

# The Compelling Case for Widespread Adoption of Residential Natural Gas Alarms

By Marc Huestis, Retired Senior Vice President, Consolidated Edison of New York

## Executive Summary

Decades of experience have demonstrated that natural gas transmission and distribution infrastructure is a safe, reliable, resilient, and cost-effective energy delivery system. Over 187 million Americans and 5.8 million businesses rely on natural gas to heat their homes, warm their water, and cook their food. In addition, natural gas is our largest source of energy for electric generation, and it provides a myriad of other uses in manufacturing.<sup>1</sup>

Natural gas utilities continue to invest heavily in upgrading and modernizing their gas systems to minimize leaks through the replacement of leak prone cast iron and bare steel pipe. In addition, utilities expend significant effort to find and repair leaks as part of their responsibility to operate their systems as safely and efficiently as possible on behalf of their customers and the public at large.

Public safety awareness campaigns educate natural gas customers and the public about safe excavation practices and the distinctive “rotten egg” odor created by sulfur-based odorants injected into natural gas which itself is colorless and odorless. These public safety awareness campaigns emphasize the need to evacuate and immediately report the odor of natural gas leaks by calling 911 or their local utility.

Unfortunately, despite these efforts, too many natural gas leaks continue to go unreported, which under the wrong circumstances can create hazardous conditions for life and property. Recurring significant events, Pipeline and Hazardous Material Safety Administration (PHMSA) incident data, and National Fire Protection Association (NFPA) research bears this reality out. There are many reasons why the odor of a natural gas leak may go unreported. The distinctive odor of natural gas may not be recognized, people assume someone else has already reported the odor, they are discouraged from reporting it by others, or as is not uncommon with elderly people, they may not have a strong sense of smell. Relying on an individual’s sense of smell to recognize the odor of natural gas and then take action to report a potential natural gas leak has proven throughout the years to be a good, but imperfect process. Our industry’s history of tragic events where people either do not smell, do not recognize, or fail to act promptly when they do smell the odor of natural gas speaks for itself.

Searing tragedies involving needless loss of life and tremendous property damage associated with lack of reporting of the odor of natural gas leaks continue to occur. Significant incidents include the natural gas fueled explosions in the East Harlem and East Village neighborhoods of New York City in March of 2014 and 2015, Silver Spring Maryland in 2016, Dallas Texas in 2018 and as recently as the R.M. Palmer Company chocolate factory in West Reading Pennsylvania in March of 2023. These are exactly the type of events that could be avoided if we stopped relying on people’s sense of smell as the primary layer of safety from a natural gas leak. PHMSA’s serious incident statistics since 2003 demonstrate that these events are not anomalies. Fatalities caused by natural gas system incidents are essentially unchanged over the last 20 years, despite significant efforts by the natural gas utilities and industry partners to continuously improve public safety.

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<sup>1</sup> American Gas Association, 2023 Playbook

Fortunately, there is a proven alternative to relying only on the human nose to keep our homes and communities safe. Tragic events involving senseless loss of life and life-long immeasurable impacts on families and loved ones don't have to happen. Early warning of a natural gas leak can be the difference between a non-event and a gas fueled explosion. Natural gas alarms will sense the presence of natural gas independent of anyone recognizing the odor, or even being home to smell it, prompting action to locate the leak and make the area safe. Both the National Transportation Safety Board (NTSB) and PHMSA have recognized the additional layer of safety provided by in-home methane detectors. Notably, the NTSB included in-home methane detection on its 2021-2022 Most Wanted List following its investigations into several recent natural gas fueled explosions, including the Silver Spring Maryland and Dallas Texas incidents.<sup>2</sup> In addition, PHMSA's recent Notice of proposed rulemaking (NPRM), *Pipeline Safety: Gas Pipeline Leak Detection and Repair* states: "PHMSA encourages the adoption of in-home methane detectors by operators, States and standards developing organizations".<sup>3</sup>

Commercially available gas alarm technology is field proven at scale. Its reliability and effectiveness for preventing events has been demonstrated for over four decades in Japan. Following a nationwide regulatory mandate to install gas alarms in residential and commercial building locations, the annual rate of fatalities caused by natural gas incidents in Japan was reduced from 50 in 1980, to zero in 2019. As the number of gas alarm installations increased, the number of fatalities caused by gas explosions steadily decreased.

This same technology has also proven its effectiveness in the U.S. through a large-scale deployment of utility connected natural gas alarms by Con Edison of New York. Battery powered natural gas detectors that can be easily mounted within 12-inches of the ceiling, because natural gas rises, have proven to be a game changer for public safety. Con Edison of New York has deployed nearly 200,000 utility connected natural gas alarms across its service territory since 2018 proving the technology to be reliable, appropriately sensitive, and resistant to false alarms. Potentially significant events have been averted because of the early warning of a hazardous gas leak provided by these alarms. Ultimately, Con Edison plans to install 376,000 natural gas alarms at every gas service point-of-entry in its New York City and Westchester County gas service territory by the end of 2025.

Natural gas alarm technology that meets UL-1484 *Standard for Safety - Residential Gas Detectors* listing requirements is commercially available and proven reliable. In addition, a complementary installation standard, NFPA 715 *Standard for Fuel Gases Detection and Warning Equipment*, was published in May of 2022 to facilitate the incorporation of natural gas alarm requirements into State and local municipality building codes and standards.

With proven technology and appropriate performance and installation standards now established, the essential elements are in place for natural gas utilities, industry trade associations and public safety advocates to assume a leadership role in actively promoting wide scale consumer adoption of natural gas alarms. Industry trade associations could support such efforts by including information on the additional layer of safety natural gas alarms provide in public awareness and education campaigns in tandem with existing campaigns that highlight the "rotten egg" odor of a natural gas leak, as well as lobbying for incorporation of requirements for natural gas alarms into State and local municipality building codes and standards. Natural gas utilities could advance the

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<sup>2</sup> NTSB, "Improve Pipeline Leak Detection and Mitigation: 2021-2022 Most Wanted List of Transportation Improvements", April 6, 2021

<sup>3</sup> PHMSA NPRM - "Gas Pipeline Leak Detection and Repair", Federal Register/Vol, 88 No. 96/Thursday, May 18, 2023/Proposed Rules

effort through deployment of communication enabled natural gas alarms as in the Con Edison of New York example, through distribution of standalone alarms to targeted segments of their customer base, or to employees to expand consumer awareness and use of natural gas alarms.

It's well past time to move beyond our nose as the primary line of defense against a natural gas leak and leverage proven natural gas alarm technology listed to UL 1484 as an additional layer of safety to keep our homes, communities, and loved ones safe, just like smoke and carbon monoxide detectors have been doing for decades.

## Serious Natural Gas Fueled Incidents Continue to Occur

The public safety value of an additional layer of safety that can be provided by natural gas alarms is self-evident. The March 12, 2014, natural gas fueled explosion in the New York City neighborhood of East Harlem caused eight fatalities, injuries to more than 50 people, displaced 100 families from their homes, destroyed two buildings and caused the suspension of all commuter rail service headed north from Grand Central Station for 7-1/2 hours due to debris on the track.<sup>4</sup> The March 26, 2015 gas explosion in the East Village neighborhood of New York City caused two fatalities, injured 13 and destroyed three historic buildings.<sup>5,6</sup> The August 10, 2016, gas explosion in Silver Spring Maryland killed seven people and injured 65.<sup>7</sup> The February 23, 2018, gas explosion in Dallas Texas killed one and injured five.<sup>8</sup> The most recent incident involving multiple fatalities occurred on March 24, 2023, when a natural gas explosion in the R.M. Palmer Company chocolate factory in West Reading, Pennsylvania caused seven fatalities, injured 11, displaced three families from a neighboring apartment and destroyed the economic center of a close-knit community.<sup>9</sup> While there were differences in how each of these events unfolded, the common thread that runs through all of them is that odorization of natural gas as the primary safety barrier to protect people from the hazards created by a natural gas leak was not effective.

In the case of the East Harlem event, the odor of natural gas was noticed by residents for at least 20 hours before the explosion, but no one reported it until 25 minutes before the explosion occurred, which was tragically too late to prevent it. In the case of the Silver Spring Maryland event, the NTSB stated "...had methane detectors been installed in the building, an alarm would have alerted residents to a gas release and reduced the potential and consequences of a natural gas explosion. Therefore, the NTSB is recommending the installation of fixed methane detectors that go beyond relying on smell. The odorant in natural gas provides some warning but methane detector alarms can provide a reliable additional safeguard."<sup>10</sup> In the case of the Dallas Texas event the NTSB found in the two days before this explosion, "two gas-related incidents occurred on the same block at houses that were served by the same natural gas main, each resulting in significant structural damage and burn injuries to one occupant. Although Atmos Energy Corporation added odorant to its gas distribution system in a manner consistent with Pipeline and Hazardous Materials Safety Administration regulations, none of the residents at any of the affected homes smelled gas. Although odorant can act as an early warning of a gas release to prevent an explosion and fire, it is known to become depleted if it travels through soil."<sup>11</sup>

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<sup>4</sup> NTSB, Pipeline Accident Report 15-01, "Natural Gas-Fueled Building Explosion and Resulting Fire"

<sup>5</sup> Shapiro, Emily (March 27, 2015), "NYC Building Fire: Restaurant Owner Smelled Gas Before Massive Explosion", ABC News

<sup>6</sup> Ransom, Jan (November 15, 2019), "An illegal Gas Line, a Deadly Explosion, and Now Guilty Verdicts", The New York Times

<sup>7</sup> NTSB, Pipeline Accident Report 19-01, "Building Explosion and Fire, Silver Spring Maryland, August 10, 2016"

<sup>8</sup> NTSB, Pipeline Accident Report 21-01, "Atmos Energy Corporation Natural Gas-Fueled Explosion Dallas Texas, February 23, 2018"

<sup>9</sup> NTSB, Ongoing Investigation PLD23LR002, "Preliminary Report, May 2, 2023"

<sup>10</sup> NTSB, Pipeline Accident Report 19-01, "Building Explosion and Fire, Silver Spring Maryland, August 10, 2016"

<sup>11</sup> NTSB, Pipeline Accident Report 21-01, "Virtual Meeting of January 12, 2021, Atmos Energy Corporation Natural Gas-Fueled Explosion", Dallas Texas, February 23, 2018

## PHMSA Serious Incident Data Demonstrates Opportunity for Improvement

Beyond the catastrophic events that create headlines, PHMSA incident statistics demonstrate that natural gas fueled explosions continue to occur at a rate essentially undiminished from 20 years ago, despite the industry’s best efforts to drive safety improvements, including the accelerated removal of leak prone cast iron and bare steel pipe from natural gas distribution systems. Since 2005, the industry has reduced leak prone pipe inventory by nearly 40,000 miles or 36%, and the number of leak prone gas services by nearly 2.8 million, or 65%. Despite this significant elimination of leak prone gas main and services, the annualized rate of natural gas fueled fire and explosion incidents associated with natural gas transmission and distribution systems causing fatalities and injuries remains stubbornly high.

Between 2003 and 2022 there were 613 natural gas fueled incidents classified as “serious” by PHMSA that were associated with natural gas transmission and distribution system events. PHMSA defines serious gas system transmission and distribution incidents to include a fatality or injury requiring in-patient hospitalization. The following table summarizes PHMSA data for serious gas transmission and distribution system incidents from 2003 through April 2023.<sup>12</sup>

### U.S Natural Gas Transmission and Distribution System Serious Incidents Reported to PHMSA 2003 - 2023

	Number of Incidents	Fatalities	Injuries
Total - 2003 - 2022	613	225	997
3-Yr Avg (2020 - 2022)	22	10	27
5-Yr Avg (2018 - 2022)	25	10	39
10-Yr Avg (2013 - 2022)	25	10	48
20-Yr Avg (2003 - 2022)	31	11	50
2023 YTD through April	4	9	9

The PHMSA data demonstrates, despite significant continuing efforts by the industry to improve public safety through elimination of leak prone pipe, use and promotion of safe excavation practices, deployment of advanced gas leak survey detection technology and implementation of Pipeline Safety Management Systems (PSMS), the incidence rate and severity of natural gas fueled incidents remain unacceptably high and essentially unchanged from 20-years ago, as measured by fatalities.

## NFPA Research Aligns with PHMSA Serious Incident Data

NFPA natural gas incident research further accentuates the imperative to leverage technology to save lives and protect property. NFPA research data published in 2018, includes all incidents, fatalities and injuries caused by natural gas fueled fires and explosions, whether caused by natural gas system infrastructure failures, or leaks beyond the utility’s gas meter involving building piping or natural gas appliances. The NFPA research found from

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<sup>12</sup> PHMSA Serious Incident Data as of May, 1, 2023

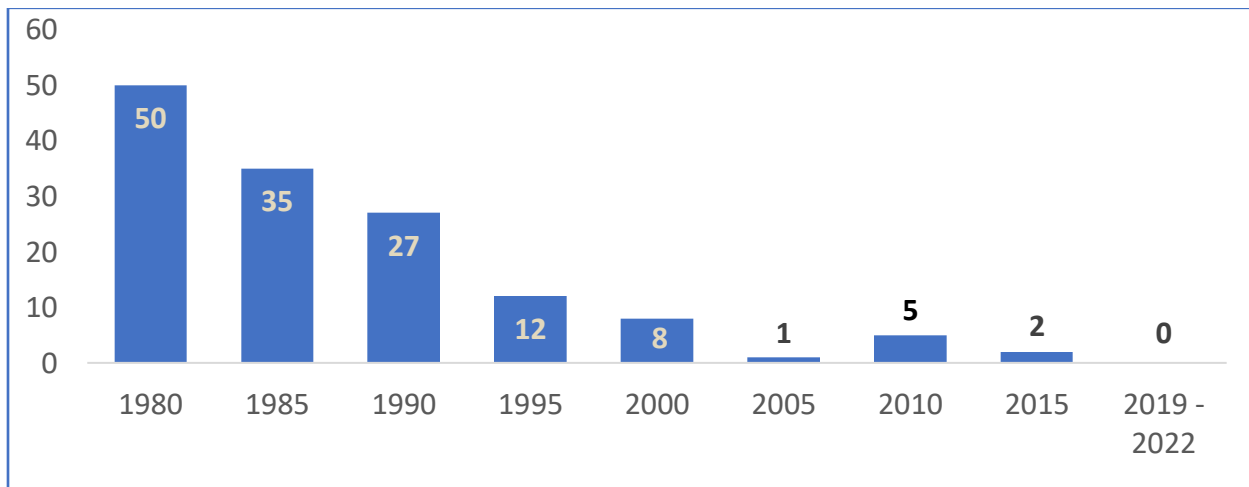
2012 – 2016 an average of 4,200 home structure fires per year started with the ignition of natural gas. These fires caused an average of 40 fatalities and 140 injuries per year.<sup>13</sup>

Clearly, a different approach is required to arrest these trends and prevent serious incidents, fatalities, and injuries associated with natural gas leaks.

### Japan’s Gas Alarm Experience

The U.S. natural gas industry would be well served to take a lesson from Japan which mandated the installation of gas alarms in residential and commercial spaces in 1980 after experiencing numerous gas-fueled fires and explosions causing fatalities and injuries. In 1980, Japan experienced 50 fatalities due to gas fueled incidents. The mandate to install gas alarms gradually drove down fatalities associated with natural gas incidents to zero as shown in the following bar chart.<sup>14</sup>

**Reduction in Natural Gas Incident Fatalities in Japan**



Odorization of natural gas via injection of sulfur-based chemicals that create the “rotten egg” odor associated with colorless and odorless natural gas has been the primary means for ensuring the safe utilization of natural gas for decades. However, catastrophic events in terms of loss of life, the PHMSA serious incident trends from the last 20 years, and NFPA research demonstrate there is an undeniable need for an additional layer of safety to reduce the rate of serious incidents and save lives. Japan’s experience leveraging gas alarm technology to drive fatalities associated with gas incidents to zero demonstrates there is a clear path to achieving the desired goal of enhancing natural gas safety and eliminating fatal incidents in the U.S.

<sup>13</sup> NFPA Research – Natural Gas and Propane Fires, Explosions and Leaks Estimates and Incident Descriptions, October, 2018

<sup>14</sup> Japan Ministry of Economics, Trade, and Industry National Natural Gas Safety Data, 1980 - 2022

## **Natural Gas Alarm Experience in the U.S.<sup>15</sup>**

Following the catastrophic natural gas explosions in the New York City neighborhoods of East Harlem in 2014 and the East Village in 2015, which together caused 10 fatalities and more than 60 injuries, Con Edison of New York sought natural gas alarm technology that could be integrated with its Advanced Meter Infrastructure (AMI) communication system to provide continuous natural gas leak monitoring and early warning of potentially hazardous conditions. The program started as a pilot in 2018 and has since progressed to full scale deployment across Con Edison's gas service territory.

Con Edison's natural gas alarm program prioritizes installation of devices near the gas service point-of-entry (POE) in basements, as opposed to dwelling living spaces, to guard against migration of outside gas leaks into basements through gas, electric, telephone, sewer, and water POEs which could accumulate unnoticed and create a hazardous condition.

To date, nearly 200,000 natural gas alarms have been incorporated into a monitoring network that covers Con Edison's gas service territory in New York City and Westchester County. These alarms have already identified more than 2,000 natural gas leaks of which 17% originated from utility gas distribution piping outside the structure. Con Edison's full deployment plan calls for the installation of a natural gas alarm at every gas service POE, or approximately 376,000 by the end of 2025.

Con Edison has stated "Gas leak alarm results have been accurate and reliable, initiating prompt response from our first responders and fire department personnel to mitigate potentially dangerous conditions." The following two examples of several close calls experienced to date demonstrate the public safety value of the Con Edison natural gas alarm program:

### Mount Vernon, Westchester County, New York

In the spring of 2021, a natural gas alarm installed at the gas service POE in a single family home was activated at approximately 2 AM. Responding crews found natural gas at the inside foundation wall of the home at 40% of the Lower-Explosive-Limit (LEL). During the investigation to determine the source of the leak, another natural gas alarm was activated in a home adjacent to the location of the initial alarm. Crews found natural gas at 8% LEL at the inside foundation wall of this home. As the leak investigation progressed, crews found natural gas at 90% LEL at the inside foundation wall in a residence across the street that did not have a natural gas alarm installed. The source of the leak was ultimately traced to a 4-inch diameter cracked cast iron main in the adjacent intersection. As a result of the early warning provided by the natural gas alarms to the Con Edison Gas Emergency Response Center, the potential for natural gas to accumulate, find a source of ignition and cause an explosion was averted.

### New York City, Midtown Manhattan, Hotel

In September of 2022, a natural gas alarm in the basement of a midtown Manhattan hotel activated at approximately 3 AM. The cause of the alarm was the failure of an underground electrical cable that subsequently burned through a 3-inch plastic gas service supplying the hotel. When emergency response personnel from the Fire Department of New York (FDNY) and Con Edison responded to location to conduct a gas leak investigation, they found 100% LEL in the hotel's basement meter room as well as similar readings in the adjacent buildings. Due to the early warning provided by the natural gas alarm, Con Ed emergency response and FDNY crews were able

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<sup>15</sup> In-Home Methane Leak Detection: A Case Study presented at Pipeline Safety Trust Conference, December 1 & 2, 2022. Hotel Monteleone, New Orleans, LA

to quickly identify the source of the leak and ventilate the affected buildings, making the area safe, thereby averting a potentially catastrophic event.

### Elimination of False Alarms

Even with the success of the Con Edison program to date, it should be acknowledged that a significant operational concern at the early stages of the project was the potential for the natural gas alarms to generate false alarms. This concern stemmed largely from the industry's negative experience associated with the initial mass deployment of carbon monoxide detector technology in the early 1990's. A December 1994 temperature inversion in Chicago, Illinois caused over 3,500 false carbon monoxide alarms in a 48-hour period, overwhelming emergency response capability.<sup>16</sup> To resolve this concern Con Edison worked with the Gas Technology Institute to test the susceptibility of commercially available natural gas detectors to generate false alarms when exposed to 20 different common household chemicals. The detector that best demonstrated immunity to false alarms when exposed to these chemicals, as well as a <10% detection threshold utilized a micro-electromechanical systems (MEMS) sensor.<sup>17</sup> This detector was ultimately certified in accordance with UL-1484 *Residential Gas Detectors* and selected by Con Edison for its large-scale natural gas alarm program.

Over more than four years, with nearly 200,000 natural gas alarms installed and more than 2000 alarms received, Con Edison has only experienced one false alarm due to a defective device, in other words the technology has proven itself to be more than 99.95% accurate with the demonstrated ability to detect natural gas leaks at levels < 10% LEL.

This industry leading initiative has clearly demonstrated under real world conditions the public safety value and reliability of natural gas alarm technology – including when no one is home to smell and report a natural gas leak.

### **Natural Gas Alarm Performance and Installation Standards are Established**

Industry safety advocates and fuel gas alarm manufacturers came together to update the performance standard for natural gas alarms, issuing the latest revision to UL 1484, *Standard for Safety - Residential Gas Detectors* in January 2022. The most significant change to the standard established 10% LEL as the minimum gas concentration alarm threshold, reducing it from 25% LEL. An alarm threshold of 10% LEL compared to 25% LEL provides a significant additional safety margin before a natural gas leak can accumulate to hazardous levels as demonstrated by testing conducted by the Fire Risk Alliance in 2018.<sup>18</sup> Of note, UL 1484 also stipulates that natural gas alarms must demonstrate the gas alarm itself shall not be the source of ignition when exposed to the most easily ignitable concentration of gas and air (8.3% for natural gas) to be successfully listed to the standard.<sup>19</sup>

In 2016, Local Law 157 (LL 157) was passed by the New York City Council that mandated installation of natural gas alarms following development of “an industry standard concerning the use of natural gas detecting devices in

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<sup>16</sup> Davis, Robert (December 24, 1994), Detectors False Alarms Fade Away, Chicago Tribune

<sup>17</sup> Gas Technology Institute report, Evaluation of Residential Methane Detectors, Phase III. Project No. 21696

<sup>18</sup> Fire & Risk Alliance LLC, Natural Gas Dispersion Testing Report, Prepared for: Richard J. Trieste, Jr. Department Manager Research, Development, and Demonstration Consolidated Edison Company of New York February 2, 2018

<sup>19</sup> UL 1484, Standard for Safety, Residential Gas Detectors



residential buildings”.<sup>20</sup> The catalyst for this legislation was the natural gas fueled explosions in the East Harlem and East Village New York City neighborhoods that occurred in 2014 and 2015. The implementation of this law was held in abeyance by the New York City Department of Buildings (DOB) until the appropriate industry performance and installation standards were established as cited in the law. The revision to UL 1484 in January of 2022 to lower the detection threshold to 10% LEL was the first step to satisfy this requirement. Development and issuance of a natural gas alarm installation standard – NFPA 715 *Standard for the Installation of Fuel Gases and Warning Equipment* in May of 2022 was the second and final step required for the New York City DOB to move forward. The New York City DOB in collaboration with FDNY are currently developing rules for implementation of LL 157.

The complementary standards UL 1484 and NFPA 715 provide the appropriate natural gas alarm performance and installation standards for any state or local municipality to deliberately move forward with developing state and local building code requirements for the installation of natural gas alarms, just like smoke and carbon monoxide detectors.

## Conclusion

Despite significant efforts by the natural gas industry to improve performance and public safety, natural gas fueled fires and explosions involving fatalities and serious injuries continue to occur at rates equivalent to 20-years ago. Natural gas alarm technology is mature and has proven to be an effective additional layer of safety in Japan and now the U.S. Commercially available technology supports utility owned and installed connected alarms, as in the case of Con Edison of New York, as well as consumer installed natural gas alarms, including models capable of voice alerts. Technology advances anticipated before the end of 2023 will expand notification channels to text messaging and email. The technology is reliable, readily available, and the appropriate performance and installation standards have now been established. Furthermore, deployment of this additional layer of safety can be done in parallel and in a fraction of the time and cost it takes to replace leak prone pipe to reduce the associated risk of natural gas leaks.

It’s time for the natural gas utilities, trade associations and public safety advocates to take a leadership role in advancing widespread consumer adoption of this important public safety technology. In addition to supporting changes to State and local building codes, information on the additional safety value of natural gas alarms could be included in public awareness and education campaigns as well as through direct distribution of natural gas alarms to targeted customer segments and employees. Natural gas alarms have proven they prevent events, save lives, and protect property, just like smoke and carbon monoxide detectors have been doing for decades.

Let’s move on from depending on our sense of smell as the primary line of defense against a natural gas leak and leverage proven natural gas alarm technology listed to UL 1484 as an additional layer of safety to keep people, communities, and our loved ones safe.

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<sup>20</sup> Local Laws of The City of New York for the Year of 2016, No. 157, December 16, 2016

*Marc Huestis is a retired utility professional with over 40 years of experience. He served 13 years in executive leadership positions including nearly seven years as the senior executive of Con Edison of New York's natural gas operations and is a past chairman of the Northeast Gas Association. He is currently the principal of Huestis Consulting LLC.*