.[573] Four of these approaches reduce emissions by reducing the amount of gas released from the system during blowdowns, while the fifth, flaring the gas, significantly reduces the climate harm from releasing gas (by converting most of the methane in the natural gas to carbon dioxide), but is nevertheless a highly polluting process which also wastes the gas which is flared.

Therefore, while flaring is clearly preferable to venting gas, it should only be used as a last resort to reduce emissions after other options to reduce gas releases during blowdowns and similar processes have all been fully utilized. PHMSA should strengthen its proposal to clearly require that operators use as many of the non-flaring methods as are applicable in each situation to reduce the volume of gas released during each event to the greatest extent possible, and then utilize flaring to reduce emissions from the residual gas release. Operators should be required to document and report which practices were used, estimated mitigation achieved by each practice, and the quantification of gas released (with mitigation).

A 2016 analysis by MJ Bradley & Associates, summarized in the table below, found that blowdown mitigation technologies could achieve the following reductions in emissions.[574] And operators and other stakeholders have indicated that the efficacy and cost-effectiveness of these technologies have improved since the above-referenced 2016 analysis.[575]

Mitigation Technology	% Reduction in Emissions
Flaring	95%
Pressure Reduction with Inline Compressors	50%
Pressure Reduction with Mobile Compressors	80%
Transfer Gas to Low Pressure System	50%
Isolate Small Section Using Stopples	75%

[571] *See supra*, Part III, Legal Authority.
[572] Proposed Rule at 31948, 31978 (quoting proposed 49 C.F.R. § 192.770(a)).
[573] *See* Dana Lowell, *Pipeline Blowdown Emissions and Mitigation Options* (June 2016), https://blogs.edf.org/energyexchange/wp-content/blogs.dir/38/files/2016/07/PHMSA-Blowdown-Analysis-FINAL.pdf.
[574] *Id.* at 14-16.
[575] *See, e.g.*, PG&E, 2020 Leak Abatement Compliance Plan (submitted Mar. 16, 2020; amended Oct. 19, 2020); Colorado Air Quality Control Commission, Regulation No. 7, 5 CCR 1001-9 Section II.H at p164-171, available at https://drive.google.com/file/d/1JXzWUuPedxqHVCqiU6BdK3GJn_Z0x50X/view.

B. Recommended Improvement to the Proposed "Alternative" Approach

The proposal would permit operators to "employ alternative approaches…provided that the operator can demonstrate that a proposed approach reduces the volume of released gas by at least 50% compared with taking no mitigative action."[576] This proposal does not specify how the percentage mitigation would be calculated, and there are significant uncertainties in how operators might do so, presenting concerns that the math could be manipulated in order to avoid full compliance with the primary standard discussed above. If there are not known proven options to mitigate blowdowns outside of the ones discussed above, then PHMSA should remove this alternative. If the agency does retain this alternative option, PHMSA must adopt a clear standard for how operators should calculate the original unmitigated emissions estimate for a blowdown/release, as well as the estimated mitigation for the listed options. Operators must be required to show how they estimated the extent of mitigation for any alternative approach. Furthermore, based on the MJ Bradley analysis, PHMSA should strengthen this alternative option to require blowdown mitigation of at least 75%, which is readily achievable.

XI. Pressure Relief Devices

In the Proposed Rule, PHMSA is "prescribing release mitigation as a mandatory factor in the design and selection of new pressure relief devices," and "existing pressure relief device configurations would need to be tweaked to minimize releases as well, but only so far as such configurations can be changed."[577]

The proposed standards for design, configuration, and maintenance of pressure relief devices at proposed §§ 192.9, 192.199 and 192.773 would improve system safety and reduce negative environmental impacts associated with possible system incidents or ruptures. PHMSA should adopt the proposed standards.

XII. Underground Natural Gas Storage Facility Regulations Must Be Updated

Section VI(E) of these comments discusses the need to require surface leak detection at Underground Natural Gas Storage Facilities ("UNGSFs"), a topic not covered by the American Petroleum Institute ("API") Recommended Practices ("RPs") 1170 and 1171 that govern UNGSF construction, operations, maintenance, and closure as adopted by PHMSA in 2017.

A topic as complex and consequential as UNGSFs requires a full rulemaking and not merely an adoption of industry guidelines that explicitly note they are "intended to supplement, but not replace, applicable local, state, and federal regulations."[578] Many key areas of UNGSF regulation

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[576] Proposed Rule at 31948.
[577] Proposed Rule at 31951.
[578] *See, e.g,* Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs, API Recommended Practice 1171, First Edition (July 2015), at 1 [hereinafter API RP 1171, First Edition].

fall outside the scope of the RPs, including the primary topic of these comments, surface leak detection.[579]

While PHMSA contemplates a comprehensive UNGSF rulemaking that includes surface leak detection, such an effort could take a long time and in the interim PHMSA should adopt the second editions of API RPs 1170 and 1171, which were finalized in late 2022, and should ensure that any adopted RPs , whether the first or second edition, readily accessible to the public.

The remainder of this section describes the improvements in the second edition over the first edition that bring the RPs more in line with recommendations of the PHMSA/DOE Interagency Task Force 2016 Final Report on Natural Gas Storage Safety (including elimination of single points of failure).[580] These improvements also better address the issue of surface leak detection, better align approaches between depleted reservoir and salt cavern regulation, improve risk management and emergency response, and generally lower the risk of accidents that threaten public health, safety, and the environment.

A. Risk Management

Perhaps the most significant concept now incorporated is a protocol to quantify risk management in the RP's. The concept of "as low as reasonably practicable" ("ALARP") as it pertains to the entire "area of review" is now in the second editions. Both concepts, "ALARP" and "area of review," were completely missing in the f irst e ditions. It is also important that the risk management section in API RP 1171 is now extended into API RP 1170, as 1170, first edition, did not address risk management at all. Other key features added is an <u>audit function</u> coupled with a set of meaningful metrics or <u>KPI's</u> that actual measure performance against pre determined <u>goals and objectives</u>.

- *i. ALARP/Area of Review*

A definition of ALARP is now incorporated in the risk chapters of both API RP 1171 and API RP 1170 as, " reducing the risk to a level which is ALARP involves objectively determining the balance where the effort and cost of further risk reduction measures becomes disproportionate to the additional amount of risk reduction obtained."[581] The definition is important as it stipulates objectivity and balance. Another notable inclusion is a definition of "area of review." The definition includes the entire area encompassing infrastructure (above and

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[579] Docket No. PHMSA-2016-0016, EDF Gas Storage IFR Comments (Nov. 20, 2017), https://www.regulations.gov/comment/PHMSA-2016-0016-0083; Docket No. PHMSA-2016-0016, Comment from Environmental Defense Fund (Feb. 17, 2017), https://www.regulations.gov/comment/PHMSA-2016-0016-0031.

[580] *See generally* DOE & PHMSA, *Ensuring Safe and Reliable Underground Natural Gas Storage: Final Report of the Interagency Task Force on Natural Gas Storage Safety* (Oct. 2016), https://www.energy.gov/sites/prod/files/2016/10/f33/Ensuring%20Safe%20and%20Reliable%20Underground%20Natural%20Gas%20Storage%20-%20Final%20Report.pdf.

[581] Design and Operation of Solution-mined Salt Caverns Used for Natural Gas Storage, API Recommended Practice 1170, Second Edition (Nov. 2022), at 2 [hereinafter API RP 1170, Second Edition]; Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs, API Recommended Practice 1171, Second Edition (Nov. 2022), at 3 [hereinafter API RP 1171, Second Edition].

below the surface) and the reservoir.[582] Therefore, nothing will be left out of consideration for ALARP whatsoever.

- *ii. Goals, Objectives, KPI's, Audit Function*

In the first edition of API RP 1171, there was little to no focus on setting goals and objectives for the risk management program. Neither was there specific reference to developing and using appropriate key performance indicators ("KPI s") or any attempt to recommend auditing the program and evaluating its performance against any benchmarks. If a program has no goals or objectives, there is little chance it will perform effectively. If a program has goals and objectives, but no performance indicators, it i s impossible to gauge performance against the goals and objectives. Finally, if there is no audit function with a defined timeframe and benchmarks to make an objective evaluation, there can be no assurance that the program is performing as designed. M anagement will have little or no idea how the organization and its operations are performing with regard to acceptable risk environments. All three of these facets work together and must each be present in a proper risk management program. They are now incorporated into the RP's second editions.[583]

B. Functional Integrity of Natural Gas Storage Wells

- *i. The Mechanical Integrity Stage*

There are approximately 400 underground gas storage facilities in the lower 48 of the United States, and close to 80% are depleted natural gas or oil fields.[584] It is advantageous to convert a depleted field to underground storage because of the existing wells and associated infrastructure. However, the disadvantage is often, and increasingly so, the age of the physical assets. Frequently the older facilities have wells that are well over 50 years old, meaning that they were constructed using very old, outdated technology and procedures and may be failing, or at least compromised. Recent well failure events in California[585] and Pennsylvania[586] point directly to the fact that these facilities are not of the highest quality construction and in many cases are not being maintained as they should.

- *ii. Primary and Secondary Barriers*

A new subsection in API RP 1171 discusses the general nature and need for well barriers to contain reservoir fluids, and references ISO 16530-1 (petroleum and natural gas industries - well

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[582] *Id.* (defining area of review as "[t]he underground gas storage reservoir and all wells associated with it, as well as all non-associated subsurface or surface structures, formations, or activities proximal enough that could impact or be impacts by the underground gas storage facilities and operating process.").
[583] *See generally* API RP 1170, Second Edition; API RP 1171, Second Edition.
[584] *Underground Natural Gas Storage*, ENERGY INFRASTRUCTURE API, https://www.energyinfrastructure.org/energy-101/natural-gas-storage (last accessed August 15, 2023) .
[585] CPUC, *Aliso Canyon Well Failure*, https://www.cpuc.ca.gov/regulatory-services/safety/gas-safety-and-reliability-branch/aliso-canyon-well-failure.
[586] Reid Frazier, *DEP says leaks, spill damage continue at Pa. storage site where gas leaked for weeks*, WESA News (Dec. 12, 2022, 05:25 AM), https://www.wesa.fm/environment-energy/2022-12-12/dep-says-leaks-spill-damage-continue-at-pa-storage-site-where-gas-leaked-for-weeks.

integrity).[587] The new subsection goes into considerable detail about primary and secondary barrier elements, design, construction, and implementation. Operators should evaluate all newly constructed wells for competent primary and secondary barriers and envelopes . Examples are given for barrier elements to add clarity. Also, a subsection on barrier evaluation is presented that notes the site specific nature of evaluations and how they should be risk- based. This is an important and valuable addition in the s econd e ditions.

C. Health, Safety & Environment

A sound Health, Safety, and Environment ("HSE") program is best described in the context of an HSE m anagement s ystem. While each organization must choose specific elements of a management system tailored to its needs, there are several fundamental functions that are required. There were many deficiencies and inconsistencies in the first editions of API RP 1170 and API RP 1171. Key principles of good HSE management systems either were not present or quite vague.

Through the efforts to upgrade several subsections in at least two chapters in each RP, API RP 1173 included elements of good HSE management systems.[588] This improvement is an excellent recommended practice for dealing with pipeline safety management systems, which really applies to all aspects of underground gas storage operations as well.

- *i. Emergency Response Plans*

Well constructed Emergency Response Plans ("ERP s") that provide the proper level of emergency preparedness begin with ERP organization and include key elements such as purpose and scope, leadership commitment, response team organization, well defined roles and responsibilities, resource allocation, and communication systems. The ERP ought to include planning elements such as goals and objectives, proper design, an effective incident management system coupled with hazard identification. Finally, the ERP implementation requires clear standards, procedures, training and education, record keeping, exercises and means to implement learnings, and adjustments to evolving business models.

The second editions of API RP 1170 and API RP 1171 include all the key elements of a comprehensive ERP.[589] While they broadly cover a full range of topics and possibilities, there is enough specificity to bring clarity to what the ERP should contain and do. There are three other pieces in the general section of the new editions that were either not present or were inconsistent between the two RP's f irst e ditions.[590] First, it is now clear that the safety of life, property, and the environment should be the goal of an ERP. Second, operators are directed (shall) to integrate emergency procedures with required regulatory procedures where possible

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[587] *See API RP 1171, Second Edition, at 6.5* "Well Barriers."
[588] *See generally* Pipeline Safety Management System Requirements, API Recommended Practice 1173, First Edition (June 2014).
[589] *See API RP 1170, Second Edition, at 12* "Site Security and Safety Programs"; API RP 1171, Second Edition, at 10.4 "Emergency Preparedness/Emergency Response."
[590] C*ompare API RP 1170, Second Edition, at 12.1* "General"; API RP 1171, Second Edition, at 10.4 "General"; with API RP 1170, First Edition, at 9.6.1 "General"; API RP 1171, First Edition, 10.2.1 "General".

and applicable. Finally, operators' ERPs shall include processes and procedures that address accidental releases, natural disasters, equipment failures and third-party emergencies.

- *ii. Well Control Plans*

Any operation involving wells and storage of natural gas must address well control. Both first editions of API RP 1170 and API RP 1171 had a section on a blowout contingency plan but lacked conformity and sufficient guidance on how to develop a well control plan or behave during a well control emergency. The lack of continuity, specificity, and coverage of key points in a comprehensive well control plan left the operator with no clear template to address an extremely important issue. The first editions did not come close to addressing this vital part of emergency preparedness. Both documents now have important detail regarding well control that did not exist in the first editions.[591] The plans are linked to site specifics identified by proper risk assessment and at a minimum include planning around drilling, operation, and workover. Current wellbore schematics and specific hazards are addressed along with communications, event organizational structure, site safety and security, required materials and services, roles and responsibilities, and training that assures adequate knowledge. Another very important new feature is that the operator must demonstrate competency in its procedures. Finally, the primary goal, stated clearly, of the well control plan is to protect life, property, and the environment.

- *iii. Safety and Environmental Programs*

The first edition of API RP 1171 had a subsection on safety and environmental programs,[592] but no such section existed in API RP 1170. This discrepancy offered an opportunity to add important text to 1171 and to include it in 1170. Topics in the first edition did not contain vital elements of comprehensive HSE management systems. The First Edition focused on minor details such as job plans, reviews, and analysis. These are important points, but they should be under broader terms such as operational controls or safe work practices. New language brought the entire host of HSE management program elements into the second editions. These include operational controls (safe work practices, system integrity, management of change, contractors, and incident investigation), safety assurance (audit, goals and objectives, evaluation of safety culture), management review, continuous improvement, training (competence demonstration and awareness), documentation and record keeping, and other elements deemed necessary by the operator.[593] The subsection on safety and environmental programs now exists in both API RP 1171 and API RP 1170. There is also reference to API RP 1173 which is an outstanding document on pipeline safety but obviously applicable from a safety principles standpoint to all points of underground gas storage.

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[591] *See* API RP 1170, Second Edition, at 12.4.3 "Well Control Plan"; API RP 1171, Second Edition, at 10.4.3 "Well Control Plan."
[592] *See* API RP 1171, First Edition, at 11.9 "Safety and Environmental Programs".
[593] *See* API RP 1170, Second Edition, at 13 "Procedures and Training"; API RP 1171, Second Edition, at 11 "Procedures and Training".

XIII. Stronger Oversight is Needed for Hydrogen Pipelines

The Proposed Rule acknowledges that hydrogen transportation by pipeline poses unique issues compared with natural gas, such as increased leakage concerns.[594] Methane[595] and hydrogen are different molecules with different properties, each posing safety and environmental risks—but PHMSA's current "gas" pipeline standards apply generally to natural gas, hydrogen, and other gaseous pipelines. PHMSA sought comment in the Proposed Rule on the value of "adopting hydrogen gas pipeline-specific provisions,"[596] and the agency should adopt certain initial provisions in this rulemaking specific to hydrogen pipelines, detailed herein. However, PHMSA should fully address the unique elements of hydrogen transportation in a separate rulemaking to ensure that hydrogen infrastructure is designed or modified to operate safely, with minimum leaks and leveraging all possible learnings from methane leak monitoring and prevention programs. This is particularly relevant as certain federal policies are incentivizing development of hydrogen pipelines, and as research continues to demonstrate the climate impacts of hydrogen emissions.

A. Methane and Hydrogen Have Different Physical and Chemical Properties and Behave Differently

Hydrogen and methane are distinct molecules with unique properties and behaviors. Notable differences are:

- Hydrogen is approximately eight times lighter than methane, the primary component of natural gas (2.11 g/mol vs. 16.04 g/mol). Because of this, hydrogen permeates faster from gaskets, seals, and plastic pipes.
- Hydrogen also has a much higher diffusivity than methane in the air, water, steel, and all materials, which makes it leak more easily than methane from seals and piping joints.[597]
- Hydrogen is around eight times less dense than methane (0.08375 kg/m^3 (NTP) vs. 0.668 kg/m^3 (NTP)),[598] so it can rise and accumulate in enclosed spaces to a greater extent than methane / natural gas.

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[594] *See* Proposed Rule at 31899, note 75 ("certain part 192-regulated gas pipeline facilities (e.g., gas pipeline facilities transporting hydrogen gas) may be particularly susceptible to leaks because of (inter alia) the smaller size of hydrogen gas molecules compared to methane molecules"); *id.* at 31906, n.123 ("PHMSA notes that the limitations of current part 191 and 192 regulations for meaningful and timely identification, repair, and reporting of leaks discussed in this section II.D may be particularly acute in connection with the pipeline transportation of gaseous hydrogen, which is a much smaller molecule (with potentially greater leakage is ipotential) than methane.").

[595] Pipeline-quality natural gas is composed of about 95% methane. Thus, comparisons between the behavior of hydrogen and methane molecules are appropriate comparisons of differences between hydrogen and natural gas.

[596] Proposed Rule at 31926.

[597] *See, e.g.*, *Air - Diffusion Coefficients of Gases in Excess of Air*, ENGINEERING TOOLBOX (2018), https://www.engineeringtoolbox.com/air-diffusion-coefficient-gas-mixture-temperature-d_2010.html (accessed Aug. 12, 2023); *Gases Solved in Water - Diffusion Coefficients*, ENGINEERING TOOLBOX, https://www.engineeringtoolbox.com/diffusion-coefficients-d_1404.html (accessed Aug. 12, 2023).

[598] HYDROGENTOOLS, *Basic Hydrogen Properties*, https://h2tools.org/hyarc/hydrogen-data/basic-hydrogen-properties (accessed Aug. 12, 2023); *Gases – Densities*, ENGINEERING TOOLBOX, https://www.engineeringtoolbox.com/gas-density-d_158.html (accessed Aug. 12, 2023).

- Hydrogen's calorific value per unit volume is approximately one third of methane (0.0108 MJ/L vs. 0.0358 MJ/L) or natural gas.[599] This means hydrogen requires at least three times higher velocity and input energy to deliver the same amount of energy as natural gas.
- Hydrogen is more reactive than methane, which, together with its high diffusivity, results in embrittlement of steel pipelines.
- Hydrogen has a higher/wider explosive limit than methane (4 – 75%$_v$ vs. 5 – 15%$_v$) and lower ignition energy. Consequently, hydrogen poses a higher fire risk than methane or natural gas.[600] Additionally, hydrogen flames have lower visibility than methane, making burning hydrogen harder to detect.
- Hydrogen flame speed velocity is approximately eight times higher than methane's, leading to lower burner stability and a higher risk of flash-back, which occurs when the flame propagates back into the fuel supply system of a combustion process, posing a safety risk.[601]
- Hydrogen has a higher flame temperature than methane (2210 °C vs. 1950 °C).[602] This distinction contributes to increased production of NOx, an air pollutant associated with respiratory and cardiovascular diseases that is also a precursor to ozone, when hydrogen is combusted compared to methane.

These characteristics are relevant to the engineering, maintenance, and operation of pipelines and storage infrastructure for each gaseous fuel.[603] Because leakage and operational releases of both hydrogen and methane can pose safety risks and contribute to the climate crisis, it is important that operators deploy the most effective technologies and practices to minimize leakage. The properties identified above indicate the importance of specific standards for pipelines transporting different gases. PHMSA should consider and account for such differences in its minimum pipeline safety standards.

B. Hydrogen Emissions Contribute to Climate Warming

Peer-reviewed research has highlighted that hydrogen acts as an indirect greenhouse gas and its emissions into Earth's atmosphere contribute to near-term warming of our climate. Hydrogen triggers chemical reactions in the atmosphere that increase the amounts of potent greenhouse gases methane, stratospheric water vapor, and tropospheric ozone.[604] Hydrogen contributes to warming in the following ways:

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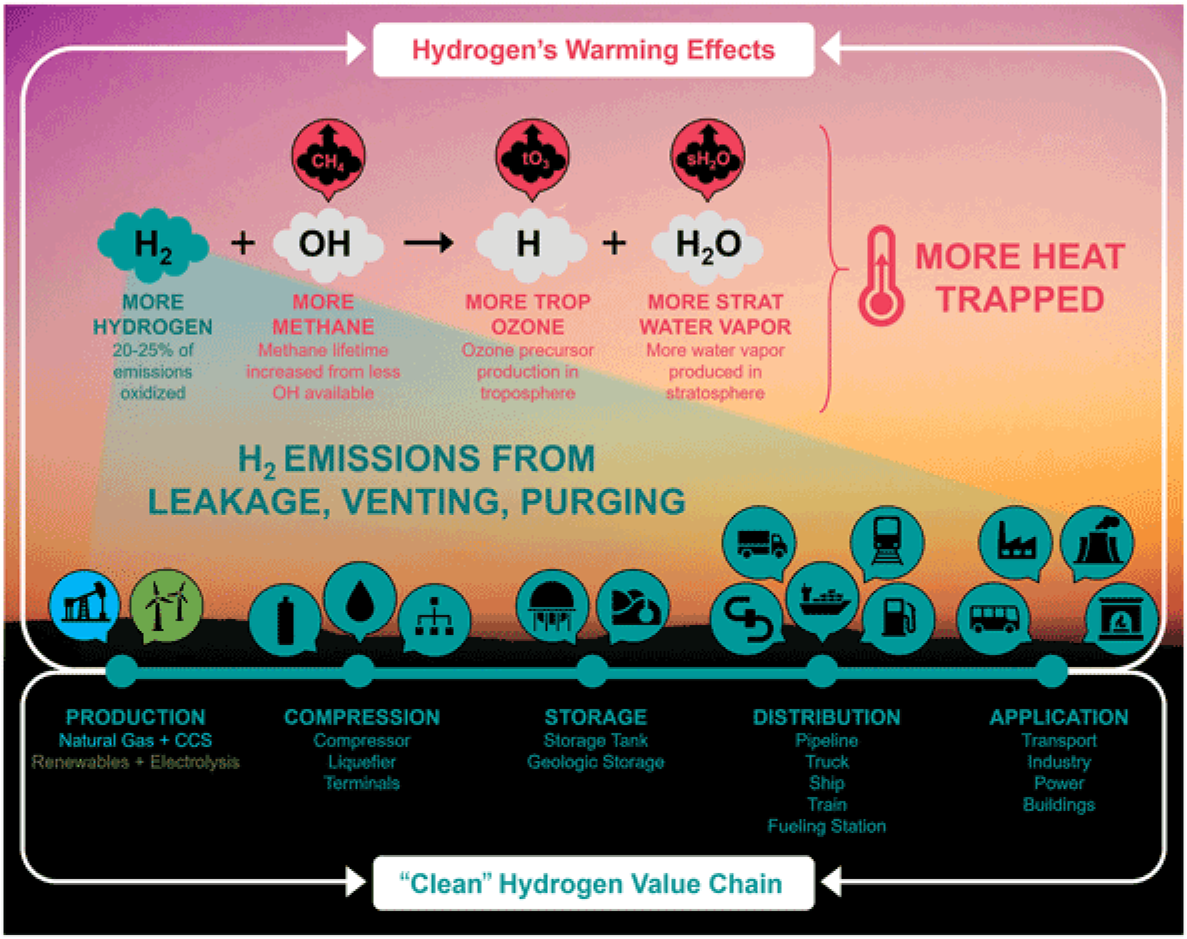
[599] *Fuels - Higher and Lower Calorific Values*, ENGINEERING TOOLBOX, https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html (accessed Aug. 7, 2023).
[600] *See Gases - Explosion and Flammability Concentration Limits*, ENGINEERING TOOLBOX, https://www.engineeringtoolbox.com/explosive-concentration-limits-d_423.html (accessed Aug. 10, 2023); Proposed Rule at 31955 (stating that the lower explosive limit is 4% for hydrogen and 5% for methane natural gas).
[601] *See Paraffins and Alkanes - Combustion Properties*, ENGINEERING TOOLBOX, https://www.engineeringtoolbox.com/paraffins-alkanes-combustion-d_1430.html (accessed Aug. 12, 2023); Chen Dong et al., *Experimental study on the laminar flame speed of hydrogen/natural gas/air mixtures*, 4 FRONT. CHEM. ENG. CHINA, 417 (2010), https://doi.org/10.1007/s11705-010-0515-8.
[602] *Flame Temperatures – Gases*, ENGINEERING TOOLBOX, https://www.engineeringtoolbox.com/flame-temperatures-gases-d_422.html (accessed Aug. 12, 2023).
[603] *See, e.g.*, *Safety Data Sheet: Methane*, AIRGAS, https://www.airgas.com/msds/001033.pdf (last updated Nov. 15, 2020).
[604] Richard G. Derwent et al., *Global modelling studies of hydrogen and its isotopomers using STOCHEM-CRI: Likely radiative forcing consequences of a future hydrogen economy,* 45 INT'L J. HYDROGEN ENERGY 9211 (2020); Richard G. Derwent et al., *Global environmental impacts of the hydrogen economy,* 1 INT'L J. NUCLEAR HYDROGEN

- Oxidation of hydrogen depletes the hydroxyl radical (OH), the primary sink for methane, leading to a lengthening of the methane atmospheric lifetime ($H_2 + OH = H + H_2O$).[605]
- Production of atomic hydrogen (H) from H_2 oxidation leads to a chain of reactions that produces tropospheric ozone (O_3). When H_2 oxidation occurs in the stratosphere, the water vapor produced leads to stratospheric cooling due to the enhancement of the stratosphere's radiative capacity, which results in the planet's overall warming.[606]



PRODUCTION & APPLICATION 57 (2006), Richard G. Derwent et al., *Transient Behaviour of Tropospheric Ozone Precursors in a Global 3-D CTM and their Indirect Greenhouse Effects*, 49 CLIMATIC CHANGE 463 (2001); R.A. Field & R.G. Derwent, *Global warming consequences of replacing natural gas with hydrogen in the domestic energy sources of future low-carbon economies in the United Kingdom and the United States of American*, 46 Int'l J. Hydrogen Energy 30190 (2021), https://doi.org/10.1016/j.ijhydene.2021.06.120; Fabien Paulot et al., *Global modeling of hydrogen using GFDL-AM4.1: Sensitivity of soil removal and radiative forcing*, 46 INT'L J. HYDROGEN ENERGY 13446 (2021); Nicola J. Warwick et al., *Atmospheric composition and climate impacts of a future hydrogen economy*, ATMOS. CHEM. PHYS. DISCUSS (2023), https://doi.org/10.5194/acp-2023-29.

[605] Sofi Esquivel-Elizondo et al., *Wide range in estimates of hydrogen emissions from infrastructure*, 11 FRONTIERS ENERGY RSCH. 1207208 (2023), https://doi.org/10.3389/fenrg.2023.1207208; D.H. Ehhalt & F. Rohrer, *The tropospheric cycle of H2: a critical review*, 61B TELLUS 500 (2009); Richard G. Derwent, Hydrogen for Heating: Atmospheric Impacts—A Literature Review, BEIS Research Paper Number 2018: no 21 (2018).

[606] Richard G. Derwent, Hydrogen for Heating: Atmospheric Impacts—A Literature Review, BEIS Research Paper Number 2018: no 21 (2018); D.H. Ehhalt & F. Rohrer, *The tropospheric cycle of H2: a critical review*, 61B TELLUS 500 (2009).

Source of image: Ocko & Hamburg (2022).

The warming impact of hydrogen occurs over several decades, because H_2 oxidation occurs around 1-3 years after emission and its warming effects last a couple decades, making it more potent in the short term after it is released.[607] The latest science indicates that hydrogen can cause 37 times more warming than carbon dioxide (CO_2) over a 20-year period.[608] "Because its impacts are short-lived, hydrogen's warming potency is around 12 times that of CO_2 over 100 years. Thus, the overall climate benefits, especially in the near term, from replacing fossil fuel systems with hydrogen alternatives will depend on how much H_2 is emitted."[609]

If not designed properly, hydrogen production, transportation, storage, and end use infrastructure can all emit hydrogen into the atmosphere, and therefore warm the climate . While the hydrogen production method (such as electrolysis with renewable electricity or the use of fossil fuels with or without carbon capture) largely determines its climate impact,[610] hydrogen emissions influence the overall climate impacts from replacing fossil fuel technologies with hydrogen. For example, while a low hydrogen emissions rate paired with near-zero greenhouse gas emissions from the hydrogen production could nearly eliminate the climate impacts compared with use of fossil fuels,[611] the climate benefits decrease significantly with increased emissions of hydrogen.[612] Accordingly, hydrogen leakage and operational releases must be avoided.

Because of limitations in hydrogen sensing technologies and analysis, there is not a good understanding of the level of hydrogen leakage from pipelines and other infrastructure. Without the ability to make direct measurements, studies have "attempted to estimate total value chain and component-level hydrogen emissions using various approaches, e.g., assumptions, calculations via proxies, laboratory experiments, and theory-based models (simulations)."[613] Results include:

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[607] Nicola J. Warwick et al., *Atmospheric composition and climate impacts of a future hydrogen economy*, ATMOS. CHEM. PHYS. DISCUSS (2023), https://doi.org/10.5194/acp-2023-29.

[608] Sand et al., *A multi-model assessment of the Global Warming Potential of hydrogen*, 4 COMMS. EARTH & ENV'T 203 (2023), https://www.nature.com/articles/s43247-023-00857-8.

[609] Ilissa Ocko & Steven Hamburg, *Climate consequences of hydrogen emissions*, 22 ATMOS. CHEM. PHYS. 9349 (2022), https://doi.org/10.5194/acp-22-9349-2022.

[610] Hydrogen production methods can also contribute significant emissions of harmful air pollution. Sun et al., *Criteria air pollutants and greenhouse gas emissions from hydrogen production in U.S. steam methane reforming facilities*, 53 ENV. SCI. TECH., 7103 (2019), https://pubs.acs.org/doi/10.1021/acs.est.8b06197

[611] Ilissa Ocko & Steven Hamburg, *Climate consequences of hydrogen emissions*, 22 ATMOS. CHEM. PHYS. 9349 (2022), https://doi.org/10.5194/acp-22-9349-2022.

[612] *See* Sofi Esquivel-Elizondo et al., *Wide range in estimates of hydrogen emissions from infrastructure*, 11 FRONTIERS ENERGY RSCH. 1207208 (2023), https://doi.org/10.3389/fenrg.2023.1207208; Didier Hauglustaine et al., *Climate Benefit of a future hydrogen economy*, 3 COMMUNICATIONS EARTH & ENV'T 295 (2022); Ilissa B. Ocko & Steven P. Hamburg, *Climate consequences of hydrogen emissions*, 22 ATMOS. CHEM. PHYS. 9349 (2022); Nicola J. Warwick et al., *Atmospheric composition and climate impacts of a future hydrogen economy*, ATMOS. CHEM. PHYS. DISCUSS (2023), https://doi.org/10.5194/acp-2023-29.

[613] Sofi Esquivel-Elizondo et al., *Wide range in estimates of hydrogen emissions from infrastructure*, 11 FRONTIERS ENERGY RSCH. 1207208 (2023), https://doi.org/10.3389/fenrg.2023.1207208.

- Estimated hydrogen emissions (amount of hydrogen emitted per amount of hydrogen transported) from transmission pipelines: 0.02 – 5.0 % (Fan et al, 2022; Cooper et al., 2022; Frazer-Nash, 2022; Arrigoni and Diaz, 2022; van Ruijven et al., 2011).
- Estimated hydrogen emissions from distribution pipelines: 0.0003 – 5.0 % (Fan et al, 2022; Cooper et al., 2022; Frazer-Nash, 2022; Arrigoni and Diaz, 2022; van Ruijven et al., 2011).
- Estimated hydrogen emissions from transportation (pipelines, road tube trailer, trucking, shipping): 0.0 – 20.0 % (Fan et al, 2022; Cooper et al., 2022; Frazer-Nash, 2022; Arrigoni and Diaz, 2022; van Ruijven et al., 2011)

C. General "Gas" Standards Do Not Adequately Address Hydrogen Pipelines

Existing pipeline standards in Parts 191 and 192, and the leak detection and repair standards in the Proposed Rule, "apply generally to pipeline transportation of any 'gas,'" including natural gas and hydrogen.[614] After first adopting minimum safety standards for gas pipelines in 1970, the agency issued an interpretation letter in 1975 confirming that hydrogen unambiguously fit into the agency's definition of "gas."[615] In 1980, the Office of Pipeline Safety narrowed its coverage of hydrogen pipelines, concluding in an interpretation letter that federal standards would not apply to hydrogen pipelines between facilities owned by the same company, because the producer and consumer of the gas are the same entity.[616] The Office subsequently rescinded the 1980 letter in 1992 and stated that the federal safety standards have broad applicability, including to consumer-owned gas pipelines.[617]

Although they apply more broadly, PHMSA's gas pipeline standards are designed with a primary focus on natural gas (methane) pipelines. The Proposed Rule states that pipelines transporting hydrogen "may be particularly susceptible to leaks,"[618] and "the limitations of current part 191 and 192 regulations for meaningful and timely identification, repair, and reporting of leaks . . . may be particularly acute in connection with the pipeline transportation of gaseous hydrogen, which is a much smaller molecule (with potentially greater leakage potential) than methane."[619] PHMSA also states that its evaluation of leak data to inform the Proposed Rule is "focused on the location, frequency, and severity of leaks on natural gas pipeline facilities."[620]

Hydrogen pipelines have historically made up a very small subset of the regulated infrastructure overseen by PHMSA. There are about 1,500 miles of U.S. hydrogen pipelines, compared with the 3 million miles of natural gas pipelines that make up the vast majority of U.S. gas pipeline

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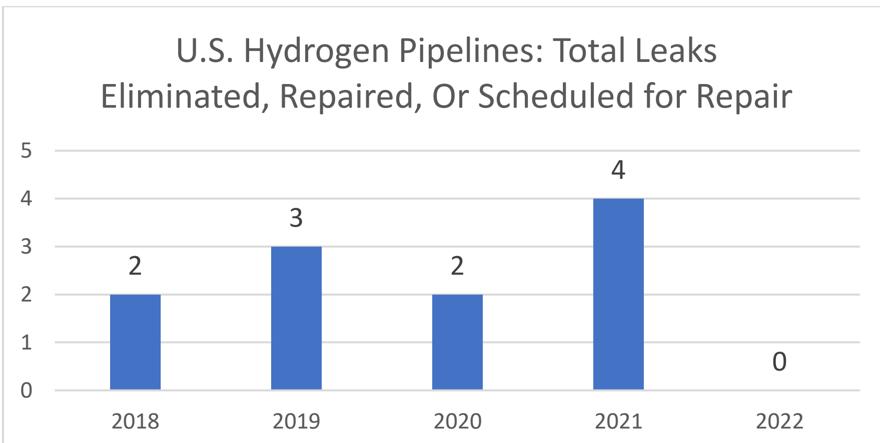
[614] Proposed Rule at 31926; *see also* 49 C.F.R. Parts 191, 192.
[615] Interpretation Letter from Joseph C. Caldwell, Director, Office to Pipeline Safety, to William V. Bud Porter, President, The Porter Company (Apr. 30, 1975), https://www.phmsa.dot.gov/regulations/title49/interp/PI-75-044.
[616] Interpretation Letter from Melvin A. Judah, Acting Associate Director for Pipeline Safety Regulation, Materials Transportation Bureau, to Raymond M. Ripple, E.I. Du Pont De Nemours & Company (Sept. 8, 1980), https://www.phmsa.dot.gov/regulations/title49/interp/PI-80-014.
[617] Interpretation Letter from Cesar De Leon, Director, Regulatory Programs, Office of Pipeline Safety, to Raymond M. Ripple, E.I. Du Pont De Nemours & Company (July 14, 1992), https://www7.phmsa.dot.gov/regulations/title49/interp/PI-92-030.
[618] Proposed Rule at 31899, n.75.
[619] Proposed Rule at 31906, n.123.
[620] Proposed Rule at 31899, n.75.

infrastructure.[621] Existing hydrogen pipelines are concentrated in the Gulf Coast region, with over 90% of the pipelines located in Texas and Louisiana.[622] This infrastructure is operated by a relatively small group of companies: there are 31 total operators, and 3 companies operate 90% of hydrogen pipeline miles.[623]

The limited mileage and geographic scope of existing hydrogen pipelines, along with the extremely limited data reported to PHMSA, indicate that the agency's historic level of oversight is not adequate for the anticipated growth in hydrogen transportation. Existing hydrogen pipeline operators are required to file annual reports to PHMSA, including reporting the number of leaks repaired during the previous year, and the number of known leaks planned for repair in the coming year.[624] According to the 2022 Annual Reports, operators reported on over 1,500 miles of hydrogen pipelines that transport 902.9 billion standard cubic feet of hydrogen each year.[625] But in a review of recent data, all U.S. hydrogen pipeline operators reported zero leaks repaired or planned for repair in 2022, and reported very few leaks in the preceding years—demonstrating that existing leak survey practices are of limited effectiveness.[626]



[621] Proposed Rule at 31926.
[622] Attachment C, Kate Roberts, Analysis: Natural Gas Gathering and Hydrogen Pipeline Reported Data (Aug. 2023).; *see also* PAUL PARFOMAK, CONG. RSCH. SERV., R46700, PIPELINE TRANSPORTATION OF HYDROGEN: REGULATION, RESEARCH, AND POLICY (2021), https://crsreports.congress.gov/product/pdf/R/R46700.
[623] Attachment C, Kate Roberts, Analysis: Natural Gas Gathering and Hydrogen Pipeline Reported Data (Aug. 2023).
[624] *See* 49 C.F.R. § 191.17.
[625] PHMSA, *Gas Distribution, Gas Gathering, Gas Transmission, Hazardous Liquids, Liquefied Natural Gas (LNG), and Underground Natural Gas Storage (UNGS) Annual Report Data*, https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids (ZIP file: Gas Transmission & Gathering Annual Data – 2010 to present"; file name: "Gas Transmission & Gathering Annual Form – PHMSA F7100.2-1 (rev 3-2022) – Data Fields.pdf"; at 14-15 *crossed with* file name: "annual_gas_transmission_gathering_2022.xlsx" at tab. "GT AR Part M").
[626] Attachment C, Kate Roberts, Analysis: Natural Gas Gathering and Hydrogen Pipeline Reported Data (Aug. 2023).

D. Expansion of Hydrogen Pipelines Should be Anticipated and Enhanced Federal Oversight is Essential

With major federal programs incentivizing hydrogen deployment, PHMSA should anticipate significant development of hydrogen transportation infrastructure in the near future and respond to ensure adequate oversight.

1. PHMSA Must Prepare for Significant Hydrogen Pipeline Development

The Infrastructure Investment and Jobs Act ("IIJA"), signed into law in November 2021, appropriates $9.5 billion to the U.S. Department of Energy for clean hydrogen.[627] And the Inflation Reduction Act, signed into law in August 2022, creates numerous policies and incentives, including the production tax credit, that are driving rapid large-scale investment in hydrogen projects.[628] The Department of Energy's U.S. National Clean Hydrogen Strategy identifies pipelines as one of the main methods of hydrogen delivery, primarily for "when demand is predictable for decades and at a regional scale of thousands of tonnes per day."[629] The Princeton Net-Zero America study envisions a series of "hydrogen trunk and spur pipeline system[s] connecting hypothetical H2 production facilities with hypothetical industrial H2 users," in multiple regions around the country.[630] SoCalGas in California is developing a new dedicated hydrogen pipeline, the Angeles Link project, and the California Public Utilities Commission has approved the company's request to track costs for advancing the first phase of the project.[631] And numerous Hydrogen Hub proposals across the country are under review by the Department of Energy, eligible for $8 billion in total federal funding to support their development.[632] The Western Inter-States Hydrogen Hub ("WISHH"), for example, proposes to "move hydrogen as a mixed gas in existing pipelines, as 100% hydrogen through new pipelines, and as cryogenic hydrogen for more remote usage sites," and to store hydrogen in part "through 'line pack' on hydrogen pipelines."[633] Of the listed projects in the WISHH regional hub proposal, 6 of the 8 projects would involve hydrogen transport by pipeline.[634]

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[627] U.S. DEP'T OF ENERGY, *U.S. Nat'l Clean Hydrogen Strategy & Roadmap,* at 1 (June 2023), https://www.hydrogen.energy.gov/clean-hydrogen-strategy-roadmap.html. [hereinafter DOE, *U.S. Nat'l Clean Hydrogen Strategy*].
[628] *Id.*
[629] *Id.* at 45.
[630] Eric D. Larson, *Princeton's Net-Zero America study Annex L: Hydrogen and Synthetic Fuels/Feedstocks Transition,* ANDLINGER CTR. FOR ENERGY & ENVT'L, at 11 (Aug. 1, 2021), https://netzeroamerica.princeton.edu/img/NZA%20Annex%20L%20-%20Hydrogen%20and%20synthesized%20fuels.pdf.
[631] *See* CAL. PUB. UTIL. COMM., Application 22-02-007, *Application of SOUTHERN CALIFORNIA GAS COMPANY (U904G) for Authority to Establish a Memorandum Account for the Angeles Link Project,* Decision 22-12-055, Decision Approving the Angeles Link Memorandum Account to Record Phase One Costs (Dec. 15, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M500/K167/500167327.PDF; SOCALGAS, *Angeles Link: Shaping the Future with Clean Renewable Hydrogen*, https://www.socalgas.com/sustainability/hydrogen/angeles-link (accessed Aug. 12, 2023).
[632] *See* DOE, *U.S. Nat'l Clean Hydrogen Strategy* at 7.
[633] Western Inter-States Hydrogen Hub, *Concept Paper – Regional Clean Hydrogen Hubs Funding Opportunity* at 2-3 (Nov. 7, 2022), https://wyoenergy.org/wp-content/uploads/2022/12/concept-paper.pdf.
[634] *Id.* at 5.

PHMSA thus needs protective standards in place to address the potential for significant buildout of new dedicated hydrogen pipelines, conversion of natural gas pipelines into dedicated hydrogen transportation infrastructure, and proposals to mix hydrogen into existing natural gas pipelines. This influx of investment and potential buildout of pipeline infrastructure—for a gas that poses environmental and safety risks—can be compared to the heightened interest in carbon dioxide (CO2) pipelines that the agency is also responding to.[635] In the context of CO2 pipelines, PHMSA is inviting input from the public, stakeholders, and industry; recently held a public meeting in Des Moines, Iowa, with communities facing numerous proposals for CO2 pipeline buildout; and has announced its intention to develop dedicated CO2 pipeline standards—both new standards and possible updates to existing standards.[636] PHMSA should approach hydrogen pipelines similarly – through a coordinated regulatory strategy.

2. *The Pursuit of Hydrogen/Methane Mixing by Utilities Raises Concerns*

Around the country, local gas distribution companies are proposing, seeking approval for, and moving forward with projects to mix hydrogen into existing natural gas distribution pipeline systems. For example, CenterPoint Energy began mixing hydrogen into its natural gas pipeline system in Minneapolis in 2022, at a 1-5% blend rate.[637] A group of California gas utilities have proposed hydrogen blending demonstration projects, which are now going through a stakeholder input process before the utilities submit revised pilot proposals for review by the California Public Utilities Commission.[638] Xcel Energy in Colorado has proposed to mix 2% hydrogen into the gas pipeline system in a 236-home subdivision, starting in December 2023, and to reach up to a 10% hydrogen blend over the next two years.[639]

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[635] *See* Mike Soraghan, *Midwest CO2 pipeline rush creates regulatory chaos*, E&E NEWS (Mar. 3, 2023), https://www.eenews.net/articles/midwest-co2-pipeline-rush-creates-regulatory-chaos/; Dept. Energy Off. Fossil Energy & Carbon Mgmt., Statement: DOE Welcomes New Carbon Dioxide Pipeline Safety Measures Announced by the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (May 27, 2022), https://www.energy.gov/fecm/articles/statement-doe-welcomes-new-carbon-dioxide-pipeline-safety-measures-announced-us.

[636] *See* Press Release, PHMSA, PHMSA Announces New Safety Measures to Protect Americans From Carbon Dioxide Pipeline Failures After Satartia, MS Leak (May 26, 2022), https://www.phmsa.dot.gov/news/phmsa-announces-new-safety-measures-protect-americans-carbon-dioxide-pipeline-failures; PHMSA, Notice of Public Meeting, 88 Fed. Reg. 24465 (Apr. 20, 2023), https://www.federalregister.gov/documents/2023/04/20/2023-08369/pipeline-safety-carbon-dioxide-pipeline-safety-public-meeting; Grant Gerlock, *Iowa carbon pipeline opponents voice concerns to federal regulators*, IOWA PUB. RADIO (June 1, 2023), https://www.iowapublicradio.org/ipr-news/2023-06-01/iowa-carbon-pipeline-opponents-voice-concerns-to-federal-regulators.

[637] Frank Jossi, *Gas utility's Minnesota hydrogen pilot 'good news' so far, but questions remain*, ENERGY NEWS NETWORK (Jan. 27, 2023), https://energynews.us/2023/01/27/gas-utilitys-minnesota-hydrogen-pilot-good-news-so-far-but-questions-remain/.

[638] *See* CAL. PUB. UTIL. COMM., Rulemaking 13-02-008, *Order Instituting Rulemaking to Adopt Biomethane Standards and Requirements, Pipeline Open Access Rules, and Related Enforcement Provisions*, Decision Directing Biomethane Reporting and Directing Pilot Projects to Further Evaluate and Establish Pipeline Injection Standards for Clean Renewable Hydrogen, Decision 22-12-057 (Dec. 19, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M500/K055/500055657.PDF.

[639] Sam Brasch, *Xcel Energy wants to mix hydrogen into the natural gas system. It's starting with this neighborhood.*, COLORADO PUBLIC RADIO (July 18, 2023), https://www.cpr.org/2023/07/18/xcel-energy-wants-to-mix-hydrogen-into-the-natural-gas-system-starting-with-hudson/.

In these instances, operators are proposing to mix hydrogen into complex pipeline networks that are designed and maintained specifically to transport natural gas, primarily methane. But there is not clear consensus from industry or the scientific community about a safe level at which hydrogen can be blended into natural gas pipelines, and it will likely depend on the specific properties of the infrastructure. An NREL 2013 study claimed that less than 5%-15% hydrogen blended by volume has minor issues and should not increase risks associated with end use devices and public safety.[640] NREL later published a 2022 report which argues that "[b]lending limit generalization is problematic because hydrogen compatibility depends on existing infrastructure component factors including specific equipment model, equipment condition, and material of construction".[641] A 2022 UC Riverside study says only 5% by volume is safe for system-wide blending,[642] and a 2022 report by Fraunhofer Institute says there is no established limit value for hydrogen when blending, and that it depends on a case-by-case basis.[643] The main engineering concerns with hydrogen blending includes embrittlement in steel pipelines, compromising the integrity of polymeric materials (such as those used in pipelines in the gas distribution systems), capacity of in-line compressors, and compatibility with end-use appliances like cooktop burners and heating furnaces. Without a clear path to reach a scientific consensus on a universal safe hydrogen blending limit, large-scale hydrogen blending into gas distribution systems should not be pursued without careful safety, environmental, and community evaluation.

Experts and communities have identified numerous concerns with such projects, including safety, climate impacts, air quality impacts, costs to consumers, and whether hydrogen is a scalable decarbonization solution to mitigate natural gas reliance in buildings.[644] Many of these concerns relate back to the fact that operators are seeking to inject a new gas, hydrogen, into pipeline systems that are specifically used to transport natural gas and are not designed for the leakier hydrogen molecule. The proposals from industry illustrate a weakness of PHMSA's current approach to having universal standards for "gas" pipelines: all gases are not interchangeable, and changing the use of existing pipeline systems to transport a different gas must be carefully evaluated.

In the U.S. National Clean Hydrogen Strategy and Roadmap, the Department of Energy identifies some of these needs, in the context of enabling use of hydrogen / natural gas blends or pure hydrogen for manufacturing and industrial heat:

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640 M.W. Melaina et al., *Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues*, NREL (Mar. 2013), https://www.nrel.gov/docs/fy13osti/51995.pdf.

641 Kevin Topolski et al., *Hydrogen Blending into Natural Gas Pipeline Infrastructure: Review of the State of Technology*, NREL (Oct. 2022), https://www.nrel.gov/docs/fy23osti/81704.pdf.

642 Arun SK Raju & Alfredo Martinez-Morales, *Hydrogen Blending Impacts Study*, CAL. PUB. UTIL. COMM. (July 18, 2022), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

643 Jochen Bard et al., *The Limitations of Hydrogen Blending in the European Gas Gird*, FRAUNHOFER IEE (Jan. 2022), https://www.iee.fraunhofer.de/content/dam/iee/energiesystemtechnik/en/documents/Studies-Reports/FINAL_FraunhoferIEE_ShortStudy_H2_Blending_EU_ECF_Jan22.pdf.

644 *See, e.g.*, PIPELINE SAFETY TRUST, *Summary for Policymakers: Hydrogen Pipeline Safety* (Jan. 2023), https://pstrust.org/wp-content/uploads/2023/01/hydrogen_pipeline_safety_summary_1_18_23.pdf; Andee Krasner & Barbara Gottlieb, , *Hydrogen Pipe Dreams: Why Burning Hydrogen in Buildings is Bad for Climate and Health*, PHYSICIANS FOR SOCIAL RESPONSIBILITY (June 2022), https://psr.org/wp-content/uploads/2022/07/hydrogen-pipe-dreams.pdf.

> Future work, which will be done in collaboration across agencies and states, will enable the development of injection standards for blending hydrogen into natural gas pipelines used in high-temperature heat applications—including the upper blend limits for hydrogen. Other work includes assessing opportunities to repurpose natural gas infrastructure for hydrogen, identifying conditions under which deployment of new infrastructure would be necessary to enable the use of high concentrations of blends and advancing the use of clean hydrogen in combined heat and power applications.[645]

As the federal agency with an obligation to ensure pipeline oversight for public safety and environmental protection, PHMSA should not remain idle as hydrogen / methane mixing projects move forward. Clear federal standards to address hydrogen mixing into natural gas pipelines will provide regulatory signals, and can provide communities with reassurance that any such projects must be consistent with protective standards. Adequately addressing these issues, however, is best achieved in a separate rulemaking.

3. PHMSA Must Consult with Environmental Justice Communities and Prioritize Concerns About Hydrogen Infrastructure

Environmental justice organizations and communities are expressing strong concerns related to the proposed buildout of hydrogen infrastructure. A recent Joint Statement by Environmental Justice Organizations states that a "discussion of so-called 'guardrails' is imprudent and premature when proponents of CCS/CCUS, DAC, and hydrogen fail to acknowledge the known and potential hazards for communities as well as operation failures that increase climate risks. The hazards, risks, and uncertainties of large-scale deployment of industrial carbon removal strategies should not be hidden, ignored or dismissed, but should be clearly identified, defined, and made known as public information."[646] In a recent utility rate case before the New York Public Service Commission, WE ACT for Environmental Justice and Alliance for a Green Economy stated that the utility was ignoring the safety risks associated with hydrogen and expressed concerns with harmful NOx emissions associated with hydrogen combustion.[647]

Hydrogen pipelines present unique, significant safety and environmental concerns, and communities have expressed deep concern about the possible influx of new, burdensome energy infrastructure. Because many hydrogen development proposals would add to existing infrastructure, such projects could add cumulative impacts to communities that are already burdened—or overburdened—by energy infrastructure.

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[645] DOE, *U.S. Nat'l Clean Hydrogen Strategy* at 31. Note that the DOE Hydrogen Strategy does not recommend hydrogen deployment for home or building heating, but rather primarily for decarbonizing heavy industry.

[646] Deep South Center for Environmental Justice et al., Statement by Environmental Justice Organizations on the National Symposium on Climate Justice & Carbon Management (June 7, 2023), https://www.dscej.org/the-latest/statement-by-environmental-justice-organizations-on-the-national-symposium-on-climate-justice-carbon-management.

[647] NYPSC, Cases 22-E-0064 & 22-G-0065, *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric & Gas Service,* Statement of WE ACT for Environmental Justice & Alliance for a Green Economy in Opposition to the Joint Proposal, at 43-46, (Mar. 29, 2023), https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={50E32E87-0000-C151-A78D-21981A461865}.

It is critical that PHMSA, as well as other stakeholders, engage with communities to hear and incorporate their input as the agency considers how to protect public safety and the environment in its oversight of hydrogen infrastructure.

4. PHMSA Should Initiate a Rulemaking to Develop Standards Specific to Hydrogen Pipelines

PHMSA should initiate a separate rulemaking focused on oversight of hydrogen pipelines and hydrogen/methane mixing.

The rulemaking at hand seeks to strengthen PHMSA's standards for gas pipelines, with a primary focus on the natural gas pipelines that make up the vast majority of the infrastructure regulated under this section (49 C.F.R. Parts 191 and 192). This rulemaking is required, in part, by the PIPES Act of 2020, several adjacent provisions of which are specifically focused on the importance of improving methane management practices on natural gas pipelines.[648] Section 113 of the PIPES Act of 2020 specifically requires that advanced leak detection performance standards adopted by PHMSA must be appropriate for "the type of pipeline" and "the materials transported by the pipeline."[649] The Proposed Rule does not provide adequate support for why the general "gas" pipeline standards, which are tailored to natural gas pipelines, are appropriate to hydrogen pipelines. PHMSA should complete this rulemaking in a timely manner with a focus on natural gas pipelines, and commit in this rulemaking to a clear, near-term timeline to conduct a subsequent rulemaking focused on hydrogen.

E. The Proposed Rule Should be Improved to Address Near-Term Hydrogen Oversight Needs

As stated above, PHMSA should initiate a separate rulemaking focused on standards for hydrogen pipelines, to evaluate the changing landscape and ensure adequate coverage. But in the rulemaking at hand, the agency has proposed and invited comment on a number of topics related to hydrogen pipelines, and it should implement appropriate and protective safeguards.

1. Leak Survey Frequency and Repair Standards

Today, hydrogen pipeline operators are subject to PHMSA's minimum pipeline safety standards for gas pipelines. As PHMSA establishes more protective standards applicable to natural gas pipeline operators in this Proposed Rule, requiring more frequent leak surveys and faster repair timelines, it is appropriate and beneficial for hydrogen operators to be held to the same standards. The components of the Proposed Rule that would require heightened leak survey, repair, and reporting practices should be applied to hydrogen pipeline operators. PHMSA's proposal that "Grade 2 is the minimum priority grade for leaks of gaseous hydrogen" is

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[648] *See* PIPES Act of 2020, P.L. 116-260 Division R, Section 114 (requiring that Inspection and Maintenance Plans explain how operators will eliminate and minimize "releases of natural gas from pipeline facilities" and requiring that the Secretary report on "best available technologies or practices" to minimize "the release of natural gas" from pipelines under various circumstances).

[649] PIPES Act of 2020, P.L. 116-260 Division R, Section 113.

beneficial and should be adopted, to ensure careful monitoring and timely leak repair.[650] Particularly because hydrogen detection technologies are currently less sensitive than methane (see discussion below), treating any known leaks as a high priority will reduce safety risk and environmental harm. As the Proposed Rule states, "these heightened safety requirements (compared to natural gas pipelines) are warranted because hydrogen is itself a flammable gas with a lower explosive limit and lower autoignition temperature than methane."[651]

2. Advanced Leak Detection Program and Alternative Standard

The Proposed Rule would establish an Advanced Leak Detection Program ("ALDP") standard that requires operators to deploy leak detection equipment with minimum sensitivity of 5 parts per million for leakage surveys, pinpointing leak locations, investigating, and inspecting leaks; plus other requirements regarding survey frequency and evaluating different leak survey technology options. The proposal acknowledges that this proposed performance standard is "based principally on commercially available, advanced methane leak detection technology for use with natural gas pipelines."[652] The proposal also includes an *Alternative* Advanced Leak Detection Performance Standard, which allows operators to "request an alternative ALDP performance standard (and use of supporting leak detection equipment)," pursuant to notification and review. The agency notes that this alternative standard may be appropriate for gas pipelines other than natural gas, such as hydrogen, "for which commercially available, advanced leak detection technology either uses different units of measure than that provided for in § 192.763(a) or is less sensitive than the default 5 ppm performance standard."[653]

Elsewhere in this comment, recommendations are provided to improve the proposed 5ppm technology performance standard for natural gas pipelines. Hydrogen detection technologies are less advanced than methane technologies—see below—and neither PHMSA's proposed standard or commenters' recommended standard is likely to be well suited to hydrogen leak detection and remediation. Accordingly, in the near-term, operators of hydrogen pipelines—and perhaps other non-methane gas pipelines—will likely propose Alternative ALDP standards to PHMSA under the ALDP framework established in this Proposed Rule. PHMSA should require that operators of hydrogen (and perhaps other non-methane gas pipelines) submit proposed Alternative ALDP plans in light of the current state of hydrogen leak detection technology. Although other components of the leak detection and repair standards in the Proposed Rule should be equally applicable for hydrogen pipelines, such as increased leak survey frequency and more rapid leak repair timelines, the technology standard requires distinct treatment because of the significant differences between the state of detection technologies for different gasses.

Requiring that all hydrogen operators propose an Alternative ALDP in the near-term will provide PHMSA with more systematic information about existing norms and practices through the notification and review process and likewise support a near-term, hydrogen-specific rulemaking. However, the notification and review component of the Alternative ALDP standard should not be permanent for hydrogen operations – as PHMSA's familiarity with the technology

[650] Proposed Rule at 31941.
[651] Proposed Rule at 31941.
[652] Proposed Rule at 31934, n.235.
[653] Proposed Rule at 31937.

improves, operators should be required to apply to PHMSA with a proposed Alternative ALDP, and should not be authorized to proceed s with an alternative path until PHMSA has affirmatively approved the operator's proposal. And PHMSA should modify operator proposals as appropriate to ensure a high level of care is taken to find and fix leaks using available technologies and practices.

Available Hydrogen Sensing Technologies. A variety of commercial hydrogen detectors and sensors are designed to detect relatively high hydrogen concentrations – at the parts-per-million level (ppm) level – as those can pose a safety risk. However, these commercial technologies cannot detect the smaller emissions leaks that are environmental and less-urgent safety risks (such as at the parts-per-billion (ppb) level). These technologies also lack the fast response time necessary to identify and measure hydrogen plumes of low concentration released from various areas of the facility, which will disperse into ambient air quickly.

The four common operating principles of commercially available H_2 sensors include metal oxide sensors (MOS), thermal conductivity (TC), catalytic combustion (CC), and electrochemical (EC).[654] Each of these methods can have issues with accuracy associated with interference of hydrocarbons, thermal drift, and long-term overexposure to hydrogen.

- Handheld H_2 detectors are available as leak detectors and belt-worn safety devices. The H_2 concentration range offered is <1 – 40,000 ppm with a resolution between 0.001 – 500 ppm, an accuracy of +/- 3 – 5%, and a 3 – 20 seconds response time. Their cost varies from $225 to $4200. Some examples include:
    - Forensics Detectors, Hydrogen Analyzer, 0-1000 PPM, https://www.forensicsdetectors.com/products/hydrogen-analyzer
    - ATO, Portable Hydrogen (H2) Gas Detector, 0 to 500/1000/2000 ppm, https://www.ato.com/portable-h2-gas-detector
    - RKI Instruments, Eagle 2 Gas Detector, https://www.rkiinstruments.com/product/eagle-2-gas-detector/
- Other hydrogen sensors have a detection range of <1 – 14,000 ppm with an accuracy of +/- 0.5 – 10%. The sensors range in price from $1 to $150. Some examples include:
    - Japan Figaro Hydrogen Sensor TGS2615-E00, https://www.alibaba.com/product-detail/Japan-Figaro-Hydrogen-Sensor-TGS2615-E00_1600102769043.html
    - Winsen, Flammable Gas Sensor, Model MQ-8, Manual, https://cdn.sparkfun.com/datasheets/Sensors/Biometric/MQ-8%20Ver1.3%20-%20Manual.pdf
    - International Gas Detectors, Hydrogen Gas Detection Solutions, https://www.internationalgasdetectors.com/applications/hydrogen-gas-detection
    - Nissha FIS Inc., Hydrogen Sensors, https://connect.nissha.com/gassensor/en/product/hydrogendetector/
    - Kennedy Space Center, Applied Chemistry and Applied Physics Laboratories, Hydrogen Sensor Test Report (Apr. 2021), https://ntrs.nasa.gov/api/citations/20210014146/downloads/Hydrogen%20Sensor%20Test%20Report%20Final%2004142021%20wo%20EC%20Review.pdf

[654] EBICS, *The Working Principle of 4 Different Types of Hydrogen Sensors* (Oct. 19, 2022), https://ebics.net/the-working-principle-of-4-different-types-of-hydrogen-sensors/.

- The commercially available detectors and sensors are needed for safety, but they could also be used to measure hydrogen emissions from operational procedures, like venting and purging, where hydrogen is known to be released.
- Sensors that can accurately and quickly detect low concentrations (*i.e.*, ppb level) *in situ* are currently unavailable. However, there is significant industry and government interest in improving hydrogen detection technologies, and progress is expected. A new technology that could fill this gap was recently announced and is under development.[655]

3. *Reporting*

In addition to natural gas reporting recommendations presented elsewhere in this comment, PHMSA should require that natural gas pipeline operators report publicly on any mixing of hydrogen into natural gas pipelines and storage facilities. Natural gas companies are currently not required to notify regulators or the public when they mix hydrogen into natural gas pipeline systems.[656] To maximize transparency and ensure community awareness and safety, operators should report these operations before they occur. PHMSA should require the following reporting elements:

- Operators must submit a public report to PHMSA noticing an intent to mix hydrogen into a natural gas pipeline, at least 60 days in advance of commencing the mixing. The report should identify the injection site, the anticipated geographic scope of where hydrogen will be mixed into the gas pipeline system, the percentage blend anticipated, and the duration of the project.
- Operators must submit a public report to PHMSA noticing the commencement of mixing hydrogen into a natural gas pipeline, with the same details as above.
- As part of their annual reports to PHMSA, operators must report the duration of any hydrogen mixing activities, the minimum, maximum, and average percentage blend during the duration of the activity, and the geographic scope of where hydrogen was estimate to reach within the natural gas pipeline system and end users.
- All of the above requirements also apply to the mixture of any other gas into a natural gas pipeline exceeding a 1% blend rate.

Detailed reporting on activities to mix hydrogen into natural gas pipeline systems will promote transparency and accountability for operators and provide valuable information to the public and regulators.

[655] EDF & Aerodyne, Press Release: As Climate Concerns About Hydrogen Energy Grow, New Tech Unveiled at CERAWeek Delivers Unprecedented Results Measuring Leaks, Other Emissions (Mar. 7, 2023), https://www.businesswire.com/news/home/20230305005045/en/As-Climate-Concerns-About-Hydrogen-Energy-Grow-New-Tech-Unveiled-at-CERAWeek-Delivers-Unprecedented-Results-Measuring-Leaks-Other-Emissions.

[656] *See, e.g.*, Sam Brasch, *Xcel Energy wants to mix hydrogen into the natural gas system. It's starting with this neighborhood*, CPR NEWS (July 18, 2023), https://www.cpr.org/2023/07/18/xcel-energy-wants-to-mix-hydrogen-into-the-natural-gas-system-starting-with-hudson/#:~:text=In%20Box%20Elder%20Creek%20Ranch%2C%20Xcel%20Energy%20plans%20to%20start,will%20monitor%20for%20any%20leaks.

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