Survey gives clearer view of risky leaks from gas mains

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Precise measurements of leaks from natural gas pipelines across metropolitan Boston have demonstrated that almost a sixth of the leaks qualified as potentially explosive, and that a handful of leaks emitted half of the total gas lost.

The findings by Boston University researchers differ significantly from results gathered by gas companies and other monitoring groups, and highlight the risks that these "fugitive" gas emissions pose both for safety and the environment, says Margaret Hendrick, a PhD candidate in BU's Earth & Environment department.

Hendrick is lead author on a paper published today in *Environmental Pollution*, which emphasizes the need to develop standardized ways to detect leaks and prioritize their repair.

Natural gas is considered a relatively clean fossil fuel, but a substantial amount of the gas is lost in production and distribution. In addition to the safety risks, methane (the main component of natural gas) is a major contributor to atmospheric warming.

Gas pipelines may date back as early as the mid-nineteenth century in east coast cities such as Boston. About a third of the installed pipelines use leak-prone materials such as cast iron, wrought iron or unprotected steel. There are thousands of gas leaks in these cities, but how the sizes of these leaks vary in an urban area "was a big black box until this project," Hendrick says.

She and her colleagues looked at emissions from cast iron pipelines at 100 sites in greater Boston where leaks had been detected in the air along roadways. The researchers painstakingly analyzed the release of methane inside custom-built chambers created with plastic buckets and the lids from child sandboxes. "To fully ascertain the safety hazards of leaks really does require us to get out on the ground with instrumentation," Hendrick explains.

This was the first survey that performed detailed measurements of loss from pipelines on this urban scale, says Professor of Earth and Environment Nathan Phillips, Hendrick's advisor and senior author on the paper.

Risk of explosion doesn't necessarily correlate with the amount of methane leaking, because the local environment around the leak also plays a part. "Even a very small leak can be a great safety concern," says Hendrick, who notes that a 2014 gas explosion in Dorchester injured 12 people. There were 113 gas distribution pipeline incidents, with 18 fatalities, in the United States that year.

The seven "super-emitter" leaks that released half the methane in the study also raise warning signs for climate change. Methane accounts for about one tenth of U.S. greenhouse gas emissions. On average over a 20-year period, a methane molecule released into the atmosphere traps about 86 times as much heat as does a carbon dioxide molecule, Phillips points out.

"We know we have a problem with aging natural gas infrastructure, but we need a better understanding of how big the problem is and the best ways to solve it," Hendrick says.

One major issue is a lack of agreement on the number of gas leaks. For instance, Phillips led a 2013 survey on all Boston city roads that found

3,356 gas leaks. The most recent estimate from an annual report filed by National Grid with the Massachusetts Department of Public Utilities (DPU), which regulates natural gas in the state, is about half that number.

Massachusetts categorizes gas leaks by risk, with potentially explosive leaks given a Grade 1 classification. The National Grid annual report cited a total of 36 Grade 1 leaks—but the BU fieldwork, identifying 15 out of 100 leaks as Grade 1, suggests that that figure may be low.

Even if all parties agree on how to assess gas leaks and prioritize their repair, fixing them won't be inexpensive, and the cost is borne by gas customers.

"We're stuck in this conundrum where if we were to retrofit this infrastructure quickly, there would be huge rate increases, and families might not be able to pay their utility bills," Hendrick says. "But it isn't if these old pipes will start leaking, it's when."

Bills now before the Massachusetts legislature may help to better address these challenges. In the meantime, the BU researchers encourage the public to stay watchful for any gas leaks. "People may become habituated to the smell of a gas leak, but if you smell one you should call it in to your local gas company," says Phillips.

While the first priority in dealing with leaks is to assure public safety, it's also critical to consider the climate implications, Hendrick emphasizes. Her paper proposes a leak classification scheme that includes both safety and climate risks.

"We are consuming more natural gas than ever before in the United States," she notes. "We need research to try to characterize fugitive methane emissions across the entire natural gas system."

That need is highlighted by the recent environmental disaster as natural gas escaped from storage in Porter Ranch, California—the worst such leak in U.S. history. "We're starting to realize that unless the entire natural gas system is better regulated, the carbon footprint may be just as bad for natural gas as it is for coal and oil," Hendrick says.

More information: Margaret F. Hendrick et al. Fugitive methane emissions from leak-prone natural gas distribution infrastructure in urban environments, *Environmental Pollution* (2016). DOI: 10.1016/j.envpol.2016.01.094

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