America Pays for Gas Leaks

Natural Gas Pipeline Leaks Cost Consumers Billions

A report prepared for Sen. Edward J. Markey

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American consumers are paying billions of dollars for natural gas that never reaches their homes, but instead leaks from aging distribution pipelines, contributing to climate change, threatening public health, and sometimes causing explosions. This staff report, which was prepared at the request of Sen. Edward J. Markey (D-MA),[1] draws on data from a variety of sources to assess the impact of leaks and other "lost and unaccounted for" natural gas, using Massachusetts as a case study.

Gas distribution companies in 2011 reported releasing 69 billion cubic feet of natural gas to the atmosphere, almost enough to meet the state of Maine's gas needs for a year and equal to the annual carbon dioxide emissions of about six million automobiles.[2] Nonetheless, last year these companies replaced just 3 percent of their distribution mains made of cast iron or bare steel,[3] which leak 18 times more gas than plastic pipes and 57 times more gas than protected steel.[4] Gas companies have little incentive to replace these leaky pipes, which span about 91,000 miles across 46 states, because they are able to pass along the cost of lost gas to consumers. Nationally, consumers paid at least $20 billion from 2000-2011 for gas that was unaccounted for and never used, according to analysis performed for this report.[5]

Natural gas has been touted as a cleaner alternative to coal for producing electricity, but its environmental benefits cannot be fully realized so long as distribution pipelines are leaking such enormous quantities of gas, which is primarily comprised of methane, a greenhouse gas that is at least 21 times more potent than carbon dioxide.[6] Americans also remain at risk from gas explosions and other safety hazards caused by leaky natural gas pipelines. From 2002 to 2012, almost 800 significant incidents on gas distribution pipelines, including several hundred

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[1] The House Natural Resources Committee Democratic staff prepared the report at the request of Sen. Markey when he was serving as the senior ranking Democrat on the committee and Senator Markey's staff completed work on the report prior to its issuance.

[2] U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011,"April 12, 2013, available at http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf. Maine gas consumption levels are based on data reported to the Energy Information Administration (EIA), available at http://www.eia.gov/naturalgas/annual/pdf/nga11.pdf.

[3] Distribution mains are a common gas source for multiple customers. Individual customers receive gas via service lines. In 2012, gas companies replaced 12 percent of their leak-prone service lines, according to PHMSA data.

[4] This calculation is based on an average of the emissions factors for cast iron and bare steel pipelines assigned by the U.S. Environmental Protection Agency in 40 CFR Part 98, Subpart W, available at http://www.gpo.gov/fdsys/pkg/FR-2011-12-23/pdf/2011-31532.pdf.

[5] Based on unaccounted for gas reported to EIA, multiplied by the average city gate price, and adjusted for inflation. An EIA official recommended we use the average city gate price because it reflects the price the distribution company paid for the gas from the transmission company.

[6] Conservation Law Foundation, "Into Thin Air: How Leaking Natural Gas Infrastructure is Harming our Environment and Wasting a Valuable Resource," available at: http://www.clf.org/static/natural-gas-leaks/WhitePaper_Final_lowres.pdf.

explosions,[7] killed 116 people, injured 465 others, and caused more than $800 million in property damage.

Table 1: U.S. Unaccounted for Gas, Emissions, and Significant Incidents on Natural Gas Systems

Total U.S. Unaccounted for Gas from Natural Gas Systems from 2000-2011[a]	2.6 trillion cubic feet of natural gas
Total U.S. Reported Emissions from Natural Gas Distribution Systems from 2010 - 2011[b]	Equivalent to releasing 56.2 million metric tons of CO_2
Significant Incidents on U.S. Natural Gas Distribution Systems from 2002-2012[c]	796 incidents / 116 fatalities / 465 injuries / $810,677,757 in property damage

[a] Source: EIA, Form 176. Includes unaccounted for gas from transmission companies and distribution companies.
[b] Source: EPA, U.S. Greenhouse Gas Inventory of Sources and Sinks, 1990-2011, available at: http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf
[c] Source: PHMSA, available at: http://primis.phmsa.dot.gov/comm/reports/safety/SigPSI.html?nocache=1229

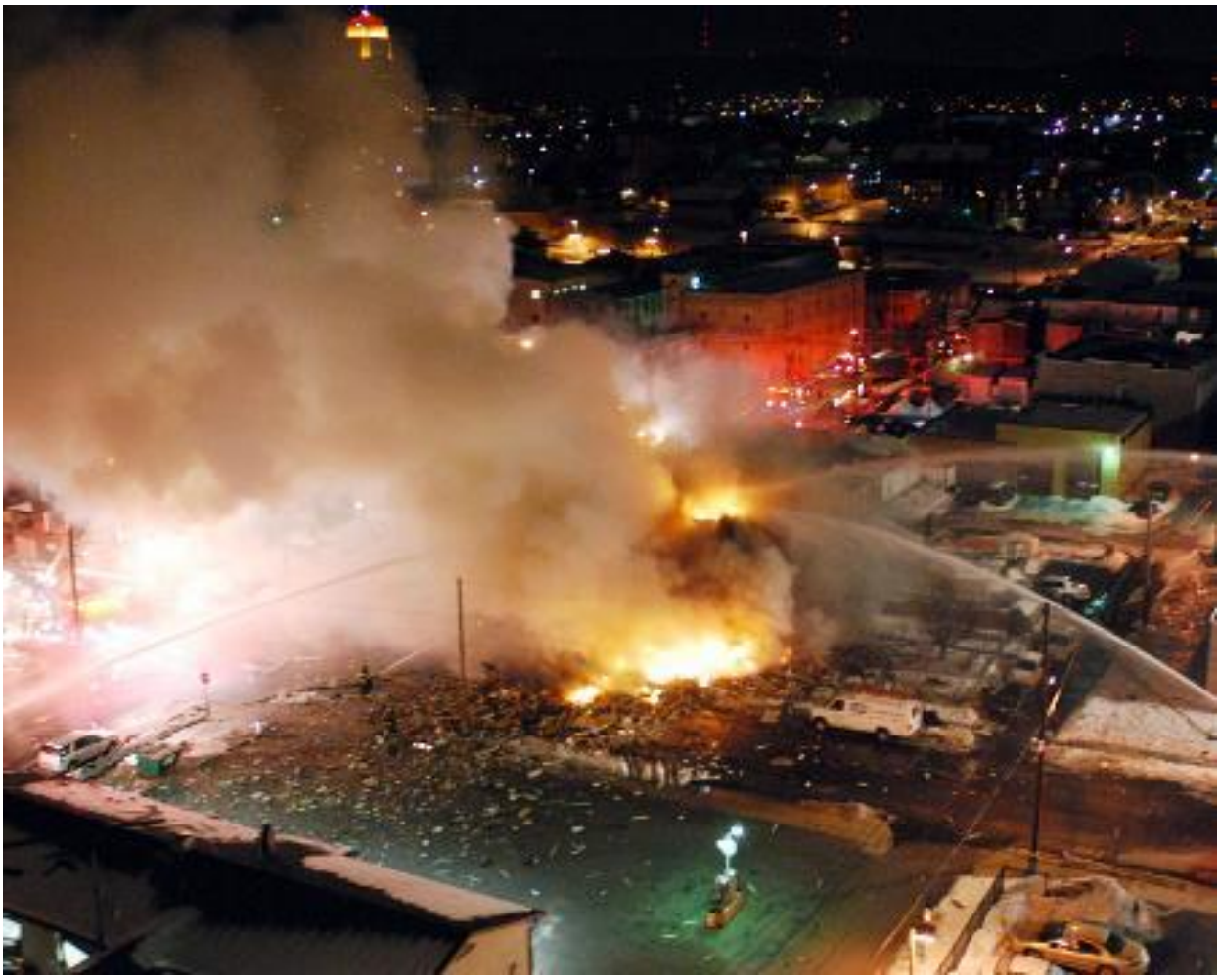
Gov. Deval Patrick's administration has started to address this problem in Massachusetts, which is a nationally recognized leader among states in energy efficiency[8] and reducing greenhouse gas emissions.[9] In particular, the commonwealth's Department of Public Utilities (DPU) recently launched incentive programs to encourage gas companies to replace leak-prone pipelines and operate more efficiently. The incentive programs are needed because gas companies in Massachusetts own and operate one of America's oldest natural gas pipeline distribution systems, ranking sixth among state systems in the number of miles of main distribution pipelines made of cast iron or bare steel.[10] These companies have replaced less than 4 percent of their leak-prone pipes per year while billing Massachusetts ratepayers an estimated $640 million to $1.5 billion from 2000-2011 for unaccounted for gas (see Table 3 on page 7).

The problem of leaky gas pipelines may be even worse than the data presented in this report suggests. Indeed, companies frequently report negative volumes of unaccounted for gas to various agencies—even though it's physically impossible to dispose of more gas than enters a closed system.[11] Federal and state regulators explained in interviews for this report that there isn't a consistent methodology for calculating lost and unaccounted for gas, and data quality problems are common. The Massachusetts DPU has responded by requesting additional funds in its 2014 budget to hire a third-party consultant to review companies' procedures for classifying leaks and calculating lost and unaccounted for gas.[12]

[7] There were 257 explosions from Mar. 2004 - Dec. 2012, according to data from PHMSA. PHMSA data before Feb. 2004 does not indicate whether significant incidents involved explosions. There were 191 significant incidents from Jan 2002- Feb. 2004.
[8] Massachusetts was the top-ranked state according to The American Council for an Energy Efficient Economy's 2012 State Energy Efficiency Scorecard, available at http://aceee.org/research-report/e12c.
[9] For example, Massachusetts is part of the Regional Greenhouse Gas Initiative—the first mandatory cap and trade emissions program in the United States.
[10] In 2012, Massachusetts had 5,482 miles of leak-prone mains and 194,326 leak-prone service lines, according to PHMSA data.
[11] Commonwealth of Pennsylvania Bureau of Investigation and Bureau of Audits, 2012 "Unaccounted-for-Gas in the Commonwealth of Pennsylvania," February 2012, available at http://www.puc.state.pa.us/transport/gassafe/pdf/UFG_Report_Feb2012.pdf.
[12] Statement of Richard K. Sullivan, Massachusetts Secretary of Energy and Environmental Affairs, before the Joint Committee on Telecommunications, Utilities and Energy, June 11, 2013.

Last year, 24.5 trillion cubic feet of natural gas was produced in the United States, up 4 trillion cubic feet since 2007. [13] Sales of natural gas from federal lands were about 18 percent (4.3 tcf) of total U.S. sales in fiscal year 2012, including 3 trillion cubic feet produced onshore and 1.3 trillion cubic feet produced offshore.[14] Additionally, about 28 percent (85 tcf of 305 tcf) of U.S. proved reserves of dry natural gas are located on federal lands.[15] Fixing leaky pipelines is important in making sure these newly abundant natural gas resources are put to responsible use and fully benefit the American people.

To address the problems identified in this report, Sen. Markey is drafting legislation that will push states and non-regulated utilities to accelerate replacement of high-risk, leaky pipelines and curtail the practice of passing along the costs of lost gas to consumers. The following section of the report uses Massachusetts as a case study to show why this legislation is necessary.



Crews work to extinguish a fire following a gas explosion in Allentown, Penn., in February 2011.

[13] Congressional Research Service, "U.S. Crude Oil and Natural Gas Production in Federal and Non-Federal Areas," March 7, 2013, available at http://www.fas.org/sgp/crs/misc/R42432.pdf.
[14] U.S. EIA, "Sales of Fossil Fuels Produced from Federal and Indian Lands, FY 2003 through FY 2012", May 2013, available at http://www.eia.gov/analysis/requests/federallands/pdf/eia-federallandsales.pdf.
[15] *Ibid,* 13.

The price of leaked gas

By not replacing leaking pipelines, gas companies nationwide are charging ratepayers for gas that never reaches homes and is contributing to climate change, endangering public health,[16] and risking explosions and other safety hazards. The problem is particularly acute in Massachusetts because of the advanced age of the commonwealth's distribution system. Specifically, the data show:

- **Massachusetts ratepayers paid between $640 million to $1.5 billion from 2000-2011 for gas that never reached their homes and businesses.** At least 99 billion cubic feet of natural gas was "lost and unaccounted for" in Massachusetts from 2000-2011, according to data reported by utilities to the Massachusetts Department of Public Utilities (DPU). The cost of this unaccounted for gas—$640 million to $1.5 billion, according to calculations performed for this report[17]—was passed on to the commonwealth's approximately 1.5 million residential, commercial and other customers (see Table 3 on page 7).[18]

  Three companies, Boston Gas, Colonial Gas, and Nstar Gas, accounted for 80 percent of these passed-on costs from 2000-2011. As a group, Boston Gas customers paid the most, covering an estimated $352 to $781 million in unaccounted for gas costs, followed by Nstar Gas customers at $109 to $229 million, and Colonial Gas customers at $92 to $221 million. On a per customer basis, Westfield Gas & Electric customers paid the most (about $304 to $2,426 per customer) because of the company's small customer base relative to its unaccounted for gas levels. Boston Gas, New England Gas, Nstar Gas and Essex Gas customers each paid over $370 to $875 on average in lost and unaccounted for gas costs from 2000-2011.

Table 2: Massachusetts Unaccounted for Gas, Emissions, and Significant Incidents on Natural Gas Systems

Total Unaccounted for Gas from Massachusetts Natural Gas Distribution Systems from 2000-2011[a]	99 - 227 billion cubic feet of natural gas
Total Reported Emissions from Massachusetts Natural Gas Distribution Systems from 2010 - 2011[b]	Equivalent to releasing between about 1 million and 1.3 million metric tons of CO_2
Significant Incidents on Massachusetts Natural Gas Distribution Systems from 2002-2012[c]	23 incidents / 24 injuries / $9,492,677 in property damage

[a] Source: Staff analysis of DPU Annual Reports. See notes under Table 3 on page 7 for our methodology. This value may not align with the national value provided in Table 1, because how companies calculate and report unaccounted for gas varies across states and agencies (see Table 7 on page 17).
[b] Source: Staff analysis of EIA data, Massachusetts Department of Environmental Protection (DEP) data, and U.S. Environmental Protection Agency emissions data, summarized in Table 4 on page 13. Unit conversions were performed using EPA's methane conversion tool at: http://www.epa.gov/cmop/resources/converter.html.
[c] Source: PHMSA data, summarized in Table 5 on page 14.

[16] West, J.J. et al., 2006. "Global Health Benefits of Mitigating Ozone Pollution with Methane Emissions Controls," *Proceedings of the National Academy of Sciences, vol.* 103, no. 11, available at http://www.pnas.org/content/103/11/3988.full.
[17] See the notes under Table 3 on page 7 for information on our methodology.
[18] The average number of customers as reported to the U.S. Energy Information Administration (EIA) for 2000-2011. The number of customers reported to EIA in 2011 was about 1.4 million.

- **Lost natural gas accounts for at least 45 percent of Massachusetts' methane emissions for large, stationary facilities.**[19] Utilities serving Massachusetts reported releasing between 1.1 and 1.4 billion cubic feet of gas into the atmosphere in 2011, accounting for between 45 and 58 percent of the commonwealth's methane emissions for large, stationary facilities, as reported to the Massachusetts Greenhouse Gas Registry (see Table 4 on page 13).[20]

  The three companies reporting the greatest emissions (Boston Gas, Nstar Gas, and Columbia Gas) were also the three companies that had the most leak-prone pipes in their distribution systems, as of 2012 (see Table 4 on page 13 and Table 6 on page 16). In addition, researchers from Boston University and Duke University recently measured methane levels over 785 miles of Boston roads and found 3,356 leaks likely due to natural gas distribution pipelines.[21]

  State law requires Massachusetts to reduce greenhouse gas emissions to 25 percent below 1990 levels by 2020.[22] Addressing gas leaks is especially important in meeting this goal because methane is such a potent heat-trapping gas, with at least 21 times the warming potential of carbon dioxide over a 100-year time horizon and as much as 72 times the warming potential over a 20-year horizon.[23] By 2010, Massachusetts had already succeeded in reducing methane emissions from the natural gas distribution system by 14 percent below 1990 levels.[24]

  However, greater reductions are still possible by accelerating replacement of leaky pipes. Natural gas companies could reduce their emissions in Massachusetts to 25 percent below 1990 levels by replacing about 777 miles of cast iron mains (the most leak-prone pipe material), according to staff calculations.[25]

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[19] Calculation is based on data reported for large, stationary facilities during 2011 as part of the Greenhouse Gas Registry, and is available at http://www.mass.gov/eea/docs/dep/air/climate/11facghg.pdf. These facilities represent one quarter of Massachusetts' total emissions inventory. The most recent year for data from Massachusetts' total emissions inventory is 2010. In 2010, distribution systems accounted for about 33 percent of total methane emissions, available at http://www.mass.gov/eea/docs/dep/air/climate/ghginv9012.xls.

[20] Companies reported different amounts of methane lost or emitted per year to different agencies—largely due to differences in reporting methodologies. EIA does not require companies to follow a specific methodology for calculating natural gas losses, and in some cases, there is a substantial difference between the numbers reported to EIA and those reported to DEP and EPA.

[21] Nathan G. Phillips et al., 2013, "Mapping urban pipeline leaks: Methane leaks across Boston," *Environmental Pollution*, vol. 173, available at http://www.sciencedirect.com/science/article/pii/S0269749112004800.

[22] The Global Warming Solutions Act of 2008.

[23] According to the EPA, methane has a global warming potential of 21 for a hundred-year time horizon, compared to carbon dioxide's global warming potential of 1. The International Panel on Climate Change (IPCC) and individual studies have assigned a higher global warming potential of 25 and 33 for hundred-year time horizons, respectively. For more information, see http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html.

[24] Calculation is based on 2010 emissions levels reported in the Greenhouse Gas Inventory, http://www.mass.gov/eea/docs/dep/air/climate/ghginv9012.xls.

[25] Calculation is based on the 1990 emissions levels for the natural gas distribution system in the Massachusetts Greenhouse Gas Inventory, the emissions reductions reported as of 2010 in the Greenhouse Gas Inventory in 2010 and EPA's emission rate for cast iron pipelines in 40 CFR Part 98, Subpart W.

Nationwide, the natural gas distribution system is the largest source of methane emissions, accounting for 19 percent of total emissions in 2011, according to the U.S. Environmental Protection Agency (EPA). EPA also found that recent reductions in U.S. methane emissions have been driven in part by replacing leak-prone pipelines in distribution systems.[26]

- **More significant pipeline incidents in Massachusetts involved cast iron or other high-risk pipes.** Incidents are four times more likely to occur on cast iron mains than mains made of other materials, according to an analysis of national pipeline incidents by the U.S Pipeline and Hazardous Materials Safety Administration (PHMSA).[27]

  In Massachusetts, 57 percent of the significant incidents[28] from 2002-2012—attributable to human error, leaks, natural forces, excavation damage, and a variety of other causes—occurred around segments of the distribution system utilizing cast iron or steel pipe (see Table 5 on page 14). One of these incidents, a gas explosion in July 2002 involving a corroded fitting on a steel pipe, leveled a home and killed two children in Hopkinton, Mass. Another powerful explosion occurred in Springfield, Mass., last November, as a result of human error after a worker from Columbia Gas of Massachusetts accidently punctured a steel service line, which had been retrofitted with plastic, while responding to a call about a gas leak. The incident resulted in injuries to 17 people and $1.3 million in property damage, according PHMSA data.

  Nationally, a number of recent killer pipeline explosions have been traced to aging, cast iron pipelines,[29] including explosions in Austin, Texas, Philadelphia, and Allentown, Penn., where a gas main explosion in February 2011 resulted in five fatalities, three hospitalizations, and eight destroyed homes (see photo on page 3). Some of these accidents might have been prevented had gas companies performed timelier repair, rehabilitation and replacement of high-risk pipeline, such as cast iron and unprotected bare steel pipes, according to PHMSA.[30] PHMSA warns that "public safety requires prompt action [by gas companies] to repair, remediate, and replace high-risk gas pipeline infrastructure."

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[26] EPA, 2013 "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011", available at http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf. The EPA Inspector General is currently reviewing what actions can be taken to reduce methane leaks from pipelines, according to the *Wall Street Journal*, available at http://online.wsj.com/article/AP68bfefc2d9ce4d2c95fba5214c33dc19.html.

[27] PHMSA's analysis is based on incidents reported from 2005 – 2011, available at http://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp#recent_incidents.

[28] Significant Incidents are those incidents reported by pipeline operators to PHMSA when any of the following conditions are met: 1) Fatality or injury requiring in-patient hospitalization. 2) $50,000 or more in total costs, measured in 1984 dollars. 3) Highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more. 4) Liquid releases resulting in an unintentional fire or explosion.

[29] See http://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp#recent_incidents.

[30] United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration, 2011, "White Paper on State Pipeline Infrastructure Replacement Programs," December, 2011. available at: http://opsweb.phmsa.dot.gov/pipelineforum/docs/PHMSA%20111011-002%20NARUC.pdf.

Table 3: Unaccounted for Gas Volumes and Estimated Cost by Company, 2000-2011, in 2012 dollars

	Lower Bound[a]			Upper Bound[b]		
Company	Unaccounted for Gas Volume (mcf)	Estimated Cost of Gas, 2000-2011	Average Cost of Gas per Customer, 2000-2011	Unaccounted for Gas Volume (mcf)	Estimated Cost of Gas, 2000-2011	Average Cost of Gas per Customer, 2000-2011
Berkshire Gas	521,363	$3,327,089	$96	4,985,339	$34,508,094	$998
Blackstone Gas	19,013	$82,400	$63	72,138	$462,469	$352
Boston Gas[c]	54,938,203	$352,164,446	$604	117,674,912	$780,832,567	$1,340
Columbia Gas[e]	6,098,769	$39,557,300	$143	17,175,142	$113,874,947	$412
Colonial Gas[c]	14,668,152	$91,740,162	$377	31,055,129	$220,658,386	$907
Essex Gas[c]	1,861,260	$12,801,477	$380	5,780,463	$43,893,343	$1,302
Fitchburg Gas & Electric[d]	908,172	$5,905,935	$211	3,592,072	$24,765,349	$886
City of Holyoke[d]	498,363	$2,914,285	$291	818,892	$4,402,208	$440
Middleborough Gas & Electric[d]	159,915	$757,985	$188	313,768	$1,663,604	$412
New England Gas	2,998,250	$19,585,719	$371	9,353,842	$64,893,441	$1,230
Nstar Gas	16,118,577	$109,076,406	$427	33,654,316	$228,538,748	$895
Wakefield Municipal Gas & Light[d]	75,498	$523,290	$88	547,872	$3,304,418	$553
Westfield Gas & Electric[d]	429,284	$1,816,422	$304	2,130,869	$14,501,210	$2,426
Total	**99,294,819**	**$640,252,916**	**$273**	**227,154,754**	**$1,536,298,783**	**$935**

Source: Staff Analysis of Massachusetts Department of Public Utilities (DPU) Annual Reports.
Notes: The transfer of gas costs onto rate payers is based on 220 CMR 6, http://opsweb.phmsa.dot.gov/pipelineforum/docs/PHMSA%20111011-002%20NARUC.pdf and http://www.aga.org/SiteCollectionDocuments/KnowledgeCenter/PGA%20Mechanisms.doc. We calculated the cost of unaccounted for gas by multiplying the reported gas volumes by the NYMEX average futures price for that month, which are commonly used in cost of gas adjustments. We adjusted costs to 2012 dollars according to PHMSA's methods for adjusting costs associated with pipeline incidents.
[a] Based on the yearly unaccounted for gas volumes reported to DPU, which include negative unaccounted for gas volumes on a monthly basis.
[b] Based on the positive monthly unaccounted for gas volumes reported to DPU, and excludes negative unaccounted for gas volumes.
[c] Owned by National Grid. Of these, Essex Gas was merged into Boston Gas in 2010.

[d] Data were not available for all the years of our analysis. For the City of Holyoke, data were missing for 2006, 2005, 2004, 2003, 2002, and 2000. For Middleborough Gas & Electric, data were missing for 2006, 2005, and 2001. For Westfield Gas & Electric, data were missing for 2006. For the City of Wakefield, data were missing for 2005, 2004, 2002, and 2001.

[e]Columbia Gas is a subsidiary of NiSource.

The slow pace of fixing leaks

There are some federal and state incentives in place to accelerate the pace of infrastructure replacement. Massachusetts is one of several forward-looking states that have either established or are considering policies that create financial incentives for gas companies to repair or replace leaky infrastructure. Despite these incentives, gas distribution companies' progress at replacing leak-prone pipeline remains slow. Specifically, the data show:

- **U.S. gas companies are replacing less than 5 percent of their leakiest pipes per year.** Cast iron and bare steel are the most leak-prone pipe materials, releasing 27.25 and 12.58 cubic feet of methane per hour, per mile, respectively, according to the EPA.[31] PHMSA also lists these materials as high-risk pipeline infrastructure that is prone to failure.[32] Nonetheless, last year gas companies nationwide replaced just 3 percent of their cast iron and bare steel distribution mains—pipes that connect transmission lines to service lines—with less leak-prone plastic pipes.[33]

  The Massachusetts gas distribution system—which is owned and operated by gas companies—ranks third among state distribution systems in the total number of miles of cast iron mains and second in the number of cast iron service lines (or "services"), which connect mains to customers. The distribution system ranks ninth and fourth in the number of miles of bare steel mains and services, respectively.[34] Gas companies operating in Massachusetts, however, replaced just 4 percent of cast iron and bare steel pipes in 2012 (see Table 6 on page 16). Of these companies, Boston Gas replaced the most miles (99) and service lines (3,277) made of cast iron and bare steel in 2012. Since 2004, Boston Gas and Columbia Gas have reduced their inventory of cast iron and bare steel pipeline the most. Boston Gas replaced 496 miles of leak-prone mains and Columbia Gas replaced 13,907 leak-prone service lines (Table 6).[35]

- **Nationwide, there are few federal or state incentives to repair or replace leaky pipes or minimize lost gas.** Federal pipeline safety regulations require only "hazardous leaks" posing imminent threat to be repaired promptly, allowing non-hazardous leaks to go unrepaired.[36] Gas companies are required to identify and classify leaks according to risk as part of their federally mandated Distribution Integrity Management Plans,[37] but only five states require all non-hazardous leaks to be repaired within a certain timeframe.[38]

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[31] 40 CFR Part 98, Subpart W, available at http://www.gpo.gov/fdsys/pkg/FR-2011-12-23/pdf/2011-31532.pdf.
[32] *Ibid*, 30.
[33] Companies may also retrofit bare steel pipelines with protective linings, which also have a lower emissions rate.
[34] The ranking is based on PHMSA's cast and wrought iron and bare steel pipeline inventory, available at: http://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp and http://opsweb.phmsa.dot.gov/pipeline_replacement/bare_steel_inventory.asp.
[35] Both of these companies participate in Massachusetts' targeted infrastructure replacement program.
[36] 49 CFR 192 Part 192.703(c). A hazardous leak represents an existing or probable hazard to people or property and requires immediate action until the conditions are no longer hazardous, according to PHMSA guidance.
[37] 49 CFR Part 192§§1005-1007.
[38] *Ibid*, 30; and National Association of Pipeline Safety Representatives, "Compendium of State Pipeline Safety Requirements & Initiatives Providing Increased Public Safety Levels compared to Code of Federal Regulations," September 30, 2011, available at: http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Pipeline/Compendium.pdf.

The Massachusetts legislature is currently considering repair timeframes for all non-hazardous leaks.[39]

Thirty-three states, including Massachusetts,[40] have infrastructure replacement programs targeting cast iron and bare steel pipelines that allow companies to recover costs for replacing their leak-prone pipelines.[41] However, companies may have little incentive to use these programs to accelerate pipeline replacement so long as they can still pass costs on to customers for lost gas.

Only two states with infrastructure replacement programs, Pennsylvania and Texas, have established limits on the amount companies can charge customers for lost gas.[42] Pennsylvania just took these actions, so the results are not in yet, but in Texas the results are dramatic. From 2010 to 2012, with four gas companies participating in infrastructure replacement programs, Texas gas companies reduced their inventory of leak-prone service lines by 55 percent (101,790 lines). In this same time period, gas companies in Massachusetts reduced their leak-prone service lines by just 4 percent (8,278 lines). Notably, the Massachusetts legislature is also considering a cap on allowable unaccounted for gas, which could provide an additional financial incentive for gas companies to repair or replace leak-prone pipes.[43]

- **It's hard to monitor company performance because data on unaccounted for gas is of such poor quality.** Companies regularly report negative volumes of unaccounted for gas, and there can be substantial variance in the numbers reported across agencies (see Table 7 on page 18). Negative unaccounted for gas volumes indicate calculating or reporting errors because it's physically impossible to dispose of more gas than enters a closed distribution system, according to a 2012 report prepared for the Pennsylvania Utility Commission.[44] This report also noted that inconsistencies in methodologies across companies can inhibit regulators' ability to monitor company performance over time.

  According to federal and state officials, companies do not use a consistent methodology to calculate unaccounted for gas. Officials from PHMSA's Office of Pipeline Safety explained in an interview for this report that the agency provides companies with a formula for calculating unaccounted for gas, as well as guidance about the types of adjustments that are appropriate to make; however, each company decides which adjustments to make and less sophisticated operators may not make basic adjustments,

[39] H. 2933, "An Act enhancing natural gas pipeline safety;" H.2950, "An Act relative to natural gas leaks;" and S. 1580, "An Act relative to natural gas leaks," available at https://malegislature.gov/Committees/Joint/J37.
[40] New England Gas, Columbia Gas, and National Grid (MA)—which includes Boston Gas, Colonial Gas, and Essex Gas (merged with Boston Gas)—all participate in Massachusetts' targeted infrastructure replacement program.
[41] Based on the states listed in *Ibid,* 30 and *Ibid,* 6.
[42] Pennsylvania capped unaccounted for gas at 3 percent, to be phased in over time, and finalized its rule in 2013, (52 PA Code §59.111). Texas capped unaccounted for gas for distribution systems at 5 percent in 2002. 16 TX Admin. Code §7.5525.
[43] See S. 1580, "An Act relative to natural gas leaks," available at https://malegislature.gov/Committees/Joint/J37.
[44] *Ibid,* 11.

such as adjusting volumes based on standard temperature pressure.[45] In Massachusetts, the Department of Public Utilities requested additional funds in its 2014 budget to hire a third-party consultant to review companies' procedures for classifying leaks and calculating lost and unaccounted for gas. [46]

Actions needed to accelerate pipeline replacement

Despite slow progress to date, some state initiatives—like those established or proposed in Massachusetts—show promise and should be expanded to accelerate the repair or replacement of leak-prone pipelines. In particular:

- **States and non-regulated utilities such as municipal gas companies should adopt cost recovery programs for accelerated replacement of high-risk, leak-prone pipelines.** Companies typically cannot recover the costs of their infrastructure investments until the utility files for and receives such approval, which can be many months—and sometimes more than a year—after costs have been incurred.[47] Cost recovery programs allow gas companies to recover the costs of infrastructure improvements on a timelier basis, which could provide more incentive for companies to replace their leaky pipelines.[48] Ratepayers and the public may also benefit from these programs through increased safety, reductions in rates from decreased operations and maintenance and unaccounted for gas costs,[49] and reduced greenhouse gas emissions, according to a recent analysis of such programs in New England.

  Taking into account widely accepted assumptions from the EPA regarding the rate of gas leaks, global warming potential and the social cost of carbon, and including costs associated with replacing pipelines, Massachusetts residents stand to realize $156 million in net benefits over 10 years from the companies participating in the commonwealth's infrastructure replacement program.[50] One of these companies, Colonial Gas, increased their annual replacement rate of leak-prone pipeline by an average of 7 percent for

[45] Examples of appropriate adjustments are temperature, pressure, heat content, meter reading cycles, calculable losses from leaks or maintenance. PHMSA's guidance is available at http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Forms/Gas%20Distr%20Annual%20Report%20Instructions%20-%20PHMSA%20F%207100.1-1%20(01-2011).pdf.
[46] *Ibid*, 12.
[47] American Gas Association, "Infrastructure Cost Recovery Mechanisms," December, 2007, available at: http://www.aga.org/SiteCollectionDocuments/RatesReg/0712INFRASREPLAC.pdf.
[48] While timelier cost recovery increases companies' incentives to replace infrastructure, it may also reduce companies' incentive to control costs, as noted in a National Regulatory Research Institute analysis, "How Regulators Should View Cost Trackers" Sept. 2009, available at http://nrri.org/pubs/gas/NRRI_cost_trackers_sept09-13.pdf.
[49] These reductions would help offset some, but not all, of the rate increase associated with replacing leak-prone infrastructure. For an example of how such a program might impact Massachusetts ratepayers, see the Attorney General's comments in the National Grid petition for targeted infrastructure cost recovery, available at http://www.env.state.ma.us/dpu/docs/gas/10-55/11310dpuord.pdf.
[50] The companies were National Grid (Boston Gas and Colonial Gas), New England Gas, and Columbia Gas. The Analysis Group, Inc. "Summary of Quantifiable Benefits and Costs Related to Select Targeted Infrastructure Replacement Programs," January, 2013, available at http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Benefits_Costs_TIRF_Jan2013.pdf.

service lines and 13 percent for main lines during its two years in the program. The other companies participating in the cost recovery program—Boston Gas, New England Gas, and Colombia Gas—have not appreciably improved their replacement rates of leak-prone pipes. This suggests that additional financial incentives, such as those currently under consideration by the Massachusetts legislature, may be needed.[51]

In 2009, Secretary of Transportation Ray LaHood called on states to adopt and expand infrastructure replacement programs. Forty-six states have leak-prone pipelines and could benefit from such programs, but so far only 33 states, including Massachusetts,[52] have answered LaHood's call to action.

- **States and non-regulated utilities should establish timeframes for repairing non-hazardous gas leaks.** Gas companies are already required by federal regulation to identify, classify, and manage safety risks posed by leaks.[53] Nonetheless, leaks that do not pose a safety risk may continue unabated. Just five states—Florida, Georgia, Kansas, Maine and Texas—have established firm timeframes for repairing all non-hazardous leaks, with timeframes ranging from 3 months to 36 months for the least hazardous leaks.[54] As noted by the Conservation Law Foundation, this program may be having an effect, as Maine had one of the lowest lost gas rates in the country, according to data from the Energy Information Administration.[55] The Massachusetts legislature is considering repair timeframes for all non-hazardous leaks.[56]

- **States and non-regulated utilities should adopt a standard definition and methodology for calculating unaccounted for gas.** Inconsistent data reported by companies inhibits regulators' ability to perform oversight, according to the Pennsylvania Public Utility Commission and others.[57] Furthermore, negative unaccounted for gas levels are indicative of calculating or reporting discrepancies, not actual gas volumes—and PHMSA does not allow companies to report negative values. To address this issue, the Pennsylvania Commission adopted a standard definition and methodology for unaccounted for gas, based in part on PHMSA's definition.[58] Other states with similar reporting issues should follow Pennsylvania's lead. Massachusetts state regulators plan to study the issue. [59]

[51] In the current legislative session, Massachusetts has at least two other innovative financing proposals for infrastructure replacement under consideration, including one—H. 2990 "An Act establishing natural gas infrastructure improvement financing"—specific to financing the repair of non-hazardous leaks.
[52] *Ibid,* 51.
[53] 49 CFR Part 192 §1007.
[54] *Ibid,* 6.
[55] *Ibid,* 6.
[56] H. 2933, "An Act enhancing natural gas pipeline safety;" H.2950, "An Act relative to natural gas leaks;" and S. 1580, "An Act relative to natural gas leaks," available at https://malegislature.gov/Committees/Joint/J37.
[57] Pennsylvania Public Utility Commission Public Meeting held June 7, 2012 Re: Proposed Rulemaking Order, Docket No. L-2012-2294746 and *Ibid,* 6.
[58] *Ibid,* 57.
[59] *Ibid,* 12.

- **States and non-regulated utilities should limit the ability of gas companies to recover costs for unaccounted for gas.** Limiting the amount of unaccounted for gas for which companies can charge would create a powerful financial incentive for gas companies to minimize emissions. As noted earlier, Pennsylvania and Texas are the only states that have set statewide caps on the percentages of gas for which companies can recover costs.[60] In both states, companies can recover costs for no more than 5 percent of the unaccounted for gas, and Pennsylvania plans to lower that to 3 percent in coming years.[61] In finalizing its plan earlier this year, the Pennsylvania Public Utility Commission stated that eliminating cost recovery for gas lost above the cap shifts the financial burden of lost gas from the ratepayer to the gas company. That approach appears to have worked in Texas, which reduced its inventory of leak-prone service lines by an impressive 55 percent over the last two years. As noted earlier, the Massachusetts legislature is considering a cap on allowable unaccounted for gas.[62]

To encourage action on these measures and build on Massachusetts' efforts, Sen. Markey is currently drafting legislation amending the Public Utilities Regulatory Policy Act of 1978.

American consumers, businesses and communities now pay for gas they don't receive and bear the risks of gas leaks they cannot repair. Gas distribution companies, on the other hand, have little reason to treat leaky pipelines as an urgent problem. They may even make money off of lost gas because they're reimbursed whether it reaches the home or not. The Markey legislation will help make sure gas companies take responsibility and fix their leaks.

[60] Pennsylvania and Texas are the only states with permanent, statewide caps in place. Other states may have temporary caps or company-specific caps in place.
[61] *Ibid,* 28.
[62] See S. 1580, "An Act relative to natural gas leaks," available at https://malegislature.gov/Committees/Joint/J37.

Appendix

Table 4: Natural Gas Losses or Emissions as reported to the U.S. Energy Information Administration (EIA), the Massachusetts Department of Environmental Protection (DEP), and the U.S. Environmental Protection Agency (EPA), 2010-2011, in thousands of cubic feet (mcf)

Company Name	2010 EIA (gas losses)	2010 DEP (emissions)	2011 EIA (gas losses)	2011 DEP (emissions)	2011 EPA (emissions)
Berkshire Gas	68,702	40,954	45,434	40,706	-
Blackstone Gas	1,016	52	4,171	-	-
Boston Gas	911,944	967,390	499,814	918,066	915,842
Colonial Gas	-	121,778	-	109,876	109,546
Columbia Gas	388,391	377,102	249,454	345,050	-
Essex Gas	40,680	-	-	-	-
Fitchburg Gas & Electric	20,049	-	13,372	-	-
City of Holyoke	-	-	-	-	-
Middleborough Gas & Electric	5,116	19,387	3,358	8,086	3,934
New England Gas	43,310	-	27,857	-	202
Nstar Gas	416,273	-	259,721	-	205,491
Wakefield Municipal Gas & Light	3,273	-	2,346	-	-
Westfield Gas & Electric	224	-	123	-	-
Total	**1,898,978**	**1,526,663**	**1,105,650**	**1,421,784**	**1,235,015**

Source: Staff analysis of EIA data as reported by gas companies on Form EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition", DEP data, downloaded from the Climate Registry at https://www.crisreport.org/web/guest/analysis-and-reports, and EPA emissions data, downloaded from http://ghgdata.epa.gov/ghgp/main.do.

Notes: Natural gas companies began reporting GHG emissions to the Massachusetts DEP in 2010 and to EPA in 2011. According to an EPA official, differences in the emission amounts reported for individual companies are due to methodological differences between the General Reporting Protocol used as part of the Climate Registry and EPA's reporting requirements. For example, the EPA official said that the General Reporting Protocol in place for 2010 did not include different emissions factors specific to the type of pipe material used in the distribution system. In 2012, DEP amended its regulations so that companies which are also required to report GHG emissions to the U.S. EPA must use the same reporting methodology when they report to DEP.

The reporting thresholds for each agency are different. According to an EIA official, all companies are required to report natural gas losses. At the state level, companies are required to report emissions to DEP if they are (a) regulated under Title V of the U.S. Clean Air Act and 310 CMR 700 Appendix C, or (b) emit more than 5,000 short tons of CO_2 equivalent. For federal GHG emissions reporting to EPA, companies are required to report if they emit more than 25,000 metric tons of GHGs annually.

Metric ton CH_4 and CO_2 equivalent values were converted to cubic feet using EPA's online methane conversion tool, available at: http://www.epa.gov/cmop/resources/converter.html.

Table 5: Significant Incidents on Massachusetts Gas Distribution Pipelines, as Reported to PHMSA, 2002-2012[a]

Date	City	Operator	Cause	Injuries	Property Damage	Type of Pipe
05/24/2002	Framingham	Nstar Gas	Excavation Damage	0	$186,437	Steel
02/13/2003	Turners Falls	Berkshire Gas	Other Cause	0	$550,330	Steel
11/21/2003	New Bedford	Nstar Gas	Other Cause	0	$391,346	No data reported
04/13/2004	Walpole	Columbia Gas	Other Cause	0	$182,281	Steel
04/06/2005	Boston	Boston Gas	Other Cause	1	$0	No data reported
11/09/2005	Lexington	Boston Gas	Other Cause	0	$1,661,938	No data reported
04/28/2006	Needham	Nstar Gas	Unknown Cause	1	$22,285	Plastic
03/08/2007	Peabody	Boston Gas	Unknown Cause	0	$110,386	No data reported
05/17/2007	Wapole	Columbia Gas	Unknown Cause	1	$27,399	Plastic
09/10/2007	Easton	Columbia Gas	Unknown Cause	2	$2,208,346	Other
01/03/2008	Maynard	Nstar Gas	Unknown Cause	0	$161,597	Steel
01/25/2009	Gloucester	Boston Gas	Unknown Cause	1	$416,505	Cast iron (likely)[c]
03/09/2009	West Barnstable	Colonial Gas	Unknown Cause	0	$364,442	Plastic
01/15/2010	Waltham	Boston Gas	Incorrect Operation	0	$510,449	Steel
01/25/2010	Reading	Boston Gas	Natural Force Damage	1	$255,224	Cast iron
01/23/2011	West Springfield	Columbia Gas	Other Cause	0	$104,409	Steel

06/24/2012	Seekonk	Columbia Gas	Other Outside Force Damage	0	$315,400	Steel
11/09/2012	Fitchburg	Fitchburg Gas & Electric Light	Excavation Damage	0	$110,000	Steel
11/23/2012	Springfield	Columbia Gas	Other Cause	17	$1,310,300	Plastic[e]
Total	**23 incidents**			**24**	**$9,492,677**	
Berkshire Gas Subtotal	**1 incident**			**0**	**$550,330**	
Boston Gas Subtotal	**8 incidents**			**3**	**$3,060,938**	
Colonial Gas Subtotal	**1 incident**			**0**	**$364,442**	
Columbia Gas Subtotal	**6 incidents**			**20**	**$4,148,135**	
Fitchburg Gas & Electric Subtotal	**1 incident**			**0**	**$110,000**	
New England Gas Subtotal	**1 incident**			**0**	**$0**	
Nstar Gas Subtotal	**5 incidents**			**1**	**$1,258,832**	

Source: PHMSA incident and accident data for gas distribution pipelines in Massachusetts. The data were accessed on June 6, 2013 at: http://primis.phmsa.dot.gov/comm/reports/safety/IncDetSt_st_MA_flt_sig.html. Data on the pipeline materials were collected from PHMSA's Flagged Incident files for May 31, 2013, accessed at http://primis.phmsa.dot.gov/comm/reports/safety/SIDA.html?nocache=1646.

[a] Significant Incidents are those incidents reported by pipeline operators to PHMSA when any of the following conditions are met: 1) Fatality or injury requiring in-patient hospitalization. 2) $50,000 or more in total costs, measured in 1984 dollars. 3) Highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more. 4) Liquid releases resulting in an unintentional fire or explosion.

[b] Property damage is estimated as the sum of all public and private costs reported in the 30-day incident report. The costs for incidents prior to 2012 are presented in 2012 dollars. Cost of Gas lost is indexed via the Energy Information Administration, Natural Gas City Gate Prices. All other costs are adjusted via the Bureau of Economic Analysis, Government Printing Office inflation values.

[c] The company did not officially report the type of pipeline material involved, however the wrongful death lawsuit filed by the parents of the victims implicated a corroded metal fitting as the source of the gas leak that led to the fatal explosion.

[d] The company did not officially report the type of pipeline material involved, however the incident report indicated that a piece of cast iron pipeline was identified at the incident scene.

[e] The company reported that the pipeline material was plastic. DPU officials clarified that the plastic pipeline had been inserted into an existing steel pipeline.

Table 6: Replacement rates for leak-prone pipeline in Massachusetts, by company, 2004-2012

Company Name	Leak-prone Pipeline Replaced Since 2004	Replacement rate 2005	2006	2007	2008	2009	2010	2011	2012	Leak-prone Pipeline Remaining in 2012
Berkshire Gas - Main Miles	23	-2%	-73%	251%	-2%	-2%	-2%	-3%	-4%	115
Berkshire Gas - Service Lines	1,088	-3%	-3%	-3%	-2%	-2%	-4%	-2%	-5%	3,864
Blackstone Gas - Main Miles	2	0%	0%	0%	0%	0%	0%	100%	0%	0
Blackstone Gas - Service Lines	0	0%	0%	0%	0%	0%	0%	0%	0%	0
Boston Gas - Main Miles[a,b]	496	-1%	-2%	-1%	-1%	-2%	-3%	-2%	-3%	2,997
Boston Gas - Service Lines[a,b]	6,609	-2%	13%	-1%	-2%	-3%	-5%	-3%	-3%	90,523
Colonial Gas - Main Miles[a,b]	189	-1%	-2%	-2%	-3%	-3%	-5%	-19%	-17%	253
Colonial Gas - Service Lines[a,b]	1,078	26%	1%	-6%	-8%	-6%	-3%	-10%	-10%	4,466
Columbia Gas - Main Miles[b,c]	344	-5%	-5%	-4%	-4%	-3%	-2%	-4%	-4%	979
Columbia Gas - Service Lines[b,c]	13,907	-3%	-4%	-3%	-3%	-3%	-3%	-3%	-4%	46,622
Essex Gas - Main Miles[a,b]	23	-2%	-4%	-1%	-1%	-3%	-6%	1%	-3%	111
Essex Gas - Service Lines[a,b]	533	-1%	4%	-2%	-2%	-3%	-2%	-3%	-3%	4,433
Fitchburg Gas & Electric - Main Miles[b]	21	-83%	433%	-3%	-3%	-3%	-3%	-3%	-4%	66
Fitchburg Gas & Electric - Service Lines[b]	-490	-6%	-14%	-8%	-9%	-8%	119%	-6%	-8%	3,379
City of Holyoke Main Miles	6	0%	-2%	0%	-3%	-3%	0%	-2%	0%	58
City of Holyoke Service Lines	1,127	-2%	-4%	-2%	-2%	-5%	-3%	-7%	-10%	2,557

Middleborough Gas & Electric Main Miles	5	-1%	-90%	795%	0%	0%	0%	-17%	-7%	11
Middleborough Gas & Electric Service Lines	86	-7%	-3%	-9%	-5%	-3%	-3%	-3%	-10%	149
New England Gas Main Miles[b]	17	-1%	-1%	-1%	-2%	-3%	-3%	8%	-4%	185
New England Gas Service Lines[b]	-5,637	-2%	-5%	-2%	-11%	-13%	-19%	448%	-5%	8,813
Nstar Gas Main Miles	145	-3%	-2%	-2%	-2%	-3%	-2%	-3%	-3%	716
Nstar Gas Service Lines	9,303	-2%	-4%	-2%	-3%	-4%	-4%	-4%	-5%	26,514
Wakefield Municipal Gas & Light Main Miles	11	-1%	-3%	-4%	-1%	-1%	-9%	-4%	-3%	37
Wakefield Municipal Gas & Light Service Lines	529	0%	-4%	-4%	-1%	-4%	-7%	-8%	-2%	1,463
Westfield Gas & Electric Main Miles	15	-4%	-2%	-2%	-2%	-5%	-4%	-1%	-10%	42
Westfield Gas & Electric Service Lines	493	14%	-7%	-6%	-8%	-6%	-4%	-4%	-5%	1,543
Massachusetts - Main Miles	1,293	-3%	-3%	0%	-2%	-2%	-3%	-3%	-4%	5,571
Massachusetts - Service Lines	28,419	-2%	-4%	-2%	-3%	-4%	-3%	0%	-4%	194,326
National- Main Miles	20,944	-5%	-3%	-3%	-2%	-4%	3%	-4%	-3%	93,705
National- Services	2,036,032	-10%	4%	-2%	-2%	-4%	-35%	-4%	-12%	2,568,279

Source: Staff analysis of PHMSA's Cast and Wrought Iron and Bare Steel Pipeline Inventory, available at: http://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp and http://opsweb.phmsa.dot.gov/pipeline_replacement/bare_steel_inventory.asp respectively.

Notes: According to PHMSA officials, changes in replacement rates are generally due to three factors: (1) pipeline replacement, (2) acquisition of or selling off part of a distribution pipeline, or (3) changes in pipeline classification due to updated information or recordkeeping.

[a] Owned by National Grid. Essex Gas was merged into Boston Gas in 2010.

[b] Participating in Massachusetts' Targeted Infrastructure Replacement Program. Fitchburg Gas & Electric applied in 2011.

[c]Columbia Gas is a subsidiary of NiSource.

Table 7: Unaccounted For Gas as reported to the U.S. Energy Information Administration (EIA), the Massachusetts Department of Public Utilities (DPU), and the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), 2000-2011, in thousands of cubic feet (mcf).

	Berkshire Gas			Blackstone Gas			Boston Gas		
Year	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**
2000[b]	120,978	9,099[b]	168,984	(15,162)	7,534[b]	(15,162)	426,214	440,510[b]	11,075,967
2001	(154,150)	109,702	(77,929)	2,663	3,172	3,198	(484,330)	2,298,696[e]	(4,122,104)
2002	(30,005)	72,381	38,868	-[c]	0	1,353	3,914,559	1,825,298[e]	3,430,856
2003	102,524	15,179	59,821	(9,910)	0	(10,257)	(7,548,200)	1,899,037[e]	2,348,739
2004	130,896	23,282	84,457	-[c]	0	3,126	349,109	1,085,110	7,530,492
2005	(55,099)	6,702	(19,904)	(1,048)	1,359	(1,048)	(7,309,864)	1,506,820[e]	2,854,048
2006	(4,341)	14,205	(54,000)	1,502	1,508	1,502	(33,818)	1,582,028	3,466,829
2007	4,608	80	73,152	258	245[d]	258	1,745,671	1,925,199	5,621,285
2008	(4,600)	0	39,820	424	42	1,117	4,753,488	1,148,131	4,398,551
2009	93,290	0	56,261	3,666	3,674	3,666	4,389,219	1,361,536	4,301,979
2010	(124,956)	0	(34,102)	(395)	612[e]	621	4,853,998	1,628,005	6,006,689
2011	(204,783)	0	(122,974)	-[c]	4,408 [d]	4,172	1,209,084	3,056,038[e]	3,902,768

	Colonial Gas			Columbia Gas			Essex Gas		
Year	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**
2000	4,156,770	261,174[b]	3,345,846	560,631	654,861[b]	383,435	448,976	39,116[b]	299,459
2001	1,547,492	818,573	1,617,123	748,841	0	(299,313)	531,639	150,556	506,173
2002	1,017,066	646,801	1,056,732	(1,828,316)	171,874	(95,467)	138,544	210,175	145,516
2003	(2,012,982)	224,138	167,355	846,681	526,380	967,263	397,023	29,213	(7,006)
2004	3,661,867	196,647	339,082	432,808	500,806	435,819	-[c]	82,640	224,803
2005	(1,665,602)	460,716	1,378,995	141,385	350,591	168,940	-[c]	193,763	288,613
2006	444,983	455,120	847,750	495,274	472,090	505,677	61,068	134,072	102,530
2007	(2,810,835)	962,352[e]	1,160,167	422,819	239,207	431,702	(873,400)	15,633	178,873
2008	1,757,733	505,349	1,105,796	897,251	889,654	906,609	589,382	0	105,165
2009	3,803,689	509,276	2,109,285	914,520	775,345	951,102	(65,256)	0	10,128
2010	2,660,178	459,805	1,268,962	(366,512)	889,321	803,978	(70,192)	0	(37,516)
2011	(116,205)	630,792	271,059	273,855	730,366	544,244	-[c]	-[c]	-[c]

	Fitchburg Gas & Electric			New England Gas			Nstar Gas		
Year	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**
2000	64,340	20,136[b]	252,875	602,683	336,194[b]	539,117	(156,442)	478,056[b]	729,716
2001	(5,504)	26,660	(117,568)	31,703	1,073,304	51,776	800,345	983,195	2,404,231
2002	40,314	86,104	162,540	349,369	287,360	430,622	991,910	559,799[e]	817,956
2003	3,790	2,970	(184,846)	(1,646,155)	286,070	285,346	1,074,279	412,850	1,287,457
2004	4,690	2,572	(8,587)	(1,995,970)	242,633	365,839	1,604,333	1,044,258	1,733,842
2005	779	18,131	136,487	(455,114)	305,275	204,480	2,597,673	919,919	1,734,586
2006	2,334	40,719	190,397	(1,061,367)	228,572	183,237	3,875,109	723,353	1,244,381
2007	(4,014)	(16,227)	42,842	(641,455)	284,468	448,312	3,161,389	971,746[e]	1,734,530
2008	75,480	32,584	4,254	(1,010,077)	210,260	133,218	5,480,650	868,733[e]	1,392,017
2009	(302,429)	20,325	118,777	(874,917)	198,355	329,704	4,880,295	821,512[e]	1,130,819
2010	63,964	15,283	(68,348)	(1,355,813)	140,535	26,599	5,467,124	591,043[e]	1,057,108
2011	(20,415)	4,581	(42,142)	(1,477,340)	116,679	(4,163)	1,971,460	584,880[e]	851,934

	City of Holyoke			Middleborough Gas and Electric			Wakefield Municipal Gas & Light Department		
Year	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**	**EIA**	**PHMSA[a]**	**MA DPU**
2000	26,252	11,076[b]	-[c]	9,604	5,546[b]	9,604	372	4,180[b]	(1,547)
2001	404	-[c]	403	5,368	1,615[b]	-[c]	12,604	4,683[b]	-[c]
2002	65,469	26,759[b]	-[c]	33,798	18,404[b]	29,723	12,284	-[c]	-[c]
2003	88,471	-[c]	-[c]	26,219	27,329	22,617	14,615	7,837[b, d]	12,494
2004	100,409	-[c]	-[c]	22,558	21,316[d]	23,289	18,345	6,345[b]	-[c]
2005	-[c]	-[c]	-[c]	7,846	3,256[b]	-[c]	28,796	-[c]	-[c]
2006	39,185	-[c]	-[c]	(1,663)	-[c]	-[c]	10,968	10,761[b]	9,386
2007	92,669	6,076[b]	90,666	52,692	4,053[b]	(9,606)	14,711	8,536[d]	9,904
2008	92,041	63,800	84,155	(2,070)	8,871	10,232	50,687	14,413[e]	21,041
2009	(49,658)	161,684	163,870	28,763	36,704[d]	36,653	18,270	9,905	19,877
2010	46,100	74,063	103,923	22,072	20,813[d]	20,256	15,752	17,709	1,398
2011	51,876	103,358	55,346	4,381	8,515	7,541	16,857	17,697	1,398

Westfield Municipal Gas & Light Department			
Year	**EIA**	**PHMSA[a]**	**MA DPU**
2000	34,191	39,246[b]	98,687
2001	7,404	54,448	24,890
2002	35,730	47,617	63,304
2003	(46,922)	52,823	37,398
2004	26,659	43,856	82,085
2005	(31,237)	28,761	10,465
2006	53,718	16,603[b]	-[c]
2007	50,401	37,696[b]	112,455
2008	(97,848)	33,429	(53,350)
2009	(79,530)	49,255	(55,449)
2010	(8,176)	12,682	(7,412)
2011	(44,794)	7,455	(45,652)

Sources: Energy Information Administration, EIA Form 176, "Annual Report of Natural and Supplemental Gas Supply and Disposition", Unaccounted for Gas item, PHMSA, "Annual Gas Distribution Reports", Form 7100.1.1, Unaccounted for Gas Percent., and Annual Reports filed with the Massachusetts DPU. The reporting timeframes are different for PHMSA versus EIA and DPU. Specifically, PHMSA requests data for the previous year through June 30 of the reporting year, while EIA and DPU request data for the previous calendar year.

[a] Unaccounted for Gas is reported annually to PHMSA as a percentage. Based on discussions with PHMSA officials, we calculated a volume of gas by multiplying that percentage by the amount of reported gas made and purchased for one year through June 30 of the reporting year, per the instructions in PHMSA's Annual Gas Distribution Report Form 7100.1.1.

[b] Only partial year data were available, since annual reports from the Massachusetts DPU were not available for both of the years necessary to calculate the gas volume from the unaccounted for gas percentage reported to PHMSA.

[c] No data were available for this year, either because annual reports from the Massachusetts DPU were not available, or companies did not report data for this field to EIA.

[d] The percentage of unaccounted for gas reported to PHMSA and DPU were the same, however the volumes are different. Some of this variation may be due to differences in reporting timeframes (e.g. July 1 of the previous year-June 30 of the reporting year for PHMSA and calendar year for DPU).

[e] The percentage of unaccounted for gas reported to PHMSA was greater than that reported to DPU, however the PHMSA volume listed here is less than that listed for DPU. Some of this variation may be due to differences in reporting timeframes (e.g. July 1 of the previous year-June 30 of the reporting year for PHMSA and calendar year for DPU).

Notes: Boston Gas, Colonial Gas, and Essex Gas are subsidiaries of National Grid. Essex Gas was merged into Boston Gas in 2010.

Columbia Gas is a subsidiary of NiSource.