METHANE GAS LEAKS

Frequent leaks are resulting in death, injury and other damage to our health and environment

U.S. PIRG Education Fund

ENVIRONMENT MAINE RESEARCH & POLICY CENTER

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EXECUTIVE SUMMARY

METHANE GAS (OFTEN KNOWN AS NATURAL GAS) has heated the homes of many Americans for over a century – and for over a century, it has been prone to leaks, putting communities and the environment in danger. With growing awareness of the impact of methane leaks on the climate, and with growing availability of safer alternatives, it is clear that **gas has no place in a modern clean energy network.**

Gas leaks and pipeline incidents are common and put public health and safety at risk.

- In 2010, a gas terminal failure in San Bruno, California, caused an explosion on the scale of a magnitude 1.1 earthquake. Eight people were killed and 58 were injured.[1] The event led to the creation of mandatory gas safety programs around the country.

- In 2018, high-pressure gas was accidentally released into low-pressure gas distribution lines in the Merrimack Valley of Massachusetts, starting more than 80 fires in three towns.[2] An 18-year-old was killed, and thousands of people went without gas for months.[3]

- In March 2022, a four-story apartment building in Silver Spring, Maryland, was destroyed in an explosion caused by a leak coming from a cut gas line.[4] In total, 14 people were hospitalized and over 200 were displaced.[5]

A gas pipeline incident occurs somewhere in the U.S. approximately every 40 hours. From 2010 through nearly the end of 2021, almost 2,600 pipeline incidents related to the release of gas occurred in the United States that were serious enough to be reported to the federal government, 328 of which resulted in explosions. Those explosions and fires killed 122 people and injured 603.[6]

The amount of gas leaking to the environment is far greater than captured in federal leak reporting or emissions estimates from the Environmental Protection Agency (EPA).[7] A 2020 study, for example, estimated that there are more than a half million leaks in local gas distribution systems in the U.S., and that leakage from these systems was five times greater than the amount estimated by the EPA.[8]

Gas can be released intentionally by a utility to lower pressure or empty pipelines for maintenance, or can be released unintentionally due to wear, equipment failure, natural causes, or accidental force or puncture. [9]

Gas leaks contribute to global warming. Gas leaks reported to the federal government resulted in the release of 26.6 billion cubic feet of methane gas from 2010 through October 2021, equivalent in its effects on global warming to emissions from over 2.4 million passenger vehicles driven for a year. [10]

TABLE ES-1: REPORTED GAS PIPELINE LEAKS

Year	Total number of incidents	Volume of gas released (million cubic feet)	Total cost (millions)
2010	228	2,582	$ 616.1
2011	239	2,538	$ 152.2
2012	185	1,891	$ 54.8
2013	194	1,864	$ 68.6
2014	232	2,587	$ 104.6
2015	234	2,327	$ 83.2
2016	199	2,100	$ 94.2
2017	221	2,653	$ 176.2
2018	217	1,702	$ 2,030.0
2019	258	2,112	$ 189.3
2020	233	2,576	$ 190.2
2021*	158	1,678	$ 99.8
Total	**2,598**	**26,609**	**$ 3,859.0**

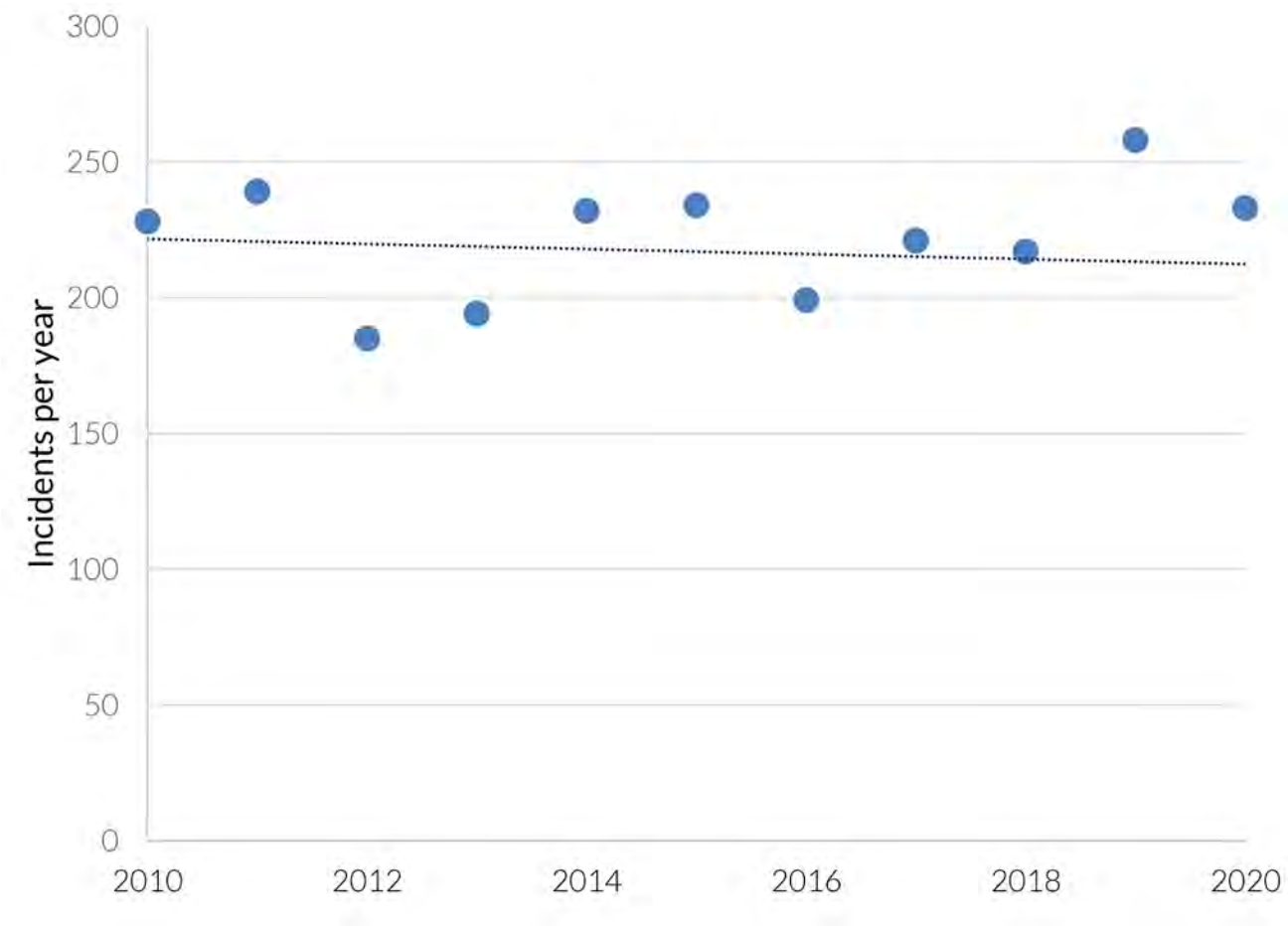
**Values for 2021 include incidents through October 6, 2021.*

The EPA estimates that emissions from natural gas transmission and distribution systems and storage fell significantly between 1990 and 2016, but progress has slowed since.[11] However, EPA reporting of greenhouse gas emissions from gas systems is likely incomplete. While EPA estimates that the rate of leaks throughout the gas supply chain is 2-3%, studies suggest leak rates throughout the supply chain are significantly higher – high enough that they offset any greenhouse gas benefit of gas over coal.[12]

The frequency of major gas leak incidents has not declined significantly since 2010, despite the time and money that gas utilities have spent to address leaks in the wake of several deadly explosions. (See Figure ES-1.)

- In states such as Illinois and Maryland, utility programs have prioritized complete system replacements over focused replacement of leak-prone infrastructure, resulting in the expenditure of billions of dollars for limited public safety benefit.[15]

FIGURE ES-1: REPORTED GAS PIPELINE LEAK INCIDENTS, 2010 TO 2020[14]



- While efforts to reduce leaks from gas distribution systems have made some progress, reliance on methane gas is inconsistent with the need to decarbonize the nation's energy system by mid-century. As a result, investments in gas systems beyond those needed to protect public health and safety could become "stranded," diverting attention and resources that should be used to transition the nation's energy system to truly clean forms of energy.

The consistent risks posed by gas leaks – coupled with the urgent need to address climate change – mean that the nation should prioritize electrifying buildings while taking immediate, focused actions to address the biggest safety risks.

Introduction

ON THE MORNING OF NOVEMBER 14, 1927, 13 men were sent out to repair a gas storage tank on Pittsburgh's North Side.[16] A malfunctioning valve had allowed a dangerous mix of gas and oxygen to enter the tank, and less than an hour into the repair a blow torch was lit, igniting the gas inside and launching the tank hundreds of feet into the air in a ball of fire.[17] The debris from the explosion crashed into surrounding houses and buildings.[18] Water and sewer mains broke, telephone lines went down, and the fire alarm system went offline.[19] Twenty-eight people were killed, nearly 600 were injured, and more than 5,000 were left homeless.[20] Unstable buildings, downed electrical lines and floodwaters threatened to do more damage.

Nearly a century later, on September 9, 2010, an electrical failure at a terminal in San Bruno, California, led to a dangerous increase of pressure in the gas system.[21] Eventually, the gas leaked at the site of a poor welding job and exploded, leaving a crater 72 feet long and launching a 3,000-lb. segment of pipe into the air. Gas continued to fuel the fire for an hour and a half.[22] More than 70 homes were damaged, 38 were destroyed, 58 people were injured, and eight were killed.[23]

Gas infrastructure has come a long way since the early 1900s. But the inherent risk of transporting flammable, explosive gas across the country and through our communities has not changed. Today, methane gas leaks and gas system malfunctions continue to put public health and safety at risk. In addition, recent studies have highlighted the contribution of gas leaks to a risk that would have seemed inconceivable to early 20th century Americans: global warming.

America no longer needs to rely on dangerous systems of gas transmission and distribution to generate electricity or heat our homes. Electric technologies – increasingly powered by renewable energy – can do the job. Public officials and utilities must focus their investments in gas infrastructure on protecting the public and the climate from gas leaks and plan for the transition to an energy system that is clean, safe, reliable and built on a foundation of renewable energy.

Gas leaks are common

GAS LEAKS ARE WIDESPREAD, COSTLY and hazardous to the public's health and safety. On average, a major new gas leak incident is reported to the federal government approximately every 40 hours.[24] Other, less immediately hazardous gas leaks in our communities can continue unrepaired for years, or even decades – contributing to global warming and, in some cases, putting public safety at risk.

Where do gas leaks come from?

The gas system in the United States is composed of three types of pipelines.[25]

- **Gathering lines** move raw gas from wells to processing facilities.
- **Transmission pipelines** are larger pipes that transport gas at high pressure for long distances across the country.
- **Distribution pipes** transport the gas directly to homes and businesses where it is burned.

There are opportunities for gas to leak throughout the system – from the transport of gas from the well, through the gathering and transmission pipelines that carry gas from the well to storage facilities, and finally through the distribution lines that carry gas to homes and businesses.

Some gas is released intentionally as part of normal operations, such as opening and closing valves for maintenance work. These plumes release enough gas that they have been spotted by satellites and noted as significant contributors to methane emissions.[26] Other releases are unintentional.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) offers a number of reasons why unintentional gas leak incidents might occur. They include:

- corrosion failure, either internal or external;
- natural forces (heavy floods, movement of earth, temperature, high winds, vegetation roots, snow/ice accumulation);
- excavation damage (either by a utility, contractor or third party);
- other outside forces (hit by vehicle, previous mechanical damage, erosion);
- pipe, weld or joint failure;
- equipment failure; and
- incorrect operation (damage by operator, incorrectly placed valves, over-pressurized equipment, incorrectly installed equipment, failure to follow procedure).[27]

Many of the conditions listed could happen at any given moment, regardless of the level of care taken in working on or around gas infrastructure.

Large volumes of gas leak

The volume of gas emitted through intentional releases and unintentional leaks is significant. The EPA estimates that the rate of leaks throughout the gas supply chain is less than 2% of gas produced nationally, though this estimate has been challenged as too low (see below).[28] The EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks found that in 2020, methane emis-

sions from leaks, venting and flaring in the U.S. gas system accounted for 6.6 million tons of methane emissions, equivalent in its impact on global warming to 164.9 million metric tons of carbon dioxide.[29]

Gas leaks are undercounted

There are two primary methods used to assess gas leaks: top-down methods, in which the content of gas within the atmosphere is measured; and bottom-up methods, in which a detailed survey of source losses is collected.[30] Both methods have their benefits and detriments. Top-down methods can survey a larger area and give a more accurate picture as to the current state of the atmosphere, but can only provide data for a single point in time, whereas bottom-up methods are localized to the emitters included but can track emissions for a greater period.[31] Both methods are used to provide an accurate and thorough picture of the state of gas emissions.

A 2020 report by the Gas Index Project notes that over time, estimates of gas emissions have risen as surveying methods have improved.[32] However, evidence has shown that gas leaks occur significantly more frequently and at higher volume than the EPA estimates:

- A study from 2018 estimates that the magnitude of gas leaked from the oil and gas supply chain was 13 million metric tons, about 60% greater than the value estimated by the EPA.[33] The study argues that the EPA had not properly taken into account emissions released during abnormal operating conditions or leaks within residential pipes.[34]

- A literature review of large-scale, top-down field studies found that estimates of methane gas emissions were about 1.5 times the EPA's inventory.[35]

- A study from 2021 analyzed historic methane emission satellite data and found that in 2012, the EPA's reporting underestimated methane emissions for gas processing and oil and gas production.[36] Emissions were found to be 50% higher in gas production than estimated by the EPA.[37]

In urban areas particularly, a significant volume of leaks are unaccounted for.

- A Harvard study found that methane emissions from gas infrastructure and use in U.S. cities are two to 10 times greater than EPA estimates, with Boston's methane emissions six times higher than the estimate reported by the Massachusetts Department of Environmental Protection, and over half of those emissions coming from non-pipeline sources both in and out of homes.[38]

- A study from 2020 estimated that there are 630,000 leaks in U.S. distribution mains and that, nationally, pipeline mains within cities leak approximately five times as much as the EPA estimates.[39]

A major gas leak incident occurs once every 40 hours

Even those major gas leak incidents that are reported to the federal government release a staggering amount of methane and pose a serious threat to public health and the environment.

In 2020, the nation's gas network leaked at least 2.58 billion cubic feet of methane gas into communities and into the atmosphere during incidents reported to the federal Pipeline and Hazardous Materials Safety Administration (PHMSA).[40]

These leaks are not few and far between – new gas leak incidents are reported to PHM-

SA nearly every 40 hours on average.[41] There were 2,598 incidents of pipeline gas leaks reported to PHMSA between January 2010 and October 2021.[42] Of those events, 1,196 leaks (46%) occurred in distribution lines and 1,402 (54%) occurred in transmission systems.[43]

As noted above, these figures only include the most serious events: those that result in the death or hospitalization of an individual; estimated property damage of $122,000 or more; the unintentional loss of gas of at least 3 million cubic feet (equivalent to the amount of gas consumed annually by 52 typical homes); emergency shutdown of a facility for a legitimate reason; or any other reason an operator classifies the event as significant.[44]

The number of incidents has not declined significantly over the last decade, despite large investments in gas leak prevention in recent years.[45] Figure 1 displays the PHMSA-reported number of gas pipeline incidents per year. Between 2010 and 2020, the frequency of reportable gas leaks stayed relatively constant.

FIGURE 1: REPORTED GAS PIPELINE INCIDENTS[46]

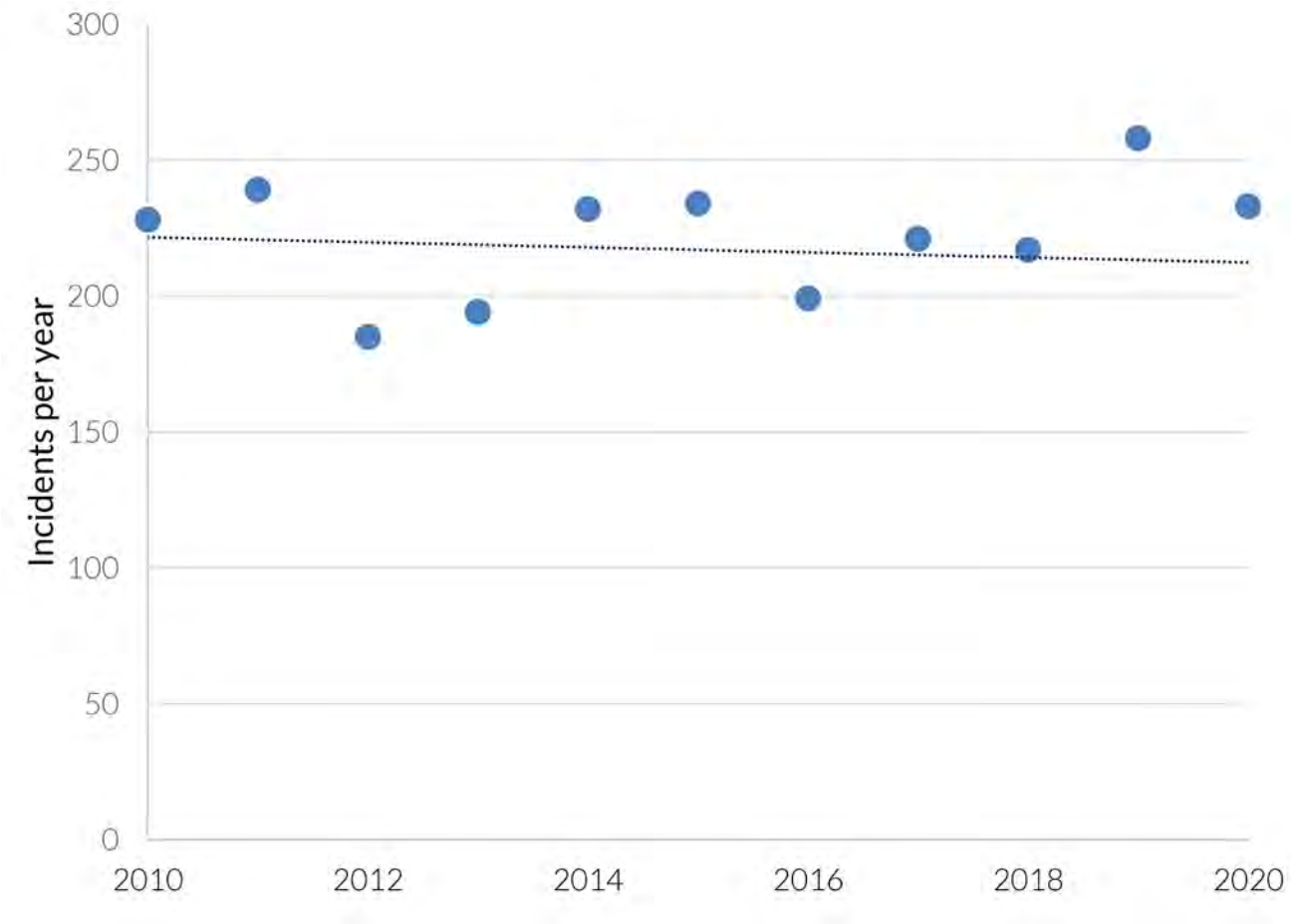


TABLE 1: NUMBER OF REPORTED GAS PIPELINE INCIDENTS BY YEAR

Year	Incidents	Incidents with explosions	Total cost (millions)
2010	228	35	$ 616.1
2011	239	37	$ 152.2
2012	185	25	$ 54.8
2013	194	20	$ 68.6
2014	232	34	$ 104.6
2015	234	28	$ 83.2
2016	199	30	$ 94.2
2017	221	23	$ 176.2
2018	217	35	$ 2,030.0
2019	258	28	$ 189.3
2020	233	19	$ 190.2
2021*	158	14	$ 99.8
Total	**2,598**	**328**	**$ 3,859.0**

**Values for 2021 include incidents through October 6, 2021.*

Gas infrastructure exists in every state, and gas leaks occur in every state. Table 2 lists the 10 states with the most gas pipeline leak incidents reported between 2010 and 2021. Some states may experience more gas leak incidents due to the existence of significant oil and gas industry infrastructure, such as Texas and Oklahoma, as evidenced by Figure 2. Others have a large population and large cities, such as California, New York and Illinois.

FIGURE 2: ALL REPORTED DISTRIBUTION AND TRANSMISSION GAS PIPELINE LEAK INCIDENTS THROUGHOUT THE U.S. FROM JANUARY 2010 TO OCTOBER 2021[47]

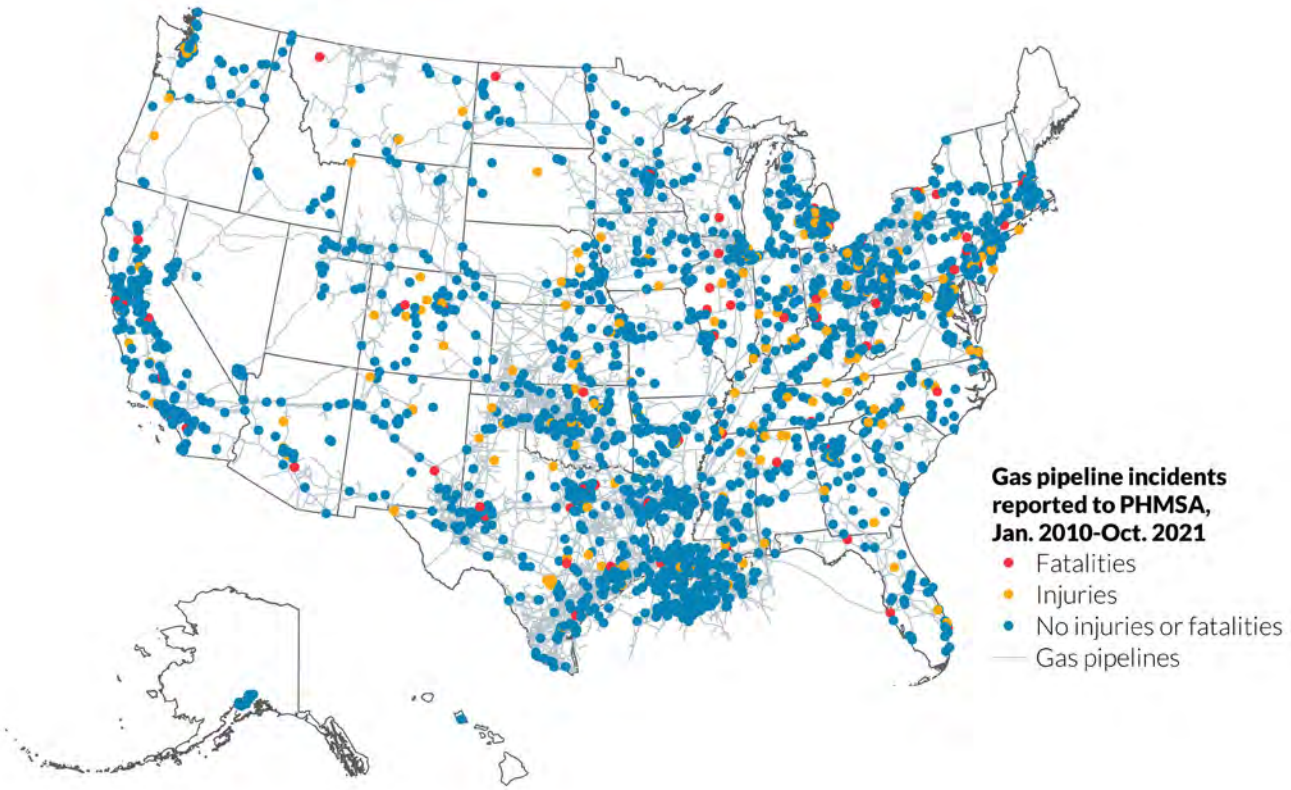


TABLE 2: TOP 10 STATES BY NUMBER OF REPORTED PIPELINE GAS LEAKS

State	Incidents	Incidents with explosions	Total cost (millions)
Texas	287	33	$ 116.6
California	229	24	$ 973.0
Louisiana	183	4	$ 69.7
Michigan	141	23	$ 86.2
New York	119	26	$ 27.3
Ohio	99	22	$ 82.7
Oklahoma	95	6	$ 20.3
Pennsylvania	89	17	$ 56.9
Illinois	64	18	$ 46.2
Georgia	59	6	$ 30.2

Gas leaks threaten our safety

THE BILLIONS OF CUBIC FEET OF GAS released each year pose a real danger to our communities. In total, from 2010 to late 2021, at least 122 people were killed and another 603 were injured in gas leak incidents.[48]

Over the period of PHMSA records from 2010 to late 2021, U.S. distribution lines saw 711 ignition incidents, and the transmission network saw another 139 incidents in which gas ignited.[49] There were a total of 328 incidents that resulted in explosions.[50] Throughout the country, nearly 33% of all reported gas leak incidents resulted in fire, and nearly 13% resulted in explosions.

Gas explosions do more than cost lives, cause injuries and inflict economic damage—they can leave scars on neighborhoods and families for lifetimes.

East Harlem, NY: In March 2014, two five-story buildings on Park Avenue of East Harlem in New York City were brought to the ground by an explosion caused by a gas leak.[51] The blast killed eight people, injured 50, displaced five businesses and left over 100 families without a home.[52] After the explosion, the Public Service Commission carried out a 20-month investigation finding Consolidated Edison (ConEdison), New York's primary gas utility provider, responsible for 11 gas safety regulation violations.[53] The cause of the explosion was determined to be an improperly connected gas service line that was put under stress by an eight-year-old sewer line breach that caused the gas main to sag.[54] ConEdison had failed to respond to two previous reports of gas odors or to notify the local fire department.[55]

In 2017, ConEdison reached a $153.3 million settlement with New York State in the largest gas safety-related settlement in the state's history.[56] According to PHMSA, ConEdison experienced 83 gas leaks per 100 miles of gas mains in 2012.[57] With nearly 2,000 miles of gas mains in New York City and Westchester County, that would translate into roughly 1,600 leaks if the same leakage rate were to apply to all the company's gas mains.[58]

TABLE 3: GAS SYSTEM IGNITIONS AND EXPLOSIONS FROM JANUARY 2010 TO OCTOBER 2021

	Incidents	Incidents with gas ignition	Incidents with explosions	Injuries	Fatalities
Distribution	1,196	711	271	493	95
Transmission	1,402	139	57	110	27
Combined	**2,598**	**850**	**328**	**603**	**122**

San Bruno, CA: On September 9, 2010, a gas terminal in San Bruno, California, experienced an electrical failure, causing increased pressure in the connected distribution line stretching to San Francisco.[59] For 40 minutes, the pressure grew until the pipe burst at the site of a poor welding job.[60] The gas ignited and an explosion shot a 1.5-ton segment of pipe into the air, leaving a gaping crater in the ground.[61] The U.S. Geological Survey recorded the explosion and resulting shock wave, equating it to a magnitude 1.1 earthquake.[62]

Without an automatic shutoff, the flames spread to surrounding homes until the valve could be manually shut more than an hour later, and the fire continued to rage for hours longer.[63] In total, 58 people were injured and eight were killed.[64] Families were displaced as 70 homes were damaged by the explosion and 38 homes were destroyed.[65]

Pacific Gas & Electric was held responsible for the electrical failure and resulting damages. In November 2009, less than a year before the explosion, the line had been checked for corrosion and had passed routine annual inspections without cause for alarm.[66] However, PG&E had documentation acknowledging the danger of the pipe, stating in an internal memo made public that "[t]he likelihood of a failure [made] the risk of a failure at this location unacceptably high."[67]

In response to the disaster, the California Public Utilities Commission launched a statewide initiative to tighten safety standards. PG&E proposed to improve the safety of its pipelines, replacing and updating valves and pipes, and improving inspection processes.[68] Over the last decade, California has continued to experience periodic gas explosions, despite spending the most of any state in the U.S. on gas line replacement.[69]

Merrimack Valley, MA: In the days before a series of explosions in the Merrimack Valley of Massachusetts, Columbia Gas employees replaced a cast iron gas pipe, but didn't replace the old pressure sensors that detected and prevented over-pressurization. On September 13, 2018, at about 4 p.m., those sensors detected a pressure of zero, triggering high pressure gas to release into low pressure distribution lines.[70] The high pressure caused explosions and fires that damaged 131 buildings and destroyed five homes in three towns.[71]

One home experienced an explosion so severe that its chimney fell onto a car containing an 18-year-old, who later died at Massachusetts General Hospital.[72] A state of emergency was declared in the region (which remained in effect for nearly two years) and homes were methodically checked for trapped gas by firefighters, police officers and gas workers.[73]

In total, 22 people were hospitalized and 50,000 people were asked to evacuate.[74] Approximately 8,600 customers lost their gas supply for weeks, waiting for 48 miles of pipes to be replaced.[75] The National Guard distributed hot plates and space heaters to the thousands lacking a functional furnace or gas stove.[76]

Columbia Gas was penalized heavily for the incident. The company was fined over $56 million and lost the right to operate in the state of Massachusetts.[77] Columbia Gas also paid $143 million to settle a class action lawsuit and $80 million in direct payments to communities affected by the disaster.[78]

Gas leaks threaten our environment

OVER NEARLY A DECADE, 26.6 BILLION cubic feet of fuel was released from gas pipes in leak incidents reported to PHMSA. This gas was released into the atmosphere as methane or, if burned, carbon dioxide.[79]

Gas is sometimes viewed as a preferable alternative to coal for electricity generation because it produces less carbon dioxide when burned, but unburned leaks of methane – a highly potent greenhouse gas – minimize or even eliminate gas' climate advantage versus coal.[80]

The global warming potential of methane is over 80 times greater than that of carbon dioxide during the first 20 years it lasts in the atmosphere.[81] When methane is burned, it produces carbon dioxide, which contributes to global warming but not as severely.[82]

Some research suggests that gas leaks have had a far greater impact on the environment than previously expected due to the high rate of unreported leaks. A study from 2018 found that leaks from gas lines over the previous two decades had nearly doubled the climate impact of gas.[83]

Gas is not a clean energy source – especially when its propensity to leak into the atmosphere is taken into account. Methane emissions pose a strong danger to our environment and will accelerate global warming faster than carbon dioxide in the coming decades.

Gas leaks are costly

REGARDLESS OF THE MAGNITUDE, every gas leak incurs some financial cost. Gas lost to the atmosphere and time spent repairing leaks and replacing lines are costly for gas utilities and their ratepayers. In worst-case scenarios, damage is done to pipeline infrastructure, public roads, buildings and private property, and fire and medical services need to respond. PHMSA lists a number of sources of costs, including property damage, emergency services, and the value of intentionally and unintentionally released gas. In total, gas leaks reported to the federal government have inflicted nearly $4 billion in damage and costs since 2010.

Of PHMSA's recorded incidents, the median total cost per incident was more than $106,000.[84] Damage to operator-owned property accounted for nearly 30% of costs, and damage to public and non-operator private property accounted for more than 27% of total costs.[85] Collectively, total property damage accounted for well over half of the cost of gas leak incidents.[86]

Since 2010, methane gas worth nearly $90 million was released to the atmosphere – both during the leak incidents and as part of the response and repair efforts.[87] Although the PHMSA dataset accounts for the largest known incidents, this figure likely underestimates the actual full cost as not all gas leaks are accounted for and leaks can last for years before being repaired.

TABLE 4: COSTS RESULTING FROM GAS PIPELINE LEAKS FROM JANUARY 2010 TO OCTOBER 2021 (IN MILLIONS)

	Distribution	Transmission	Combined
Damage to public and non-operator private property	$944	$120	$1,065
Damage to operator property	$522	$625	$1,147
Cost of emergency response	$198	$29	$228
Other costs	$772	$557	$1,330
Cost of unintentionally released gas	$7	$65	$72
Cost of intentionally released gas	$0	$18	$18
Total cost	**$2,444**	**$1,415**	**$3,859**

Utility programs to address leaks are expensive and often ineffective

IN RESPONSE TO HAZARDOUS GAS LEAK events, gas utilities have adopted programs to minimize the amount of gas leaking into our atmosphere and communities by repairing and replacing gas lines. Over the period surveyed, the rate of major gas leak incidents has not increased or decreased significantly.

Gas leaks may persist for a number of reasons. Inefficient repairs and replacement jobs may take much longer than expected, allowing gas to continue to leak for additional years. Poor management can fail to focus on the most dangerous pipes. For these reasons and more, many programs have failed to effectively handle gas leaks and have cost more money for ratepayers without commensurate environmental or safety improvement. [88] Even as billions of dollars are being spent on ineffective gas line replacement programs, the safer solution lies in getting off gas entirely and investing in clean, safe energy infrastructure.

Pipeline replacement programs can be wasteful

Peoples Gas Light and Coke, the gas utility serving the city of Chicago, has run some form of a gas main replacement program since a 1981 study recommended a 50-year dedicated program to replace a specific subset of at-risk, leak-prone cast iron pipes.[89] Outside audits in 1988 and 1994 found the program never got on course.[90]

In 2007, Peoples Gas proposed an accelerated and expanded program more focused on overhauling its system to allow gas distribution at medium pressure (rather than low pressure) than addressing the most pressing leaks.[91] The program launched in 2011, after which Peoples Gas started spending significantly more and performing more work each year in order to, in theory, complete pipe replacement faster.[92] The acceleration "overwhelmed the management of [Peoples Gas], its resources, talent, and capabilities," according to an expert witness working on behalf of the Office of the Illinois Attorney General,[93] prompting the Illinois Commerce Commission to order an audit of the program.[94] The audit found that Peoples Gas management could not articulate "(a) likely overall program costs, (b) likely program duration relative to targeted completion of leak-prone pipe replacement by 2030, and (c) the reasons why leak rates have not fallen significantly after four years of accelerated replacement of cast iron and ductile iron mains."[95]

Despite these audit findings and a follow-on two-year commission investigation, Peoples Gas management rejected key audit recommendations and doubled down on the status quo.[96] The commission allowed Peoples Gas to do so under the commission's interpretation of a 2013 law that provides Peoples Gas and other gas utilities more favorable regulatory treatment to complete safety improvements.[97] An engineering study published in January 2020 also concluded that the program "has not coincided with a noticeable reduction in pipeline failure rates – particularly in the last decade,"[98] that is, over the entire period of the accelerated program with an expanded (medium pressure) scope.

Program cost estimates have grown from over $1 billion in 2007 to as much as $11 billion in 2015 and to this day, Peoples Gas does not have a credible cost estimate.[99] Those ballooning costs are rapidly passed on to customers through a monthly bill surcharge, contributing to severe and growing home heating affordability challenges for Chicagoans.

Chicago recently updated its Climate Action Plan, including a goal of electrifying 30% of existing residential buildings by 2035.[100] The Peoples Gas pipe replacement program, with its persistent management problems, bloated scope that fails to prioritize safety, and the affordability burdens it is placing on broad swaths of its customer base,[101] makes even less sense in light of the imperative to move away from fossil fuels to address climate change.

Some pipe replacement programs do not prioritize safety

In 2013, the Maryland Legislature moved to accelerate gas infrastructure replacement in the state through the Strategic Infrastructure Development and Enhancement (STRIDE) law. Like gas infrastructure programs in other states, STRIDE enabled gas utilities to recover the costs of infrastructure projects from ratepayers faster – including by imposing surcharges on customers for construction work that had not yet begun.[102] This accelerated cost recovery was tied to the submission of five-year infrastructure plans for approval by the Maryland Public Service Commission (PSC).[103]

Critics of the program, including the Maryland Office of People's Counsel (OPC), which represents ratepayers, argue that investments made through the STRIDE program are not focused on safety. Instead, Maryland gas companies aspire to replace *all* of their infrastructure,[104] creating long-lasting financial obligations for ratepayers at a time when Maryland needs to be moving away from gas in order to meet its greenhouse gas emission reduction goals.[105] Moreover, Maryland gas utilities already have an obligation to provide safe service, regardless of any special cost recovery mechanisms created by the legislature.

In the years since the adoption of the STRIDE program, Maryland utilities have ramped up their spending on infrastructure. In a plan approved in 2020, Baltimore Gas & Electric planned to spend $1.3 billion on gas infrastructure over just a three-year period.[106]

Yet, the projects carried out under the STRIDE program have not prevented a series of deadly or damaging gas explosions across Maryland in recent years:

- In 2016, a gas explosion at the Flower Branch apartments in Silver Spring, just outside Washington, D.C., killed seven people and injured 65 others, after a device to regulate the flow of gas into the building likely failed, causing gas to build up for several hours before it was ignited.[107]

- An August 2019 explosion at a shopping center in Columbia, Maryland, dislocated 20 businesses. The explosion occurred outside business hours, averting the potential for significant loss of life.[108] PSC staff later determined that Baltimore Gas & Electric had violated safety standards.[109]

- An August 2020 explosion in Northwest Baltimore killed two people and injured seven others, after maintenance work in a home triggered a gas leak that was ignited by a stove.[110]

- A March 2022 explosion at the Friendly Garden apartments in Silver Spring took place after a maintenance worker accidentally severed a gas pipeline. The explosion sent 14 people to the hospital.[111]

The OPC argues that none of the explosions listed above that occurred between 2016 and 2020 would have been prevented by investments eligible under the STRIDE program.[112] Yet, in 2022, lawmakers considered legislation to make it even easier for Maryland gas utilities to recover infrastructure expenses from ratepayers.[113] The bills did not receive a vote.

Repairs are not always successful

A 2021 study assessed the change in methane accumulation in the atmosphere of Boston following the adoption of legislation to repair leaks in the gas system.[114] The study found that, over the eight years from 2012 to 2020, there was no significant change in methane emissions in the city – even as the state had passed laws intended to reduce leaks.[115] As is the case in Chicago and other older cities, many of the pipes in Boston are well over a century old and some have been leaking for decades. In 1985, for example, National Grid reported a gas leak on the corner of Park St. and Beacon St. in Boston – as late as 2015, it had not yet been repaired.[116]

Massachusetts' plan to combat increasing gas leaks was launched in 2014 when "An Act Relative to Natural Gas Leaks" established annual reporting, standard classification by safety hazard, and timelines for repair through the Gas System Enhancement Program (GSEP).[117] Each gas distribution company submitted an annual plan to propose replacements of deteriorating gas infrastructure.[118]

Part of the reason behind the consistent level of atmospheric methane is that the worst leaks are not necessarily prioritized for repair. A study from 2016 surveyed 100 gas leaks in metro Boston distribution mains, determining that 7% of leaks surveyed contributed to 50% of total methane emissions, and that 15% of leaks were potentially explosive.[119] However, a review of Massachusetts' pipeline replacement program from October 2021 found that prioritization of the areas with the highest leak rates had only just begun.[120] At the same time, more leaks are being reported.

Even though the state repairs between 15,000 and 18,000 leaks each year, a similar number of new leaks emerge.[121] The timeline of these projects will need to be accelerated if the level of emissions in Massachusetts is going to drop significantly.

Recommendations: It's time to move beyond gas

GAS HEATING HAS BEEN USED IN THE U.S. for more than a century and has led to leaks, explosions and environmental damage for just as long. As long as it is transported, gas will continue to pose a risk both to people who heat their homes with it and those who live in neighborhoods above gas pipes.

Fortunately, the United States no longer needs to rely on gas for home heating, or for electricity generation. Electrification of homes and businesses, coupled with the expansion of renewable energy sources like wind and solar power, offers a cleaner and safer way to heat, cool and light our homes.

The United States is investing in cleaner, safer sources of electricity and technological improvements are making it easier and more affordable than ever to power our buildings entirely with electricity. America produces over 23 times as much solar power and nearly three times as much wind power as it produced a decade ago.[122] The efficiency of heat pumps has improved to the point where they are now an attractive and realistic alternative to fossil fuel-fired furnaces and water heaters. While they are just beginning to break into the mass market, shipments of air-source heat pumps from U.S. manufacturers are rising quickly, nearly doubling between 2011 and 2020 and increasing by 10% in 2020 alone.[123] Induction stoves have recently fallen in price, improve indoor air quality, and are far more efficient than gas stoves – transferring up to 90% of energy consumed to the food versus 40% in the case of gas cooking.[124]

The electricity used to power our homes is likely to continue to get cleaner over time. Nine states have set goals to achieve 100% clean electricity use in the coming years, and 22 others have renewable energy standards in place – making the environmental benefits of a transition away from gas even greater over time.[125]

Electric alternatives are safer and cleaner

Methane gas is dangerous – it's a pressurized, flammable gas burned directly in homes. Electric alternatives are inherently safer. Electric options also eliminate the danger of toxic fumes in the home.[126] Electric air-source and geothermal heat pumps have no safety concerns on the scale of explosions and fires, and are vastly more energy efficient than gas heaters.[127]

The switch from gas to electric-powered heating has become a realistic option for consumers and can protect the welfare of families as well as the environment. Public policies should encourage electrification of homes and businesses. Tax incentives for key technologies, favorable electric rate policies for electrification, and mandating the phased transition to electric heating and appliances can all help to make the transition to a cleaner, safer energy system.

Accelerate clean energy adoption instead of investing in dangerous gas

Preventing the worst impacts of global warming requires America and the world to phase out its use of fossil fuels for all purposes, including heating for our homes and businesses – a transition that will necessarily require much of the gas infrastructure that has been built around the country to be abandoned. Given that context, it makes sense for the United States not to over-invest in gas infrastructure, creating "stranded costs" that will impose economic hardship on future generations while disincentivizing the necessary switch away from gas.

Unnecessarily upgrading or expanding gas infrastructure indicates a commitment to an outdated fuel source that we must transcend. Considering the inherent dangers of gas, its track record of lost lives, destroyed homes, and environmental damage, the time to modernize to a system safer for both consumers and the environment is now.

To get there, policymakers should not only incentivize electrification of homes, businesses and equipment, but also ensure that new buildings and neighborhoods are built to run on electricity, not gas.

Focus investment in gas infrastructure on fixing leaks

When methane gas is piped thousands of miles across the country and throughout communities, is it bound to leak. Gas leaks are frequent, dangerous and costly – targeting leaks quickly is the best short-term solution to mitigate that danger and prevent environmental damage while avoiding a decades-long commitment to a fuel source that no longer serves communities' best interests.

Fixing leaks and replacing leak-prone infrastructure is the right solution. However, that repair and replacement should be focused on the lines that are the most hazardous to environmental and public health.[128] Upgrades to entire systems or expansions of those systems allow the most potent gas leaks to continue threatening public welfare and polluting our atmosphere while inflating costs for customers.

Methodology

THE ANALYSIS OF GAS LEAK INCIDENTS in this report is based on U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) *Gas Distribution, Gas Gathering, Gas Transmission, Hazardous Liquids, Liquefied Natural Gas (LNG), and Underground Natural Gas Storage (UNGS) Annual Report Data,* downloaded from https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids, 5 February 2022. Data include incidents through October 6, 2021.

PHMSA data for gas transmission, gathering and distribution system incidents was downloaded from the above website. Only incidents in which the reported product released was natural gas were included in this analysis. The data presented in this report only include gas pipeline incidents reported to the PHMSA – that is, incidents that exceed the thresholds for monetary damage, gas releases, or injuries/deaths established in federal law. See National Archives, *Title 49 Part 191 – Transportation of Natural and Other Gas by Pipeline; Annual Reports, Incident Reports, and Safety-Related Condition Reports,* archived at http://web.archive.org/web/20211118023046/https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-D/part-191, 3 March 2021.

A small number of incidents in the PHMSA dataset include comments in the narrative description indicating that the reporting party did not believe that the incident met PHMSA reporting criteria. Those statements could not be verified and, as a result, those records were included in the totals presented in this analysis, as were 113 incidents in which no quantity of gas was reported as released or the amount reported released was zero. A review of the narrative description of these incidents indicates that a significant number of these incidents did in fact involve the release of gas, though in unspecified amounts.

Note that PHMSA data only include incidents related to the gas transmission and distribution system. Leaks and explosions that occur in other contexts may not be reflected in the data included in this report.

The term "methane gas" is used throughout this report as equivalent to "natural gas," though small amounts of non-methane gases are typically present in natural gas.

Cost estimates are presented in nominal dollars, not adjusted for inflation.

Appendix

TABLE A-1: IMPACT OF GAS PIPELINE LEAKS REPORTED TO PHMSA, JANUARY 2010 TO OCTOBER 2021[129]

State	Incidents	Incidents with gas ignition	Incidents with explosions	Fatalities	Injuries	Volume of gas released (thousand cubic feet)	Total cost
Alabama	35	18	7	2	9	324,906	$14,852,265
Alaska	13	7	1	0	0	64,148	$12,374,275
Arizona	27	8	4	2	9	525,638	$28,158,820
Arkansas	55	13	2	1	4	433,937	$20,469,690
California	229	92	24	20	89	1,800,755	$973,006,578
Colorado	54	20	15	2	13	978,320	$15,428,722
Connecticut	7	3	1	1	0	7,060	$1,754,925
Delaware	3	2	0	0	0	121	$185,257
District Of Columbia	3	2	0	0	1	20	$367,559
Florida	37	13	3	2	6	478,484	$14,597,858
Georgia	59	25	6	2	10	499,995	$30,179,454
Hawaii	1	0	0	0	0	850	$172,747
Idaho	16	2	1	0	0	107,297	$2,511,264
Illinois	64	36	18	6	27	402,299	$46,222,168
Indiana	42	20	9	1	14	233,341	$28,445,480
Iowa	38	11	4	0	6	701,554	$7,408,207
Kansas	53	17	4	2	9	641,189	$9,655,968
Kentucky	46	15	8	2	13	858,223	$40,914,151
Louisiana	183	22	4	4	14	2,047,274	$69,674,270
Maine	1	0	0	0	0	19,499	$64,971
Maryland	32	17	5	3	7	48,321	$16,097,965
Massachusetts	34	24	9	3	45	85,913	$1,598,794,388
Michigan	141	53	23	9	32	1,106,270	$86,172,301
Minnesota	53	25	6	2	3	349,730	$59,064,686
Mississippi	54	12	4	0	3	841,795	$13,168,919
Missouri	49	14	6	1	6	667,452	$35,375,055
Montana	13	6	6	1	4	454,952	$6,189,558

TABLE A-1: IMPACT OF GAS LEAKS REPORTED TO PHMSA, JANUARY 2010 TO OCTOBER 2021[129]

State	Incidents	Incidents with gas ignition	Incidents with explosions	Fatalities	Injuries	Volume of gas released (thousand cubic feet)	Total cost
Nebraska	36	15	5	3	7	222,881	$11,612,910
Nevada	25	6	2	0	0	28,092	$3,022,737
New Hampshire	1	1	0	0	0	1	$158,014
New Jersey	33	24	11	1	20	64,759	$24,338,374
New Mexico	34	13	5	1	3	453,344	$6,091,840
New York	119	58	26	11	76	202,005	$27,274,458
North Carolina	32	12	2	2	9	89,302	$49,378,702
North Dakota	14	2	1	1	0	145,540	$1,501,697
Ohio	99	43	22	4	29	1,054,452	$82,736,505
Oklahoma	95	18	6	2	13	1,229,576	$20,323,964
Oregon	5	3	1	0	2	822	$15,808,529
Pennsylvania	89	26	17	11	22	969,722	$56,879,687
Rhode Island	5	2	1	0	0	21,362	$1,331,219
South Carolina	13	4	0	0	2	56,063	$2,018,326
South Dakota	6	4	2	0	1	36,364	$890,047
Tennessee	48	19	6	2	13	492,459	$8,233,009
Texas	287	68	33	14	58	4,409,305	$116,580,634
Utah	14	6	2	0	0	134,724	$5,513,557
Vermont	0	0	0	0	0	-	-
Virginia	30	12	4	0	13	109,390	$8,023,714
Washington	34	11	3	0	8	186,087	$10,391,210
West Virginia	42	12	5	3	2	557,142	$31,244,920
Wisconsin	15	5	2	1	1	171,749	$22,464,054
Wyoming	18	6	1	0	0	405,134	$9,030,996
Federal waters	162	3	1	0	0	1,888,909	$212,853,735
Total	**2598**	**850**	**328**	**122**	**603**	**26,608,528**	**$3,859,010,339**

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