Squeaky Leak Report
Surveying Natural Gas Leaks in Cambridge and Somerville
11.11.14
Written by HEET, with the advice of Boston University Professor Nathan Phillips, Bob Ackley of Gas Safety USA, Joel Wool of Clean Water Action, and Toby Woll, with help by Daniel Thorpe (a Ph.D. student at Harvard University in Engineering and Applied Sciences)

Natural gas leaks:
- **Are potentially explosive.** 12 people were hurt in April 2014 when a Dorchester house exploded and 7 people were killed in March from another explosion in Harlem.
- **Are detrimental for human health** by creating ground-level ozone and releasing potent volatile organic chemicals.¹
- **Suffocate trees** by reducing the amount of oxygen around the roots. The cities of Brookline, Hingham, Milton, Nahant and Saugus all have pending legal actions against National Grid totally over $2,000,000 in damage to public shade trees.
- **Are a powerful greenhouse gas**, that is 21 to 72 times more powerful than CO₂.
- **Are paid for by the ratepayer** rather than the utilities since the utility factors the lost gas into the price per therm delivered.

**Background:** New England has some of the oldest infrastructure in the United States, including its natural gas pipes. As natural gas pipes age, the seams and material break down, and begin to leak natural gas (about 95% methane) into the atmosphere rather than delivering the gas to the homes or businesses they are intended for.

Across the country, a conservative estimate of the amount of natural gas that is “lost or unaccounted for” is 3%.² In Massachusetts, the cost of this wasted gas has been between $58 and $130 million on average per year since 2000.³

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¹ [Global Health Benefits of Mitigating Ozone Pollution with Methane Emission Controls](#), National Academy of Sciences

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NSTAR and National Grid, the utilities that service Somerville and Cambridge, are two of the utilities in the state that reports the overall largest amounts of lost natural gas. Although all utilities in the state map methane leaks regularly (by driving down every street with a “sniffer” truck), they do not share this information with the municipalities, state or residents. The vast majority of cities have never had their streets mapped by an outside group in order to analyze that information and make the data public. Without any idea of where the leaks are, these cities have difficulty creating proactive plans to reduce the waste.

**Impact on the climate:** Methane (natural gas) when burned turns into carbon dioxide – CO₂—a greenhouse gas. However if it is released before it is burned, it is 72 times more powerful (on a 20-year horizon) to 21 times more powerful (when considered on a 100-year time horizon) than CO₂.⁴

The 3% of lost gas thus has the relative greenhouse gas impact of between 63% and 216% of all natural gas burned in the state.

Although this report supplies both the 20- and 100-year time horizon metrics, given the fact that the next two decades are likely to be the most critical in terms of humans’ ability to prevent the worst parts of climate change, we suggest the 20-year time horizon is the more appropriate metric to use.

**Our project:** For the past decade, Cambridge has had a five-year street reconstruction plan that it has shared with the utilities, giving the utilities five years of notice to repair the infrastructure under the street before the street is repaved. The city of Cambridge believed that a decade of giving NSTAR (its gas utility) this much notice must have significantly reduced the number of natural gas leaks within the city, but before this project it had no way to confirm this belief.

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² *How Much Natural Gas Leaks?* Scientific American, 2013
³ Calculated from data reported by the utilities to the Mass. Dept. of Public Utilities
⁴ Methane’s impact as a greenhouse gas decreases over time.
HEET mapped all the natural gas leaks in Cambridge and Somerville to see if these two cities with similar population density and infrastructure age showed any difference in the extent and number of gas leaks. A large difference might be evidence that Cambridge’s five-year street reconstruction plan was effective. This information could help other municipalities adopt similar a similar program to become more effective in reducing their natural gas leaks.

**Method of study:**
Bob Ackley of Gas Safety USA (a professional with 30 years of experience performing natural gas leak analysis) drove down every street in Cambridge and Somerville with a high precision methane analyzer between June 11th and August 13th. The analyzer samples the air for natural gas (methane), while it records the GPS location and the parts per million of atmospheric methane. The data is mapped to Google Earth.

Bob went back to perform additional follow-up measurements in a few selected spots where he suspected city trees were being suffocated by natural gas leaks in the soil. In this spots, he placed a probe in the soil to measure methane by the trees roots.

In analyzing the resulting data, we used the same methods as Boston University Professor Nathan Phillips used in his 2012 Boston gas leak study. Professor Phillips has kindly been advising us on this project.

Following his methods, we counted as a leak any reading that showed over 2.5 ppm (parts per million) of methane\(^5\). If that elevated methane reading continued for more than 5 meters, it was considered a new leak because it is likely that one pipe was not putting out all that methane. (Since pipes in the same neighborhood tend to be of the same age and material, they frequently start to decay at about the same time. This is why whole neighborhoods will become “leaky” at the same time.)

\(^5\) Although any deviation from the methane baseline can be a potential risk, 2.5 ppm is a conservative threshold to be considered elevated.
The high precision analyzer in Bob’s car

Bob analyzing a tree pit where the a tree had died

The air in the soil at these tree pits registered 60% methane
A gas leak in front of the Cambridge’s main library

Dying tree poisoned by natural gas leaks in the soil. Notice the lack of leaves at the extremities.
Results

- **Frequency of leaks:**
  Somerville: an average of 5.2 leaks per linear mile of road
  Cambridge: 2.1 leaks per linear mile.
  Boston: 4.3 leaks per mile as shown by Professor Phillips’ 2012 study.

- **1 potentially explosive leak was already reported,** half a block from the King Open School in Cambridge.

- **Expected # of leaks** (based on the number of leaks per linear mile of road found in Boston during Professor Phillips’ 2012 study)
  **Somerville:** 398 leaks expected. 482 leaks found or **21% more than Boston’s frequency.**
  **Cambridge:** 675 leaks expected. 305 leaks found or **45% less than Boston**
  (Potentially this low level of leaks is due to Cambridge sharing its five-year street reconstruction plan with the utility to help incentivize it to fix all leaks in phase with street repair. Theoretically Cambridge might also have fewer leaks because NSTAR could be more proactive in general on the pipeline repair.)

- **Damaged trees** (assuming an average cost of removing a dead tree and planting a new one at $850 per tree)
  **Somerville:** 75 to 125 city trees that have been damaged or killed by methane leaks in the soil at an **estimated cost from $63,750 to $106,250.**
  **Cambridge:** 150 to 200 city trees that have been damaged or killed by methane leaks in the soil at an **estimated cost from $127,500 to $170,000.** In front of the Fogg Museum, Harvard University likely spent $10,000 on trees that were suffocated by methane leaks.

- **Health and Safety:** The utilities follow intensive safety procedures to minimize the chance of potential explosions, but minimizing the leaks could decrease this potential further. Decreasing these leaks will also decrease the associated ground-level ozone and volatile organic chemicals that can be hazardous to human health.
- **Neighborhoods:** We are making available screenshots of each of the 8 city neighborhoods as part of the report. Visually it is immediately obvious which areas have more leaks.
  
  **Somerville:** East Somerville\(^6\) has more leaks than the rest of the city combined.
  
  **Cambridge:** West Cambridge has more leaks than in the rest of the city combined.

- **Amount of wasted money:** We multiplied the average amount of gas lost per year (reported by NSTAR to the Mass. Dept. of Public Utilities between 2000 and 2011\(^7\)) by the gas customers in each city as a percent of NSTAR’s total population served.\(^8\) We then increased or decreased that total amount of lost gas by the percentage more or less of gas leaks we found in that city.
  
  **Somerville:** Since we found 21% more leaks than were expected, we increased the total amount of expected lost gas by that percentage. According to these calculations, $2,030,063 of ratepayers’ money was wasted each year by Somerville’s portion of the lost gas. That is **roughly $102 per household** (that uses natural gas) per year.
  
  **Cambridge:** Since we found 55% fewer leaks than expected, we decreased the total amount of expected lost gas by that percentage. According to these calculations, over one million dollars of ratepayers’ money was wasted each year. That is roughly **$40 per gas-customer household** per year.

- **Amount of Greenhouse Gas:** We compared the resulting greenhouse gas to the metric tons of greenhouse gases emitted each year by the emissions resulting by the vehicle miles driven in Somerville and in Cambridge (estimated using data from MAPC.org and the EPA\(^9\)):

\(^6\) Consisting of East Somerville and Winter Hill.

\(^7\) Because of utility company mergers, we couldn’t access similar data for National Grid.

\(^8\) It’s unknown how much of this leaked gas might be lost “upstream” from Somerville from the utilities to the city.

Climate Impacts of Burned and Lost Natural Gas in Somerville MA (2014 Estimate)

Climate Impacts of Burned and Lost Natural Gas in Cambridge MA (2014 Estimate)
If Somerville could work with the utilities to reduce the number of leaks in Somerville per linear mile of road to the amount that is found in Boston, the savings would be:

| Potential savings if fixed 21% of leaks (% by which Somerville # of leaks exceeds Boston’s leaks) |  
|---|---|---|---|---|---|
| 326,227 | Therms saved |
| $352,325 | $ / year |
| $18 | savings / household |
| 15,140 | CO2 ton equivalent (100 year horizon) |
| 2,969 | Equivalent passenger cars’ CO2 |
| 51,909 | CO2 ton equivalent (20 year horizon) |
| 10,178 | Equivalent passenger cars’ CO2 |
| 34,228 | # of cars registered in Somerville |

If Cambridge fixed 40 leaks of an average size:

| Fixing 40 average leaks |  
|---|---|---|---|---|---|
| 121,430 | Therms saved |
| $131,144 | $ Saving / year |
| 5,636 | CO2 tons / year (100 year horizon) |
| 1,105 | Passenger cars |
| 19,322 | CO2 (20 year horizon) |
| 3,789 | Passenger cars |

Suggested actions for any municipality working to reduce natural gas leaks:

1. **Request an updated leak map every six months** from the Dept. of Public Utilities through Massachusetts’ recent natural gas leak bill (June 2014). A sample letter for this is attached at the end of this report.

2. **Overlay a GIS map of city trees with the leak map to pinpoint trees that are being killed or damaged**, then work with the utilities to repair the leaks that are suffocating trees.

3. **Use the leak map to prioritize the repaving of streets** that have more leaks.
4. **Create a five-year plan of street repaving and share it with the utilities.** Strongly encourage them to replace all the pipes just before the streets are repaired. Working in phase with street repair is the least expensive solution for the ratepayer and taxpayer and least disruptive for nearby residents.

5. **Inform the utilities that you will check future leak maps to make sure recently repaved roads are free of leaks.** Explain you will make public information about any remaining leaks to residents and to the Attorney General.

6. **Routinely check tree pits for methane in the soil before planting.** Purchase a gas & oxygen meter and bang bar (cost @ $1,500) to check the soil in tree pits. If there is methane in the soil, work with the utility to get the leak fixed so the tree isn’t suffocated.

**Note:** Interactive Google Earth map files from our work are accessible by emailing us at heet.cambridge@gmail.com.

HEET is a tax-deductible local nonprofit that works hard to save fossil fuels and money for residents. Consider donating to us.

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*Bob finds another suffocated tree in front of Lesley University*

**Links for further study:**

- [Bob Ackley on Here and Now](#)
- [America Pays for Lost Gas](#), Senator Markey’s 2013 report
- [EDF/Google methane mapping project](#)
- [How Much Natural Gas Leaks?](#) Scientific American, 2013
- [IPCC 5th report](#)
- [Methane Leakage from Natural Gas Operations](#), Environmental Defense Fund
Sample letter for municipal governments to request gas leaks maps

Under recent state legislation, the Department of Public Utilities (DPU) acts as a conduit for gas leaks information requests from municipalities. To the authors' knowledge, no formal process has yet been devised for attaining this information.

Until further instructions are issued from the DPU, the questions listed below -provided with input from Clean Water Action, Conservation Law Foundation, and other stakeholders- can serve as reasonable requests to be made of that agency. Please contact us if you file a request, in order to track use of the new law and whether the existing statute is working for cities and towns across the Commonwealth. We welcome inquiries from municipalities or input as to what other utility infrastructure information could be useful for cities and towns.

Thanks,

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THE LETTER:

1. Please provide the [COMMUNITY of x] with a map of all pipeline facilities (services, mains, regulators, etc.) owned and/or operated by [UTILITY or UTILITIES] within the boundaries of the [COMMUNITY]. Please provide a map that includes details regarding the age or date of the installation of the pipeline, the material of the pipeline, and whether the pipeline is high pressure or low pressure. If you have these maps in shape files or in arc GIS, those formats are preferable.

2. Please provide the [COMMUNITY of x] with the most recent inventory of outstanding leaks on the distribution system within the [COMMUNITY] including the location of the leak, date the leak was identified/classified, the grade of the leak, whether the leak has been reclassified or designated for repair, and the date on which the inventory was compiled.

3. Please provide the [COMMUNITY of x] with a list or map of pipeline segments currently scheduled for replacement.

THE LAW:

Following passage of H4164, An Act Relative to Natural Gas Leaks, in summer 2014, chapter 164. Sec 144 (e) of Mass General Law now states:

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(e) As part of the annual service quality standards report required by section 1I, each gas company shall report to the department the location of each Grade 1, Grade 2 and Grade 3 leak existing as of the date of the report, the date each Grade 1, Grade 2 and Grade 3 leak was classified and the dates of repairs performed on each Grade 1, Grade 2 and Grade 3 leak. A gas company shall specify any reclassification of previously identified leaks in its annual report. Gas leak information shall be made available to any municipal or state public safety official upon written request to the department.