

Gas Pipelines: Oversight of Operators' Plans to Minimize Methane Emissions

GAO-24-106881

Q&A Report to Congressional Committees

June 3, 2024

Accessible Version

Why This Matters

Methane, the primary component of natural gas, can be emitted from pipeline facilities through unintentional leaks or through intentional releases of gas, such as “blowdowns” associated with maintenance and emergency response activities. According to the Department of Transportation’s Pipeline and Hazardous Materials Safety Administration (PHMSA), emissions from gas pipeline systems are a risk to public safety and contribute to climate change.

Operators are required to develop and follow manuals of written procedures for conducting pipeline operations, maintenance, and emergency response activities. The Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2020 (PIPES Act of 2020) includes requirements for pipeline operators to update these operation and maintenance plans to address (1) eliminating hazardous leaks, (2) minimizing releases of natural gas, and (3) replacing or remediating pipelines known to leak. The act also includes requirements for PHMSA or the appropriate state authority to review these updated plans.

The PIPES Act of 2020 also includes a provision for us to examine PHMSA’s and states’ reviews of pipeline operators’ updated plans.¹ This report includes information on the process PHMSA and states used to review operators’ updated plans, operator and inspector challenges associated with updating and reviewing these plans, and selected stakeholders’ views on ways to further minimize natural gas emissions from pipelines without compromising safety.

Key Takeaways

- PHMSA’s process for reviewing pipeline operators’ updated operations and maintenance plans consisted of (1) notifying pipeline operators of the PIPES Act of 2020 requirements, (2) developing guidance and training for federal and state pipeline inspectors, (3) conducting outreach to the public, and (4) reviewing operators’ updated plans.
- PHMSA and most states completed reviews of operators’ plans by the end of 2022. PHMSA and state inspectors generally found that operators had complied with PIPES Act of 2020 requirements for updating their operation and maintenance plans. PHMSA officials attributed these satisfactory results to existing programs, operator initiatives, and other efforts.
- The selected operators and industry associations we spoke with most frequently cited as a challenge the uncertainty of PHMSA’s and states’ expectations for how to address the PIPES Act of 2020 requirements in the updated plans. PHMSA has issued a notice of proposed rulemaking (NPRM) on leak detection and repair that proposes to codify, or incorporate, the statutory requirements into its regulations and includes more detailed requirements for leak detection and repair of gas pipelines.

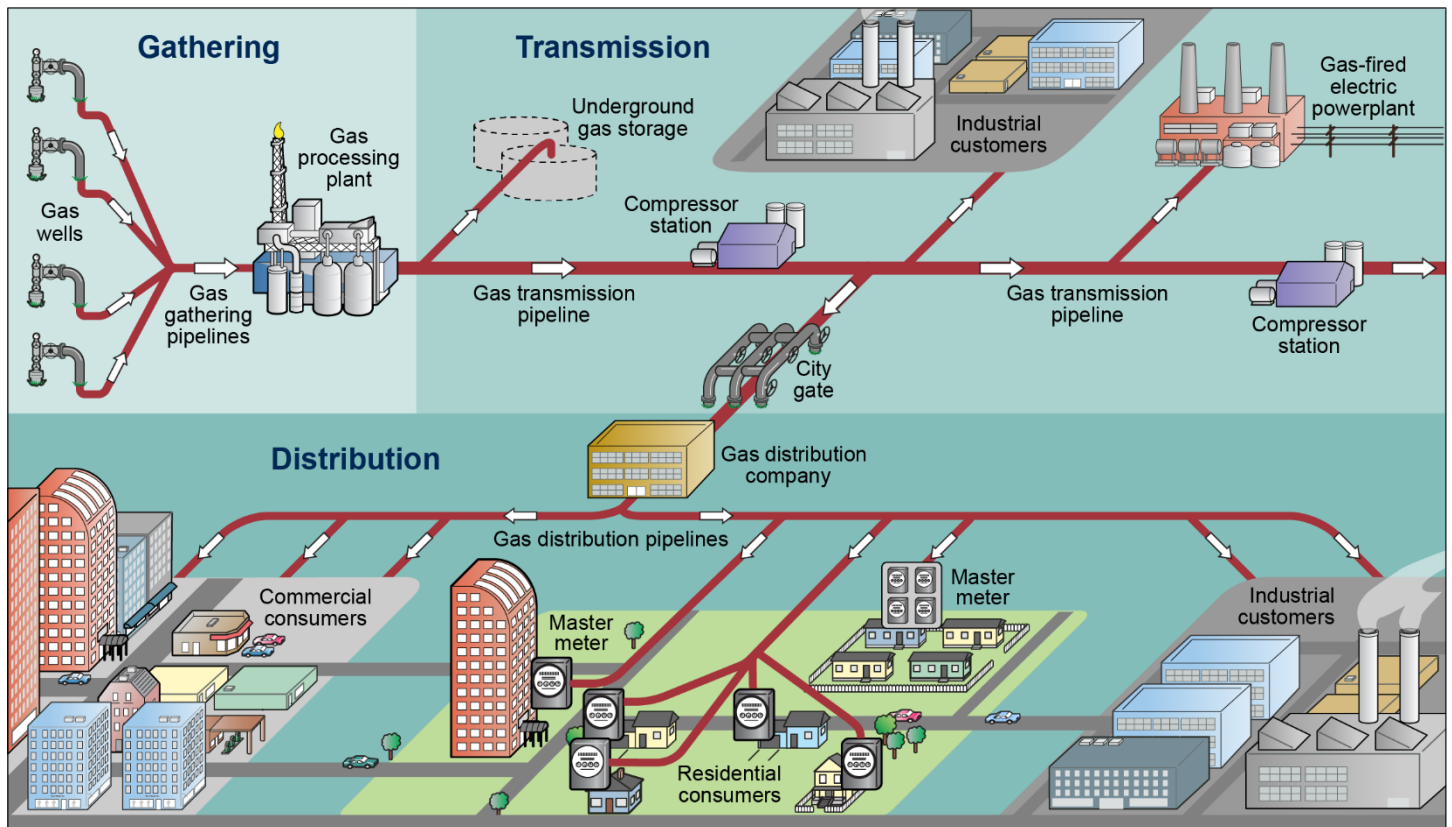
- PHMSA officials and state inspectors we spoke with most frequently cited challenges related to completing the reviews with existing resources in the allotted time period and enforcing the requirements in the PIPES Act of 2020. Specifically, some state officials said they cannot enforce federal statutory requirements that have not been incorporated into PHMSA’s pipeline safety regulations. PHMSA officials said that, going forward, (1) PHMSA and states can incorporate the reviews of operators’ updated plans into other scheduled inspections over a longer period and (2) the agency’s NPRM on leak detection and repair, if finalized, would help fill the gap in enforcement authority for states.
- Selected stakeholders we spoke with identified actions that could further reduce leaks from gas pipelines without compromising safety. These actions include improving “Call Before You Dig” programs that locate and mark underground utilities to help reduce excavation damage, updating certain operating procedures, adopting advanced technology, and replacing aging portions of certain pipelines. PHMSA has various efforts underway related to these areas.

What is the natural gas pipeline network?

A 3-million-mile nationwide network of pipelines carries gas from producing wells to processing plants, and eventually to end users, such as manufacturers, businesses, and homes. Within this nationwide system, there are three main types of gas pipelines—gathering, transmission, and distribution (see fig. 1).

- *Gathering pipelines* collect natural gas from production areas and then typically transport it to processing facilities, which in turn process the product and send it to transmission pipelines.
- *Transmission pipelines* carry gas, sometimes over hundreds of miles, to communities and large-volume users (e.g., factories).
- *Distribution pipelines* transport natural gas to residential, commercial, and industrial customers. A “master meter” is a gas pipeline system for further distributing gas within a specific area, such as a mobile home park, housing project, or apartment complex.

Figure 1: Natural Gas Pipeline Network



Source: GAO analysis of Energy Information Administration and Natural Gas Council documents; GAO (illustration). | GAO-24-106881

Natural gas can be emitted from these pipelines both unintentionally and intentionally. Pipelines or their components, such as compressor stations and valves, can leak unintentionally, due to corrosion, material or equipment failure, or external causes, such as excavation damage. Intentional emissions related to pipelines may include blowdowns to remove gas from a section of pipeline for maintenance or emergency response activities, or vents from pressure relief devices.

Who oversees pipeline safety?

PHMSA and states each have a role in ensuring gas (e.g., natural gas) and hazardous liquid (e.g., petroleum) pipeline safety. PHMSA sets the minimum safety standards for gathering, transmission, and distribution pipelines.² PHMSA's regulations include requirements for pipeline design, construction, testing, inspection, operation, and maintenance. These regulations also require operators to prepare and implement operation and maintenance plans.

States may assume regulatory, inspection, and enforcement authority for intrastate pipelines that operate within their borders through state pipeline safety programs. To do so, states must certify to PHMSA that they have adopted applicable federal minimum standards into the laws of their state and are enforcing those laws.³ These states may also adopt additional or more stringent requirements, so long as they are compatible with federal requirements.⁴ The 48 contiguous states, the District of Columbia, and Puerto Rico hold such certifications for natural gas pipelines, and 15 states hold such certifications for hazardous liquid pipelines. PHMSA may authorize states holding certifications to inspect interstate pipelines within their borders as its interstate agents. However, PHMSA retains enforcement authority over interstate pipelines.

Operators must grant PHMSA or appropriate state authorities access to their pipeline facilities and records for inspections to verify operators' compliance with PHMSA's regulations.

What does the PIPES Act require of pipeline operators, states, and PHMSA?

The PIPES Act of 2020 includes a requirement for pipeline operators to update their operation and maintenance plans no later than 1 year after enactment. The updated plans must address (1) eliminating hazardous leaks, (2) minimizing releases of natural gas from facilities, and (3) replacing or remediating pipelines prone to leaking based on the material, design, or operating and maintenance history of the pipeline, among other things.⁵

The act also contains a requirement that PHMSA, or the appropriate state authority, review these updated plans no later than 2 years after enactment (i.e., by December 27, 2022) and at least once every 5 years thereafter.⁶ The act permits PHMSA and the appropriate state authorities to conduct these ongoing reviews as part of their routine, periodic inspections of pipeline facilities.

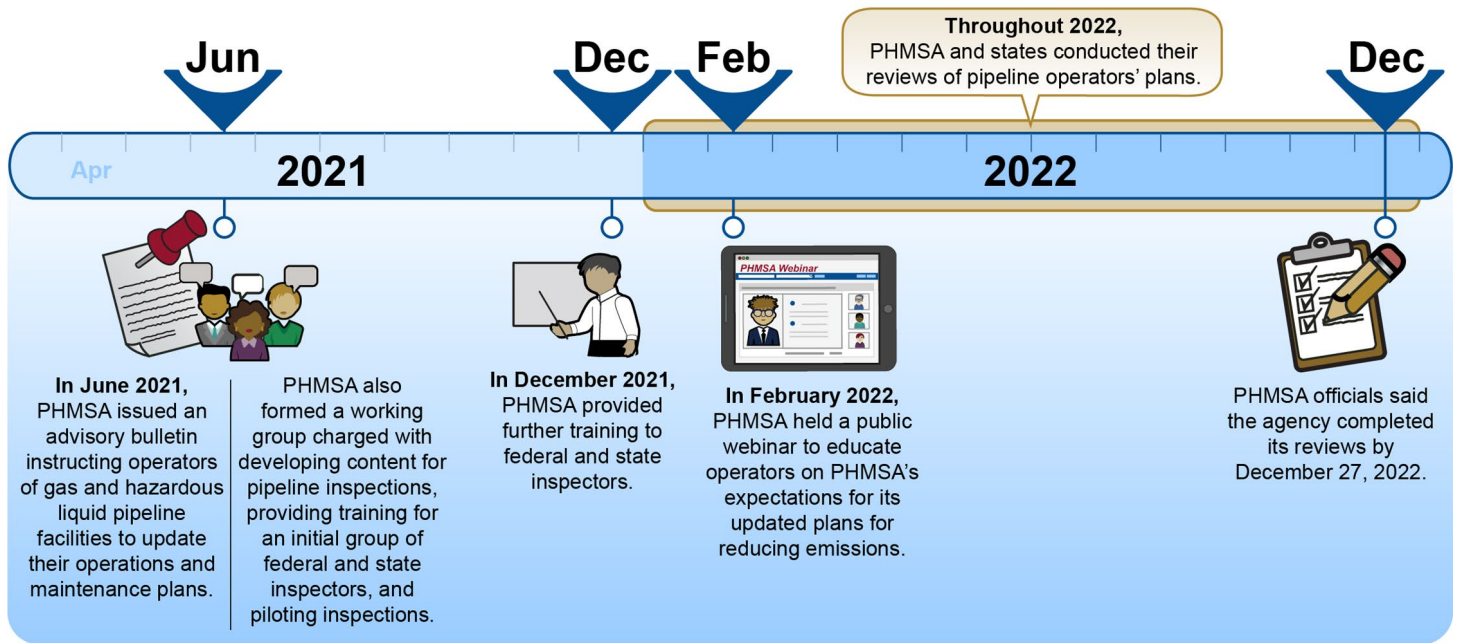
In addition, the act includes several other requirements for PHMSA. For example, the act clarifies that PHMSA must specifically consider both safety and environmental benefits when proposing or issuing a pipeline safety standard.⁷ Regarding pipeline leak detection and repair, PHMSA is required to:

- Issue regulations that (1) require, among other things, operators of certain pipelines to conduct leak detection and repair programs and (2) establish minimum performance standards for these programs that reflect the capabilities of commercially available advanced technologies, no later than 1 year of enactment.⁸
- Submit to selected congressional committees, no later than 18 months after enactment, a report that includes a discussion of the best available technologies or practices to prevent or minimize, without compromising safety, the release of natural gas from pipelines during planned pipeline repairs, replacements, or maintenance.⁹

What was PHMSA's process for reviewing operators' plans for reducing gas pipeline leaks?

PHMSA's process for reviewing operators' plans consisted of notifying pipeline operators of the PIPES Act of 2020 requirements, developing guidance and training for pipeline inspectors, conducting outreach to the public, and, in concert with appropriate state officials, reviewing operators' updated plans (see fig. 2).

Figure 2: Timeline of Key Dates for the Pipeline and Hazardous Materials Safety Administration (PHMSA) and States' Review Process



Source: GAO analysis of Department of Transportation information and GAO (icons). | GAO-24-106881

When notifying operators of requirements to update their plans in preparation for PHMSA or state reviews, PHMSA officials said they included over 4,200 operators of all regulated pipeline facilities—natural gas and hazardous liquid systems—as well as liquefied natural gas plants and underground natural gas storage facilities (see table 1). PHMSA officials stated that all of these systems could release natural gas, either through transportation or ancillary purposes.

Table 1: Pipeline Facilities and Operators Included in the Pipeline and Hazardous Materials Safety Administration (PHMSA) and States' Review of Updated Plans

Pipeline facility	Number of operators	Number of pipeline miles or facilities
Gas distribution pipelines	1,249	2,331,888 miles
Gas gathering pipelines	803	331,803 miles
Gas transmission pipelines	1,046	300,964 miles
Hazardous liquid pipelines	667	264,780 miles
Hazardous liquid breakout tanks	249	8,692 tanks
Liquefied natural gas facilities	89	168 plants, 245 tanks
Underground natural gas storage facilities	126	400 facilities, 16,630 wells
Total operators	4,229	

Source: PHMSA 2021 and 2022 annual report data. | GAO-24-106881

According to PHMSA, the scope of the initial reviews of pipeline operators' plans focused on verifying whether operator plans contained detailed, technically supported measures for reducing methane emissions and replacing or remediating leak prone pipes. For future reviews, PHMSA officials said they intend to develop more detailed inspection questions and, in addition to a records review, they plan to observe operators implementing the procedures contained in their updated plans.¹⁰

What is the status of PHMSA's and states' reviews of operators' plans?

PHMSA and most states completed reviews of operator plans by the statutory deadline of December 27, 2022. As of May 2024, PHMSA officials said six states had not completed their reviews for operators of intrastate pipeline facilities. According to these officials, most of the remaining state reviews are for master meters and liquefied petroleum gas facilities. PHMSA officials told us that they will continue to encourage states to complete the reviews and will track their progress.

PHMSA instructed states to prioritize reviews of gathering, transmission, and distribution pipeline systems because these systems are at greater risk for methane emissions. A pipeline safety official in one state that had not completed reviews said that the state also prioritized completing routine inspections, such as for construction projects before they were completed. The official also noted that there was no penalty for not meeting the PIPES Act of 2020 statutory deadline.

Through these reviews, PHMSA and selected state authorities stated that they generally found operators had sufficiently updated their plans to satisfy the PIPES Act of 2020 requirement and did not find instances where enforcement action was warranted. PHMSA attributed these satisfactory results to existing integrity management programs, operator initiatives, and other efforts.¹¹ PHMSA officials stated that they did, however, issue two letters of concern to one operator for failing to provide set thresholds for leaks, among other concerns.

What challenges did pipeline operators face updating these plans?

Selected operators and industry associations we interviewed most frequently identified the uncertainty of PHMSA's expectations for the reviews as a challenge operators faced with updating their operations and maintenance plans. PHMSA provided information through webinars on what to expect from these reviews, such as example inspection questions. However, one operator noted that without prescriptive requirements codified in federal pipeline safety regulations, it was unclear how to demonstrate compliance.

PHMSA officials said that Congress provided general requirements for operators to update plans, and PHMSA did not have the opportunity to further define those requirements in regulation before implementing its reviews. As such, PHMSA officials said that they prioritized developing inspection questions and sharing resources with operators before PHMSA and state regulators started reviewing the updated plans.

Further, according to the officials, PHMSA's NPRM on leak detection and repair—which was issued in May 2023—will address this challenge when finalized. Specifically, the NPRM proposes codifying the requirements for operators to update their plans into PHMSA's regulations and requiring operators to conduct pipeline leak detection and repair programs.¹² PHMSA officials also said that NPRM proposes more prescriptive requirements for addressing leaks. For example, the NPRM proposes minimum leak grading criteria with mandatory repair timelines; requirements for mitigation of intentional methane emissions from blowdowns; and pressure relief device design, configuration, and maintenance requirements, among other required actions for operators.

In contrast, PHMSA officials and some stakeholders we spoke with said that operators, particularly the larger ones, generally did not experience challenges with updating their plans because they already had procedures in place for minimizing emissions. Officials from two states we spoke with noted that because their states have stricter regulations for leak grading and repair than PHMSA currently requires, operators were generally prepared for the reviews.

What challenges did PHMSA and state inspectors face reviewing these plans?

While most reviews were completed on time, PHMSA officials and selected state inspectors we spoke with most frequently cited challenges related to resources and enforcement while reviewing operators' updated plans.

Time and resources

PHMSA regional officials and officials we interviewed from all five states identified time and resource constraints as challenges related to reviewing these plans. Specifically, they said it was challenging to complete the reviews with existing resources within the statutory time frame. For example, one state regulator stated that the state did not have sufficient time or resources to hire and train new inspectors. Instead, officials redirected inspectors from other pipeline inspections to review the updated plans. PHMSA officials said that, in the future, state inspectors will have 5 years to complete the reviews and can combine the reviews of operators' plans to minimize emissions with other inspections to be completed within a state's standard inspection cycle.

PHMSA must reimburse or otherwise pay eligible states no more than 80 percent of the cost that is reasonably required to carry out their oversight responsibilities, which includes the costs of their pipeline inspection programs.¹³ The agency reimburses states for these costs through its state pipeline safety grants. PHMSA officials said that this payment is in exchange for states inspecting intrastate pipeline facilities. However, PHMSA officials told us that, in recent years, the funding appropriated for these grants has been sufficient to reimburse only 50 to 60 percent of states' costs. PHMSA officials said that the agency's fiscal year 2024 and 2025 budget requests included increased funding for its state pipeline safety grants and that Congress appropriated an additional \$22 million—about a 40 percent increase—for fiscal year 2024. According to PHMSA officials, the increased funding will allow them to reimburse states close to the authorized amount of 80 percent which should, in turn, help states hire and competitively pay the additional inspectors needed to meet increased oversight demands.

Enforcement

PHMSA officials and four of five state inspectors we spoke with noted enforcement challenges associated with reviewing operators' plans to reduce pipeline leaks. Specifically, they cited concerns that states currently do not have the authority to enforce operators' compliance because PHMSA has not yet incorporated the federal statutory requirements into its regulations. States that have adopted PHMSA's regulations as state law have the authority to enforce intrastate pipeline operators' compliance with those adopted regulations, such as by issuing a warning letter or corrective action order. However, states cannot enforce requirements that only exist under federal statute, according to PHMSA officials.

PHMSA officials acknowledged that it could be challenging for state inspectors to enforce compliance with procedures required by federal statute that are not included in state law. To help address this challenge, officials said that, in February 2022, they provided examples of enforcement letters that state regulators could use for such situations. In addition, PHMSA offered its legal support should state regulators encounter difficulties in issuing warning letters to operators. The NPRM on leak detection and repair proposes to incorporate the federal statutory requirements for operators to update their plans.

What did selected stakeholders identify as actions to further reduce methane emissions from pipeline leaks without compromising safety?

Twenty-two stakeholders we talked to identified actions that could further reduce releases from gas pipelines—and corresponding methane emissions—without compromising safety. The actions they most often identified were improving “Call Before You Dig” programs, updating certain operating procedures, adopting advanced technology, and replacing aging portions of certain pipelines.

Improving “Call Before You Dig” programs

Twelve stakeholders told us that some states could improve “Call Before You Dig” programs, or one-call damage prevention programs to locate and mark underground utilities, to help reduce excavation damage to pipelines. Damage from excavation activities can release large volumes of natural gas from transmission pipelines or create slow leaks in distribution pipelines. While PHMSA’s pipeline safety regulations set minimum standards for states in establishing and operating their “Call Before You Dig” programs, some stakeholders said that the program implementation varies by state. For example, according to some stakeholders, some state programs may not have adequate enforcement or may not have penalties that deter excavators.

PHMSA officials described several efforts the agency has undertaken to improve excavation damage prevention. For example, PHMSA has provided \$40 million in grants to more than 40 states since the mid-2000s for training, improved state damage prevention laws to support enforcement actions, and improved technologies. In 2010, there were 3.8 excavation damages per 1,000 pipeline miles, compared to 2.5 per 1,000 pipeline miles in 2022. This decrease, officials said, is an indicator of progress in reducing excavation damage to pipelines and associated methane releases.

Further, PHMSA’s regulations provide that it will annually conduct an effectiveness review of states’ enforcement programs for their excavation damage prevention laws. The agency then gives states feedback on how they can improve their programs. If PHMSA determines a state’s enforcement program is inadequate, PHMSA may take immediate enforcement action against excavators in that state. As of March 2024, PHMSA considered four states’ enforcement programs inadequate. For example, PHMSA found that one state had not designated an entity to be responsible for enforcing “Call Before You Dig” laws. PHMSA found that another state had not provided appropriate sanctions, including civil penalties, for violating the excavation damage prevention law at levels sufficient to deter noncompliance.

Updating operating procedures

Five stakeholders we spoke with suggested that operators could change procedures for operating pipelines to minimize intentional gas release. Specifically, operators whose procedures include blowdowns could adopt alternative procedures that might minimize emissions. Representatives from the Pipeline Safety Trust described some of these alternatives, such as burning the gas using a flare or closing upstream valves in the pipeline to create a vacuum to draw the gas downstream. The estimated efficiency of the first alternative is removal of up to 98 percent of the methane while the second removes about 50 percent, according to a report prepared for the Environmental Defense Fund and Pipeline Safety Trust.¹⁴

In its NPRM on leak detection and repair, PHMSA proposes requiring operators to document actions taken to minimize intentional emissions from their systems. This would include documenting which method for venting the pipeline the operators choose from PHMSA’s proposed methods. PHMSA does not propose

requiring mitigation for emergency blowdowns pursuant to an emergency plan to ensure that emissions mitigation will not come at the expense of public safety. However, it proposes requiring that operators document such events, including the justification for not taking mitigative action.

Adopting advanced technology

Stakeholders also identified areas where operators could use advanced technology to reduce gas pipeline leaks. Specifically, five stakeholders told us about advancements in equipment for detecting natural gas leaks. For example, some stakeholders described vehicles equipped with gas detection equipment that can cover a larger area more quickly than a person walking with a handheld detector.

Some stakeholders described equipment, known as mobile compressor systems, that can be used to minimize gas leaks when a blowdown is required. After a section of pipeline is isolated by valves, instead of a blowdown that releases gas into the atmosphere, a mobile compressor can pump the gas from the isolated section to a downstream section of the pipeline.

PHMSA officials noted that from 2001 to 2022, PHMSA funded 32 research and development projects regarding pipeline leak detection. PHMSA is preparing a report to submit to Congress—as required by the PIPES Act of 2020—on the best available technologies or practices to prevent or minimize the release of natural gas from pipelines, without compromising safety, when operators perform certain pipeline activities.¹⁵ As of March 2024, PHMSA officials said they expect the report to be completed by July 2024.

PHMSA, in its NPRM on leak detection and repair, proposes to require that operators perform leakage surveys using specific practices and commercially available technologies that are consistent with its proposed performance standard for advanced leak detection programs. According to PHMSA, leakage surveys using gas samplers or other sensors mounted on vehicles, aircraft, or satellites to detect leaks at a greater distance may allow for more efficient leakage surveys. Some stakeholders noted that smaller operators might not have the resources to purchase some advanced technologies but could instead contract for those services.

Replacing aging pipelines

Four stakeholders said that operators can replace aging portions of pipelines made of cast and wrought iron, as well as bare steel, to reduce leaks. Cast and wrought iron are generally found on distribution systems, while most transmission pipelines are constructed of steel. According to PHMSA, the risk of leaks from iron and bare steel pipelines is high due to their age. While pipelines composed of these materials account for a very small portion of all pipelines—about 2 percent—they still represent more than 55,000 miles.

Officials pointed out that PHMSA is statutorily prohibited from requiring operators to replace pipeline materials that were compliant with applicable codes at the time of installation. However, the Infrastructure Investment and Jobs Act, enacted in 2021, appropriated \$200 million annually for fiscal years 2022 through 2026 for the Department of Transportation to provide competitive grants to municipal or community-owned utilities to modernize their natural gas distribution pipelines.¹⁶ In awarding these grants, PHMSA must consider factors such as the risk profile of the existing pipeline system operated by the applicant, including the presence

of pipe prone to leakage. From fiscal years 2022 to 2024, PHMSA awarded \$588 million in grants to 167 recipients.

Agency Comments

We provided a draft of this report to the Department of Transportation for review and comment. The department provided technical comments, which we incorporated as appropriate.

How GAO Did This Study

We reviewed applicable statutes, regulations, and PHMSA documentation. We interviewed agency officials and officials from five state pipeline safety authorities. We selected one state authority from each of PHMSA's five geographic regions: Central, Eastern, Southern, Southwestern, and Western.¹⁷ We also based our selection of states on those with higher pipeline mileage. We then randomly selected and interviewed 10 gas pipeline operators with high pipeline mileage (two from each of the selected states).¹⁸

We also interviewed a selected group of 10 relevant stakeholders that include nine industry, safety, or environmental groups, and one research organization.¹⁹ When selecting these stakeholders, we considered recommendations from other stakeholders, whether they had submitted comments to PHMSA in response to PHMSA's notice of proposed rulemaking on leak detection and repair, and whether they had participated in our prior work.

To identify challenges associated with updating and reviewing operator plans, and additional actions for further minimizing natural gas emissions from pipelines without compromising safety, one analyst identified and coded themes from the interviews we conducted; a second analyst reviewed and verified those themes. We reported the most frequently cited challenges and actions selected stakeholders identified; therefore, it is not an exhaustive list. In this report, we use the indefinite quantifiers "some" and "most" when describing responses from interview participants. We define "some" as three or more but less than a majority of all interviewees or a relevant subset of them. We define "most" as a majority of all interviewees or a relevant subset of them.

We conducted this performance audit from May 2023 to June 2024 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

List of Addressees

The Honorable Maria Cantwell
Chair
The Honorable Ted Cruz
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Cathy McMorris Rodgers
Chair
The Honorable Frank Pallone, Jr.
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Sam Graves
Chairman
The Honorable Rick Larsen
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

We are sending copies of this report to the appropriate congressional committees, the Secretary of Transportation, and other interested parties. In addition, the report is available at no charge on the GAO web site at <https://www.gao.gov>.

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Endnotes

¹Pub. L. No. 116-260, div. R, § 114(c)(1)-(2), 134 Stat. 2210, 2231-2232 (2020).

²PHMSA's general authority is under the Pipeline Safety Laws, 49 U.S.C. § 60101 et seq. Its pipeline safety regulations are located in 49 C.F.R. Parts 190-199.

³If a federal minimum standard is issued within a certain time frame before a state submits its certification, the state must certify that it is taking steps to adopt that standard into its laws. See 49 U.S.C. § 60105.

⁴49 U.S.C. § 60104(c).

⁵See PIPES Act of 2020 § 114(a)(1), (b).

⁶See *id.* § 114(a)(1).

⁷See *id.* § 118. In its NPRM on leak detection and repair, PHMSA states that this provision of the PIPES Act of 2020 clarified that PHMSA must consider environmental benefits “equally” with public safety benefits. Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890, 31891 (proposed May 18, 2023).

⁸PIPES Act of 2020 § 113.

⁹*Id.* § 114(d).

¹⁰Operators’ plans must also meet the requirements PHMSA establishes under the final rule on leak detection and repair, after the final rule is issued. See 49 U.S.C. § 60108(a)(2) (as amended by the PIPES Act of 2020 § 114(a)(1)).

¹¹Integrity management is a risk-based approach to managing certain gas transmission pipelines. Under this approach, operators are required to assess pipelines in high consequence areas—generally, areas where an incident could have the greatest impact to public safety or property—to identify threats and mitigate risks. PHMSA’s integrity management regulations are in addition to its other gas pipeline safety regulations.

¹²Pipeline Safety: Gas Pipeline Leak Detection and Repair, 88 Fed. Reg. 31890 (proposed May 18, 2023).

¹³States eligible for this funding include those that have assumed authority over the intrastate pipelines within their borders and interstate agents. Specifically, if an eligible state files an application by September 30, the Secretary of Transportation must pay no more than 80 percent of the cost of the personnel, equipment, and activities that the state reasonably requires during the next calendar year to carry out its relevant pipeline safety responsibilities. The payments may be made in installments, in advance, or on a reimbursable basis. See 49 U.S.C. § 60107.

¹⁴Although flaring natural gas produces carbon dioxide, it is a much less potent greenhouse gas than the methane in natural gas. That said, methane remains in the atmosphere for about a decade while carbon dioxide can last for centuries. Flaring thus is intended to reduce short-term impact (next 50 years) rather than longer-term impact (greater than a century). M.J. Bradley and Associates LLC, *Analysis of Pipeline and Hazardous Materials Safety Administration Proposed New Safety Rules: Pipeline Blowdown and Mitigation Options* (Concord, MA: June 2016).

¹⁵PIPES Act of 2020 § 114(d).

¹⁶See Pub. L. No. 117-58, 135 Stat. 429, 1443 (2021).

¹⁷The five state pipeline safety authorities we interviewed were the Colorado Public Utilities Commission, Kansas Corporation Commission, Kentucky Public Service Commission, Ohio Public Utilities Commission, and the Railroad Commission of Texas.

¹⁸The 10 pipeline operators we interviewed were the ANR Pipeline, Black Hills Energy, Colorado Springs Utilities, Columbia Gas of Ohio, Delta Natural Gas Company, Dominion Energy Ohio, Kentucky Frontier Gas, Kinder Morgan, Public Service Company of Colorado, and SiEnergy.

¹⁹The nine industry associations, pipeline safety, or environmental groups we interviewed were the American Gas Association, American Petroleum Institute, American Public Gas Association, Common Ground Alliance, Environmental Defense Fund, Interstate Natural Gas Association of America, GPA Midstream Association, National Association of Pipeline Safety Representatives, and the Pipeline Safety Trust. The research organization we interviewed is the Methane Emissions Technology Evaluation Center of Colorado State University.