ABB MEASUREMENT & ANALYTICS | WHITE PAPER

Meeting the Global Methane Pledge

How leak detection technology can cut methane emissions

100+ countries have pledged a 30% cut in methane emissions by 2030.

A 30% global cut in methane will prevent 0.3°C of warming by 2040 – no other measure will have an impact that quickly.

$2 billion annually is the value of leaked gas from pipelines – whether part of an incident or not.

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01 Tracking leaks with ABB Ability natural gas leak detection solutions: an advanced suite of gas detection systems.

Carbon emissions have long been the focus of global efforts to reduce the impact of industrial activities on the environment. In September 2021, the US and the EU proposed that the reduction of methane emissions into our atmosphere could have a significant and fast acting impact on the pace of global heating over the coming decades. The signing of a Global Methane Pledge at COP26 aims to cut methane emissions by 30 percent by 2030[1].

The potential effect of doing so will be to achieve at least a 0.3°C reduction in global heating by 2040. As a greenhouse gas, methane is approximately 25 percent more potent at trapping heat, causing a more powerful impact on warming in the atmosphere. Methane has a much shorter lifespan in the Earth's atmosphere than carbon dioxide – as such, moves to dramatically reduce its volume in the atmosphere now can have a more immediate impact on reducing global temperatures closer to the 1.5°C target set by the 2015 Paris Accord.

There are a variety of methane sources around the world, ranging from natural sources such as wetlands and oceans to human-induced contributors such as rice production and the decay of waste in landfills. By far the greatest proportion can be attributed to natural gas production and distribution.

Natural gas production and distribution

Growing restrictions on coal-burning, together with the inherent limitations of renewable energy sources such as wind and solar, has meant that the use of natural gas as a fuel has increased significantly and continues to grow. From an environmental perspective, natural gas burns cleaner and is less expensive than other fossil fuels. It is also a reliable power source, making it an ideal back-up when output from renewables drops. According to a report by McKinsey, natural gas will be the strongest-growing fossil fuel and will increase by 0.9 percent from 2020 to 2035. It is the only fossil fuel expected to grow beyond 2030, peaking in 2037[2]. The US Energy Information Administration also predicts a potential global increase of 30 percent in natural gas production to meet rising demand from the industrial sector in particular[3].

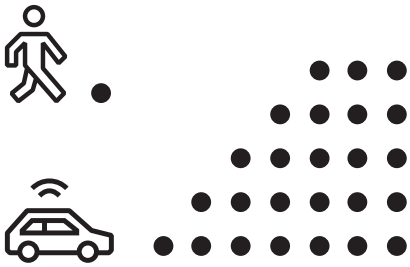
Pipelines are both the safest and most economical means for transporting natural gas (i.e., methane) and form the backbone of gas distribution because they are a safe and cost-effective way to transport natural gas.

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 rupture, nick, or puncture a pipeline
- Placing extremely heavy materials or equipment over buried pipelines
- Water main breaks that weaken roadways and pavements
- 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

Covers 10-25 times
more land area per hour than traditional on-foot methods



1,000 times
more sensitive than traditional hand-held detectors

Up to 300 feet
Distance MobileGuard™ detects methane leaks from a moving car

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01 Modern gas detection technology covers more area in less time than conventional methods.

Due to the growing appreciation of the total cost to the environment due to climatic changes, some studies indicate that the effective price of fugitive emissions could be $27/mcf[4] which would be equivalent to $12.8 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 CO_2 over a 100 year time horizon, but 84 times stronger than CO_2 over a 20-year period.[5]

Aside from environmental concerns, the ability to quickly detect and fix a gas leak also makes good economic and safety sense. Financially, gas leaking from pipelines represents the loss of billions of dollars of revenue every year, both in terms of direct product loss and the effort and costs involved in replacing it.

In terms of safety, avoiding gas leaks can also help avoid high profile incidents. While pipelines are seen as a safer way of transporting gas than road or rail, 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.[6] In October 2020, a gas line explosion killed three people and injured 28 in Thailand. These incidents also come with financial consequences that are borne by both oil and gas operators and the public.

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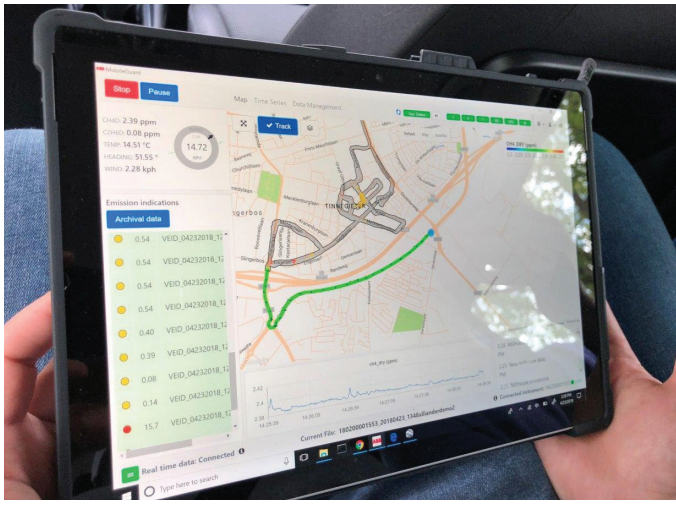

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Today's gas detection sensors can be fitted to road vehicles, aircraft or drones.
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Using today's mobile systems, gas technicians can cover 10-25 times as much area per hour compared to traditional technology.

Finding a needle in a needle stack

Traditional methods for checking for gas leaks are slow and have lacked the accuracy and sensitivity needed to detect small leaks in particular. Technicians must walk the area being inspected using hand-held analog detectors that can take a long time to calibrate once on site. Because these systems test the air only every few seconds, the technician must move slowly through the suspected leak site. Test results are manually entered in reporting systems, adding more time to the process.

The limitations of traditional gas leak detection have led to the increasing development and deployment of alternative methods utilizing new technologies. Recent advances in sensing, analytics and mobile technology have created a wave of gas leak detection solutions that perform significantly better than traditional methods. These systems can detect methane from natural gas leaks at concentrations of 1 part per billion (ppb) or less and respond in less than a second.

Some key facts about methane

- Methane is the second main greenhouse gas after carbon dioxide
- While it has a shorter lifespan than CO_2, the heating potential of methane is up to 84 times greater over a 20-year period
- Atmospheric methane reached record levels in 2019, over two and a half times more than in pre-industrial times
- Major sources of methane emissions include manure, coal mining, landfill, livestock and natural gas
- Natural gas is the largest source, accounting for over 30 percent of emissions
- The Global Methane Pledge signed at COP26 by over 100 countries aims to reduce methane emissions into the atmosphere by 30 percent by 2030

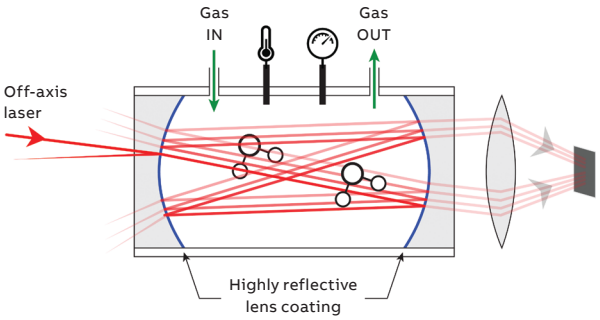
Tracking leaks with next-generation gas leak detection systems
Recent advances in sensing, analytics and mobile technology have created a wave of gas leak detection solutions that perform significantly better than traditional methods.

ABB, for example, has developed its ABB Ability natural gas leak detection solutions – an advanced suite of gas detection systems. Based on LGR-ICOS™ technology, this platform represents the latest evolution of tunable diode laser spectroscopy, offering sensitivity over 1,000 times that of older sensors and enabling unambiguous detection of leaks even hundreds of feet from the source.

Utilizing the ABB Ability platform, ABB has developed several gas leak detection solutions, including:
- MobileGuard™ – High-speed vehicle-based gas leak detection system
- MicroGuard™ – Portable gas leak detection system
- HoverGuard™ – UAV-based gas leak detection system
- EverGuard™ – 24/7 stationary gas leak emissions monitoring system

ABB advances leak detection technology's quantum leap – how does the LGR-ICOS™ technology work?
At the heart of the newly developed gas leak detection system is a high sensitivity analyzer capable of measuring and reporting methane concentrations several times per second. The analyzer uses a principle called off-axis integrated cavity output spectroscopy (OA-ICOS), which works by using a tunable laser source that produces light at a selected wavelength for interacting with the gas being analyzed (methane and ethane, in these cases).

The laser enters a highly reflective mirrored cavity, where it is reflected thousands of times before exiting onto a photodetector. This creates a very long optical path of many kilometers, increasing measurement sensitivity and producing strong absorption as the infrared light interacts with the gas present within the cavity. By changing the wavelength over which the laser operates, the concentration of the gas can be measured with high precision and accuracy.



With a sensitivity over 1,000 times higher than conventional leak detection technologies, the OA-ICOS method enables the analyzer to detect single parts per billion (ppb) levels of the target gases every second, enabling variations in atmospheric concentrations to be quickly measured from long distances where other technologies would be ineffective.

HoverGuard™
Sniffing out leaks from up in the air

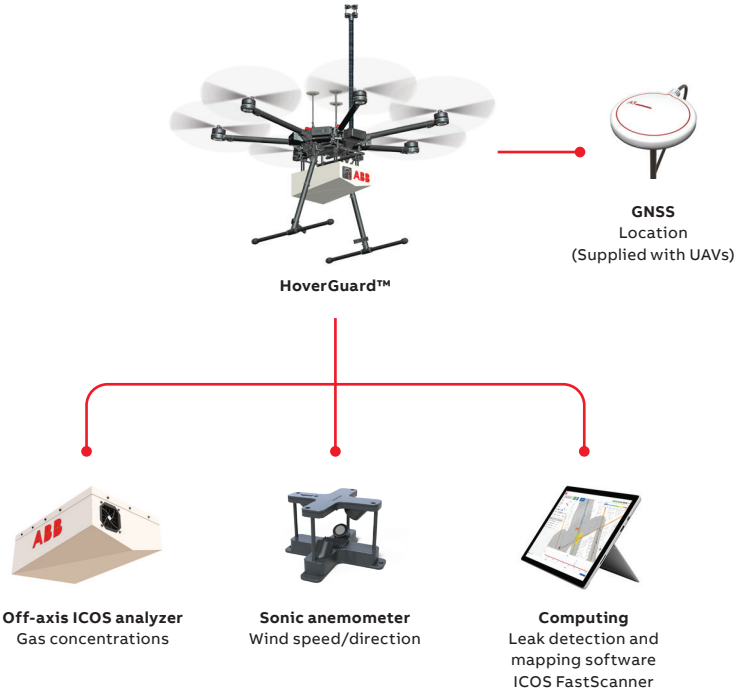
When methane leaks from a pipeline, it is carried by the wind, mixing with the air and decreasing in concentration as it travels further from the point of origin. By passing the airborne analyzer through the methane diffused in the air, the methane can be detected, and its concentration levels calculated quickly.

Able to gather accurate gas concentration data over large areas while moving at speed, UAV solutions such as the Hoverguard™ offer a fast, low cost and safe method for identifying potential leakage points, especially when compared to on-foot techniques. They also offer the ability to reach areas that would not otherwise be accessible either by foot or by a vehicle-based analyzer, such as bridges, high-rise buildings, inhospitable locations, areas with right-of-way restrictions and storage vessels. They can also offer a much less costly alternative to aircraft-based analyzers, with the ability to safely gather data at much lower heights than would otherwise be possible.

By enabling the drone to sample the air at a rate of five times per second as it flies, this approach offers advantages over other techniques. Most importantly, it offers greatly enhanced accuracy over laser-based systems using a scattered or reflected laser beam, allowing spatially resolved concentration measurements to be gathered rather than a path-averaged approximation.

The speed with which data can be gathered without compromising accuracy means that the drone can detect, locate, and estimate the size of natural gas leaks while covering 10-15 times more land area per minute than traditional methods. Additionally, with its extremely sensitive technology and fast response rate, it can quickly detect leaks more than 100 meters (328 ft) from their source.

To enable the exact location of a leak to be pinpointed, the HoverGuard™ solution combines an anemometer and GNSS (Global Navigation Satellite System) sensor to gather data on wind speed and position, together with mapping software that uses the data to produce detailed reports on leak locations. Able to be shared either directly or via the cloud, these reports can be easily made available to help pipeline operators to devise a suitable find-and-fix strategy.

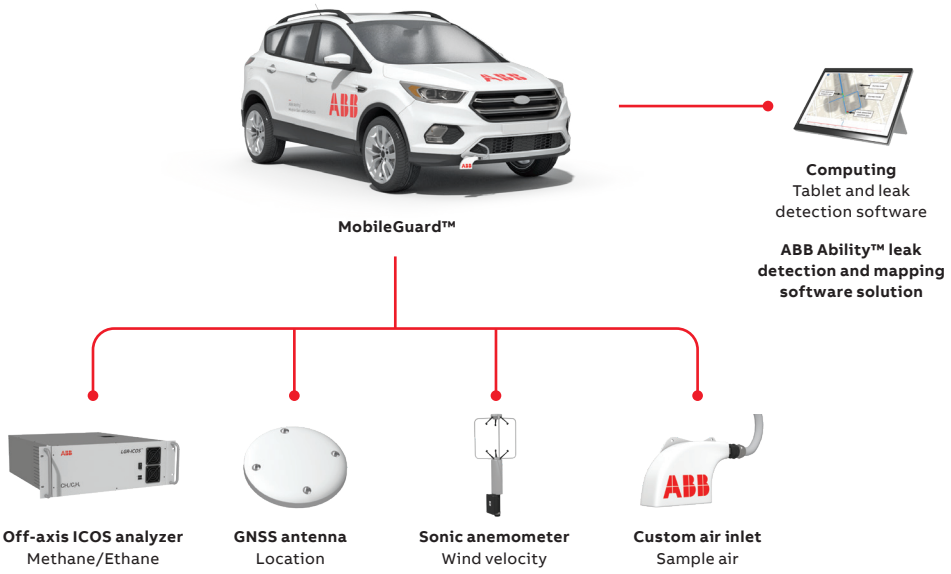


MobileGuard™

ABB's MobileGuard™ system enables accurate natural gas leak detection while driving. The vehicle-mounted system makes use of an LGR-ICOS™ analyzer in conjunction with an ultrasonic anemometer for measuring wind speed and a GNSS antenna for measuring location. The system uses advanced algorithms to combine this data with gas concentration measurements, enabling the MobileGuard™ system to locate, map and quantify the size of pipeline leaks from a moving vehicle far from the emission source.

Taking multiple measurements per second, the system can perform accurate leak surveys while driving at speeds of up to 88.5 kmh (55 mph) – enabling surveyors to cover 10-25 times more land area per minute than with traditional methods. Because the analyzer measures both methane and ethane concentrations, it can distinguish between pipeline gas or naturally occurring methane, making it reliable against false positives.

The MobileGuard™ system analyzes data locally and presents geospatial maps of all measured parameters in real-time. Data and analyses can be securely relayed to cloud storage for easy sharing and further analysis.



MicroGuard™

MicroGuard™ uses the same ultrasensitive detector technology as the MobileGuard™ system but is optimized for walking surveys. Comprising an LGR-ICOS™ gas analyzer, backpack, ruggedized tablet with Global Navigation Satellite System (GNNS) capability, proprietary software, and a custom-designed sample wand, the MicroGuard™ system enables walking surveyors to easily and accurately pinpoint natural gas leaks within minutes. MicroGuard™ software generates comprehensive digital reports of the survey, which can be shared immediately.

MicroGuard™

Off-axis ICOS analyzer
Gas concentrations

Backpack

Sample wand
Air inlet and UI mount

Ruggedized phablet with Android app
UI, GNNS, leak detection and mapping software

EverGuard™

EverGuard™ provides continuous, ultrasensitive monitoring of natural gas emissions near high-risk locations such as public gathering areas, schools and hospitals.

EverGuard™ consists of ABB's renowned micro portable multi-gas analyzer (GLA131 series) embedded into a weatherproof NEMA 4X enclosure that can be connected to several optional modules (e.g., solar panel, uninterruptible power supply, cellular transmitter, Wi-Fi router, GNSS receiver, weather station, multi-inlet sampling manifold) to meet the most stringent requirements of almost any application requiring continuous monitoring of natural gas leaks.

Local and remote communication is established using secure wireless communication and internet connectivity. This allows users to access data from anywhere and share it immediately to provide full transparency and meet all compliance requirements.

Policy recommendations

The digital age has transformed natural gas leak detection practices, enabling exponential improvements in sensitivity, accuracy, speed, and cost. As the US Congress contemplates legislation to ensure a safe and reliable natural gas pipeline system, we encourage lawmakers to take recent advances in commercially available technologies into account when designing a new pipeline safety law.

Any gas leak detection law should include the ability to do three basic things: (1) detect leaks, (2) precisely identify their location, and (3) accurately estimate their size. To accomplish this, we recommend that any leak detection system be capable of the following:

1

Detecting
Detect natural gas leaks of 0.5 standard cubic feet per hour (SCFH)

2

Locating
Provide an accurate estimate of the leak source location

3

Estimating Size
Estimate the leak's volumetric emission rate

Delivering the pledge
As in other areas of industry, measurement of methane sources provides the first major step towards improvement. By enabling the origins and extent of natural gas leaks to be quickly and accurately pinpointed, gas leak detection technologies such as those outlined in this paper have a major role to play in helping to ensure that the reductions promised by the Global Methane Pledge are delivered.

More information
To find out more about ABB's gas leak detection solutions, visit our portal page.

To arrange a call to discuss our gas leak detection solutions, click on the button below.
Contact us

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