Natural gas pipeline safety: Leak detection technology’s quantum leap
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Advanced sensors, drones, and AI are increasing safety, lowering costs, and reducing emissions.

Pipelines are both the safest and most economical means for transporting natural gas (i.e., methane). According the US Energy information Administration (EIA), nearly all gas shipments in the US happen on the almost 3 million miles of the nation’s pipeline infrastructure.

A Manhattan Institute report using data from the Pipeline and Hazardous Materials Safety Administration (PHMSA) show that pipelines are 22 times safer than road transport and 2.3 times safer than rail as measured by the number of serious incidents (those involving injury or death) per billion ton-miles transported per year.¹

However, similar to air travel, when pipelines do fail, the damage can be catastrophic. PHMSA data show that from 2000-2019 a total of 686 serious incidents occurred on gas pipelines, accounting for 253 fatalities and 1,111 injuries.² That’s an average of more than 12 deaths and 55 injuries per year—well below the rates for some other natural resource sectors like coal mining, but still sobering.

These incidents come with financial consequences that are borne by industry and the public. According to PHMSA data, between 2005 and 2020, serious incidents on pipelines resulted in more than $7.7 billion in damages with the industry picking up around 83.3% of the cost and the public the remaining 16.7%.³ EPA estimates that around 1.4% of all produced gas is lost to leaks.⁴ In 2019, that amounted to more than 471,000 mmcf⁵, which at the “city gate” price of $3.80/mcf is roughly equivalent to $1.8 billion.

Gas pipeline leaks also negate some of the environmental benefits of switching from coal to gas-fired power generation because methane is a potent greenhouse gas, 21 times stronger than CO₂.

Natural gas is king, but leaks remain a challenge

EIA forecasts US gas production to grow steadily through 2025 at 1.9% annually under the agency’s “reference case” scenario.⁶ The industrial sector (e.g., gas used as feedstock in chemical plants or for process heat) accounts for the bulk of the growth, while the biggest users remain electric utilities, which continue their transition away from coal-fired electricity and toward gas-fired generation.

Additionally, exports of liquified natural gas (LNG) are set to double by 2030 while exports to Mexico and Canada are projected to rise as well. Both trends are driving the addition of new pipeline capacity. In all, EIA estimates that more than 16 billion cubic feet per day (Bcf/d) of natural gas pipeline capacity was added in 2019 alone.⁷

While our reliance on pipelines is increasing, our gas pipeline infrastructure is aging. More than half of it was built before 1970 and can be prone to leaks though estimates vary as to the total amount of gas lost. EPA puts the figure at 1.4% of gas produced but a November 2019 study published in the journal Science estimates methane emissions from both oil and gas operations at 2.3% of total production per year.⁸

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$2 billion annually is the value of leaked gas from pipelines—whether part of an incident or not.
Regardless of the topline figure, America’s pipelines suffer thousands of leaks and ruptures every year and they can be triggered by a wide range of causes (see sidebar).

**Finding a needle in a needle stack**
The first step to fixing leaks is finding them, but traditional methods are slow, inaccurate, and insensitive. Bottom line: they miss leaks. Technicians must walk the area being inspected using hand-held detectors that can take up to 45 minutes to calibrate once on site. Because these systems test the air every few seconds, the technician must move slowly through the suspected leak site. Test results are manually entered in reporting systems, and the detectors themselves are not very sensitive, missing many leaks.

Recent advances in sensing, analytics and mobile technology have created a wave of updated gas leak detection solutions that perform significantly better than traditional methods, and at much lower cost. These systems can detect methane from natural gas leaks at concentrations of 1 part per billion (ppb) or less. For example, ABB’s mobile gas leak detection system leverages advanced laser-based sensors, GPS technology and analytic software to dramatically improve both the speed and accuracy of gas leak identification and location.

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**More than digging accidents**
Gas pipeline leaks occur at all points in the network from collection systems at the well to pipelines under streets and buildings. Causes of leaks can vary:

- Excavating accidents that result in the rupturing, nicking or puncturing of a pipeline
- Placing extremely heavy materials or equipment over buried pipelines
- Water main breaks that weaken roadways and pavement
- Excess accumulation of snow and ice on meters, gas pipes, and gas appliance exhaust and combustion air vents
- Fire or explosion near a pipeline
- Too much or not enough pressure in the gas system
- Equipment failure or corrosion
- Natural disasters such as floods, tornadoes or earthquakes
**How it works**

ABB's MobileGuard™ system is more than 1,000 times more sensitive than those found in traditional equipment, with the ability to detect methane from leaks from up to 300 feet away while moving in a car. Combined with a GPS module, an onboard ultrasonic anemometer to measure wind speed, and advanced analytics, MobileGuard™ can detect, precisely locate, and accurately estimate the size of natural gas leaks at a rate that covers 10-25 times more land area per hour than traditional methods. Importantly, it eliminates false positives associated with biogenic sources of methane like sewage and animal waste by also detecting ethane, which is found only in thermogenic pipeline gas, along with methane.

The ABB system is also cloud-connected; data recorded twice a second is reported and analyzed locally as well as being relayed to the cloud in real time. Electronic compliance records are generated on a map that is accessible on the service team's mobile device and in the operations center. The combination of speed, accuracy and operational efficiency helps pipeline operators meet the demand for fast, accurate and transparent data while streamlining their operations.

Most importantly, this new technology is commercially available on the market today. ABB's MobileGuard™, for example, is being used by customers up and down the natural gas value chain across the US and around the globe.

**Conclusion**

Advances in sensing, digitalization, and analytics make methane leak detection vastly more accurate, faster, and user-friendly. It is essential that policies and regulations focused on reducing the risks of leaking methane keep up with the pace of technology development and deployment. Doing so will ensure the greatest level of public safety while delivering benefits to pipeline operators.