Close-proximity monitoring with Nubo Sentry

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SENSIRION
connected solutions

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Executive summary

The oil and gas industry is under constant pressure to operate assets more reliably, reduce unplanned downtime and minimize product loss, while keeping people and infrastructure safe. Sensirion Connected Solutions supports these goals with continuous emissions monitoring technology that provides operators with timely, actionable insights into on-site conditions, enabling rapid response, optimized maintenance, efficient operations and a strong foundation for transparent and defensible reporting.

To address these challenges, Sensirion Connected Solutions has recently added Nubo Sentry to its portfolio of methane-emissions-monitoring solutions. This close-proximity monitoring solution is intrinsically safe and designed for placement near potential emission sources. Its rugged construction and maintenance-free battery operation make it suitable for a wide range of applications, delivering precise spatial and temporal data continuously for more granular emissions monitoring. The result: faster root-cause analysis, reduced downtime and improved safety, especially in confined areas.

Nubo Sentry is built on Sensirion's expertise in sensor development. It uses the proven and reliable sensor principle validated in the field by the fenceline monitoring solution Nubo Sphere and widely recognized by industry and academia for its accuracy. Nubo Sentry delivers best-in-class performance tailored to low-cost close-proximity monitoring. It has been thoroughly tested and proven to be effective whether operating as a standalone device, working alongside other Sensirion Connected Solutions technologies, or complementing existing safety gas sensors used in control systems.

Read on to learn where close-proximity monitoring can make the biggest impact, how Nubo Sentry fits into a comprehensive monitoring program, how it generates valuable insights, what Sensirion has done to advance this technology and why it's the best choice for close-proximity monitoring on oil and gas sites.

Why is close-proximity monitoring important?

Close-proximity emissions monitoring deploys intrinsically safe sensors close to potential emissions sources. Like fenceline monitoring, it is a powerful tool for continuous monitoring. But different problems require different solutions. Intrinsic safety enables flexible sensor placement, unlocking new monitoring possibilities delivering higher spatial and temporal resolution, as well as accelerating localization and root-cause analysis.

Onshore, offshore, anywhere

Emissions-monitoring challenges vary widely across the industry. A simple, low-production well site has different requirements than a complex midstream facility, while offshore environments introduce an entirely different set of constraints and emission profiles. Any practical monitoring solution must be flexible enough to adapt.

Nubo Sentry is built for that flexibility. It provides cost-efficient monitoring as a standalone solution or supplements large installations with additional data from the tops of tanks, pressure-relief valves, thief hatches, compressors and confined spaces, enhancing safety and operational awareness.

Offshore operations are especially well suited to benefit from close-proximity monitoring. Traditional approaches such as AVO or lower explosive limit (LEL) sensors typically miss more than 90% of leaks due to high detection thresholds or operational limitations inherent to in-person inspection. Under zero-wind conditions, explosive atmospheres can form, making hot work extremely dangerous. According to a recent study (Riddick et al. 2025), of 113 reported offshore leak-related safety incidents, 12% resulted in a fire.

Many offshore challenges stem from operational realities: dense and complex platform layouts, corrosive salt spray, high winds, difficult access and the pressure to minimize costs. According to the above study on offshore safety, 17% of incidents were false alarms, adding costs rather than reducing them.

There is a clear gap in offshore emissions monitoring. Sensirion Connected Solutions developed Nubo Sentry to close that gap.

Nubo Sentry: part of a monitoring portfolio, part of a complete picture of emissions

Nubo Sentry stands as a key component of Sensirion Connected Solutions' portfolio of continuous monitoring solutions. It works on its own or in combination with Nubo Sphere fenceline monitoring and the Kuva camera. Deploying these solutions strategically provides a cost-efficient path to expanded coverage and optimized performance. Operators gain a complete view of on-site and off-site emission profiles, accurate event detection and faster root-cause identification. That means: robust regulatory compliance, improved safety, streamlined operations and lower emissions-management costs.

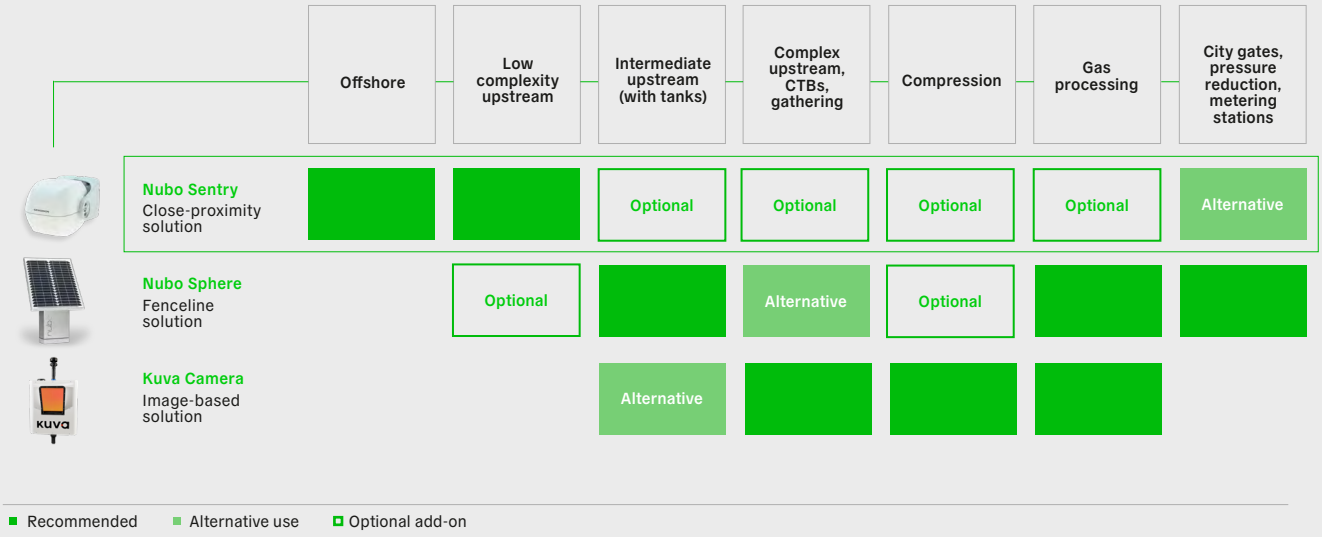

Figure 1: Use Nubo Sentry as a standalone monitoring solution or combine it strategically with Sensirion's fenceline and camera solutions across the oil and gas value chain.

The advantages of deploying Nubo Sentry

Nubo Sentry supports operators with sensitive emissions detection, reporting and LDAR workflows. With a high probability of detection and five times lower limit of detection than typical alternatives, it identifies smaller emissions and covers larger areas, reducing overall monitoring costs. Even short, intermittent emissions are captured. In hazardous, confined and remote environments, Nubo Sentry provides intrinsically safe, maintenance-free monitoring with a five-year battery life and wireless connectivity. Its rugged, resilient design makes installation simple and fast.

How can the oil and gas industry use close-proximity monitoring?

Close-proximity monitoring with Nubo Sentry serves a wide range of use cases, from retrofitting legacy offshore rigs to equipping new platforms, monitoring low-production wells and complex facilities, supporting indoor deployments and enabling compliance with EU regulations.

Designed for flexibility, Nubo Sentry performs in standalone mode or in strategic combination with the Kuva camera and Nubo Sphere fenceline monitor. Wherever operators need close-proximity data, Nubo Sentry makes deployment straightforward.

Simple to install, simple to save

Nubo Sentry installs and scales easily, whether as part of a dense sensor network or only at strategic locations. Each Nubo Sentry provides five years of maintenance-free, battery-powered operation with no need to run wires for power.

Flexible LoRaWAN integration for all setups

Nubo Sentry communicates via LoRaWAN, a low-power, long-range wireless protocol enabling reliable data transmission from remote or hard-to-access locations. It's especially well-suited for industrial environments where wired connectivity is impractical or costly, such as offshore platforms or dispersed field installations.

Whether operators already have LoRaWAN infrastructure, are just starting with the protocol, or prefer not to manage connectivity themselves, Nubo Sentry can adapt. Data can remain on existing local networks or be securely transmitted to the cloud for advanced analytics, including wind-based localization and emission quantification.

Operators can choose to keep infrastructure fully under their control or rely on Sensirion's expertise to handle connectivity and data services. This adaptable approach ensures Nubo Sentry can be deployed efficiently across sites with different connectivity and digital maturity.

Deployment scenarios

Legacy offshore operations

Beyond the challenges inherent in strong winds, saltwater exposure, remote locations, tightening regulations and safety concerns, legacy offshore sites add aging infrastructure that increases emission risks. Nubo Sentry offers a non-intrusive, cost-efficient approach to retrofit existing platforms, minimizing product loss, complementing existing LEL sensors with lower-detection-limit capabilities, improving safety and extending asset life.

Future-proof new builds

New platforms present an opportunity to integrate efficient methane monitoring from the start. With its compact design, hazardous zone certification, flexible mounting options and autonomous operation, Nubo Sentry is ideal for modern sites. It equips facilities to meet regulatory demands while maintaining operational excellence.

Low-production wells

Low-production sites require low-cost solutions. With the lowest hardware cost in the Sensirion Connected Solutions portfolio, Nubo Sentry delivers effective standalone monitoring. Adding a wind sensor allows the system to identify offsite emissions and perform accurate quantification.

Figure 2: Deployment example of two Nubo Sentry nodes covering a simple site for reliable, low-cost methane monitoring.

Maximum coverage for complex facilities

In complex or high-priority locations, Nubo Sentry complements Nubo Sphere fenceline monitoring. Together, they optimize detection of potential emissions from sources such as tank thief hatches, compressors and separators, increasing the spatial resolution of monitoring and improving location accuracy, speeding up root-cause analysis and reducing LDAR costs.

Figure 3: Deployment example of three Nubo Sentry sensors covering key equipment in addition to Nubo Sphere for fenceline monitoring.

Enclosed spaces

Confined spaces, where methane can accumulate over time, require intrinsically safe equipment and a different monitoring approach. Nubo Sentry converts methane concentration data into emission rates by factoring in building volume and ventilation, allowing operators to detect methane buildup and maintain safe working conditions.

Simplified OGMP Level 5

OGMP 2.0 Gold Standard requires reconciliation of extensive source-level (L4) and site-level (L5) methane surveys. This often means running simultaneous L4 campaigns alongside multiple L5 aerial surveys. While this supports a better understanding of discrepancies, it also ties up resources. Nubo Sentry provides continuous close-proximity monitoring that reduces uncertainty and streamlines compliance workflows by enabling comparison across campaigns, even when they occur at different times. Nubo Sentry data is available for all time stamps, giving insights in addition to those provided by other technologies.

Nubo Sentry: part of a legacy of sensor expertise

Nubo Sentry is the result of 25 years of experience developing sensors. Since 1998, Sensirion has designed, manufactured and shipped over a billion sensors across industries including medical, automotive and various industrial applications.

Nubo Sentry builds on the success of the photoacoustic-based laser spectroscopy sensor deployed in the Nubo Sphere fenceline monitoring solution. The sensor is an implementation of a lab-proven technology, miniaturized for use in the field. Probing air to detect methane's unique absorption fingerprint, it delivers long-term reliability, accurate concentration readings with a low detection limit, maintenance-free operation and high specificity to methane.

Nubo Sentry enhances this technology with reduced power consumption, enabling five years of battery-powered, intrinsically safe operation at lower cost.

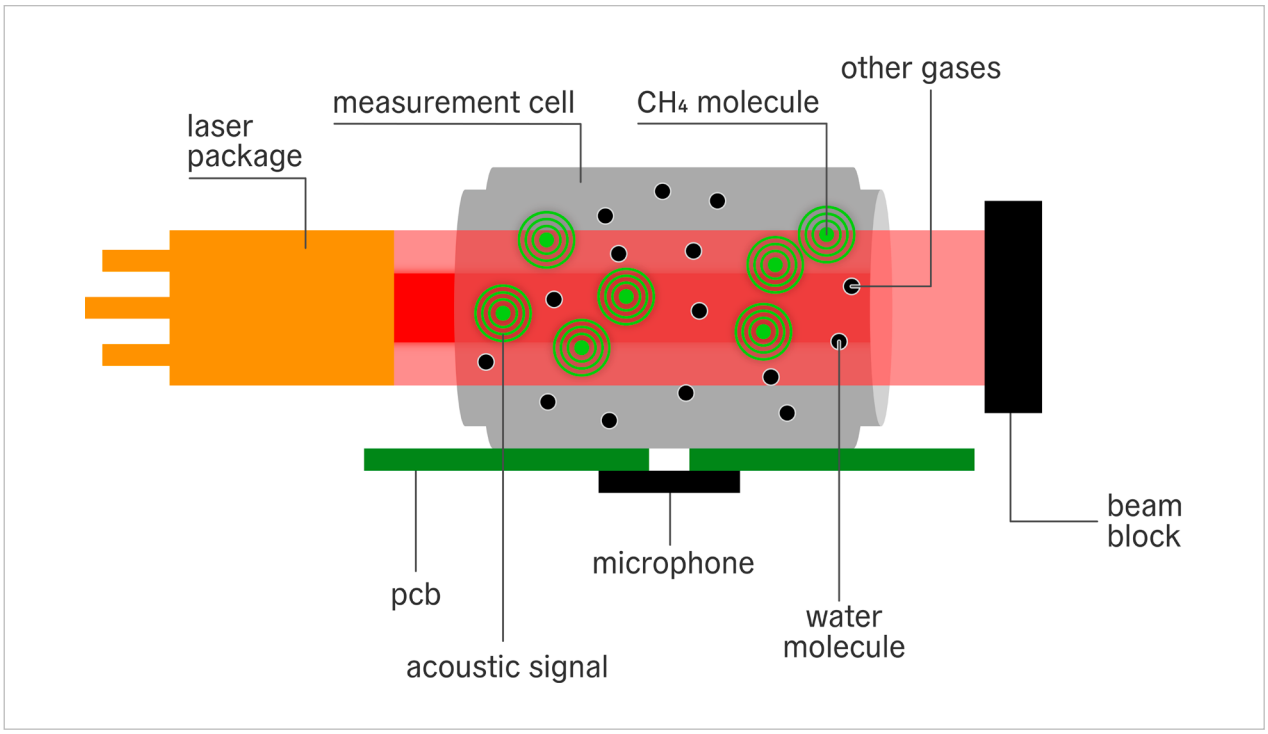

Figure 4: Working principle of Sensirion's proprietary photoacoustic sensor technology.

> For our new close-proximity sensor, we evaluated all major methane sensing technologies. Leveraging our deep expertise in thermal conductivity, MOx and NDIR—as one of the world's leading suppliers of TC sensors—the analysis was thorough. The result was clear: photoacoustic laser spectroscopy is the best choice for accurate detection near the source.
>
> Hedwig Knötig, Product Manager at Sensirion Connected Solutions

Nubo Sentry: tested and proven

After a nine-month development sprint, Sensirion Connected Solutions put Nubo Sentry to the test at the TotalEnergies Anomalies Detection Initiatives (TADI) test platform.

This test exposed Nubo Sentry to an array of controlled releases, with rates ranging from 0.4 to 15.2 kg/h, durations from 20 to 190 minutes, several simultaneous releases from multiple sources and releases of nitrogen and butane to test sensors for false positives. Sensirion Connected Solutions deployed 11 Nubo Sentry nodes. The objective: demonstrate a detection limit below 20 ppm and low noise levels in field conditions, plus showcase the benefits of that low detection limit, with a high probability of detection for both small and large emissions.

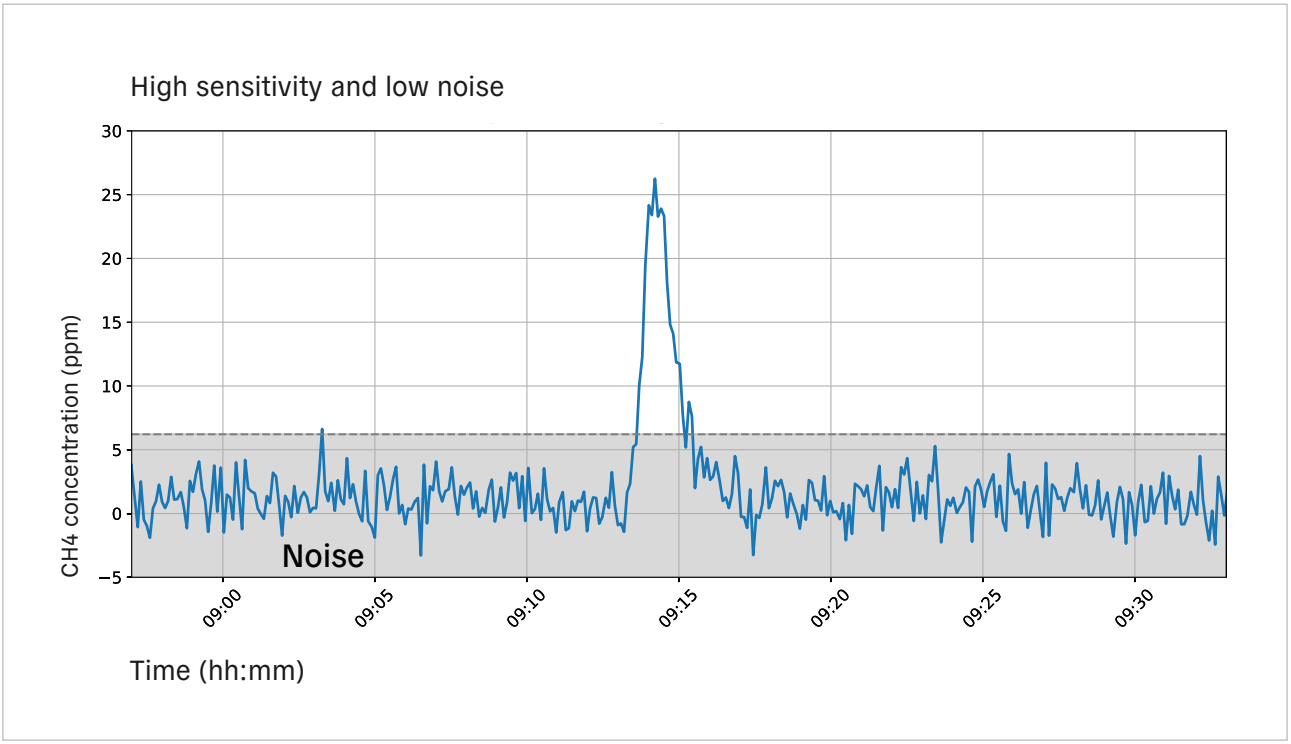

Figure 5: Nubo Sentry detecting a 25 ppm emission.

The results were excellent. Nubo Sentry achieved a detection limit below 10 ppm, based on a 3-sigma noise level in real-world conditions. This high sensitivity enabled reliable identification of methane peaks as low as 15 ppm, clearly distinguishable from baseline noise and fluctuations.

Nubo Sentry's low limit of detection translated, as expected, to a high probability of detection. From a total of 27 experiments, Nubo Sentry detected methane from every single emission evevnt across five days of testing. At the same time, thanks to Nubo Sentry's high specificity to methane, it produced no false positives, generating no signal from released nitrogen and butane.

Based on these test results, operators can count on Nubo Sentry to reliably detect emissions with a minimal deployment of sensors in the field. It's worth noting that reliably detecting methane concentrations below 10 ppm is far better than is possible with other commercially available solutions.

- **19%** of events had maximum methane concentrations below **50 ppm**, undetectable by a lower-performing solution.
- **30%** of events were below **100 ppm**, reinforcing the need for high-sensitivity sensors to achieve high detection probability.

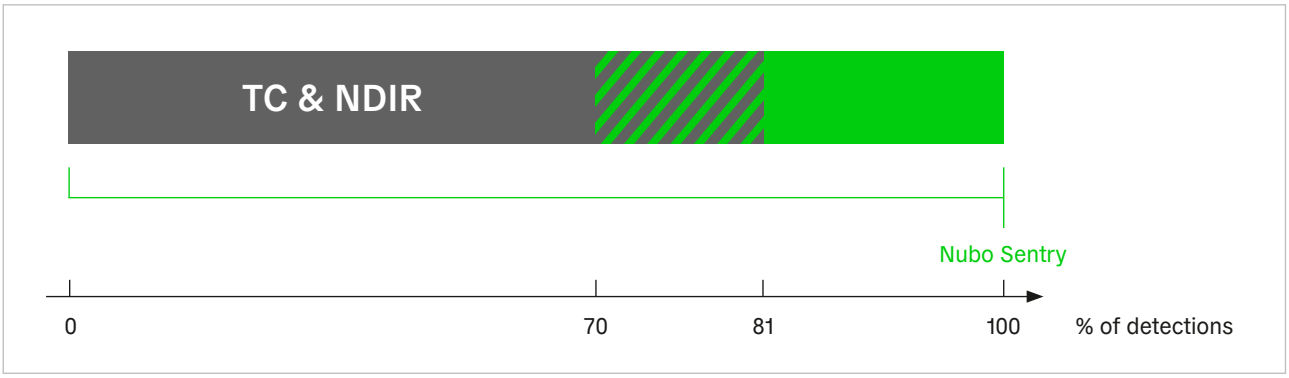

Figure 6: Nubo Sentry reliably detected methane from all controlled release events. Alternative technologies with a limit of detection of only 50 or 100 ppm suffer from decreased probability of detection.

Nubo Sentry compared to thermal conductivity and NDIR

As a global leader in advanced sensor technology, Sensirion has extensive experience with other technology available for close-proximity monitoring, such as MOx, thermal conductivity (TC) and nondispersive infrared (NDIR) sensors. In fact, Sensirion is one of the world's top suppliers of TC sensors for applications such as A2L refrigerant leakage detection, NDIR sensors for indoor CO_2 monitoring and MOx sensors for indoor air-quality monitoring. This expertise enabled Sensirion to understand each technology's capabilities, choose the right one for methane and close-proximity sensing and to innovate beyond their limitations.

Thermal conductivity

TC sensing is based on the inherent thermal conductivity of gases. The measurement principle involves heating the air within a measurement cavity and detecting heat transfer with a temperature sensor.

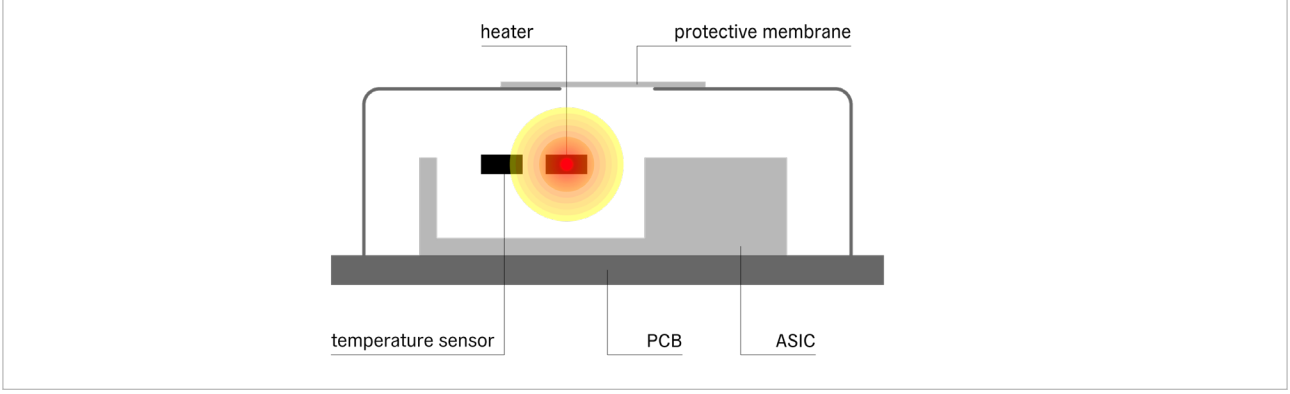

Figure 7: Working principle of TC sensors as used for CO_2 monitoring by Sensirion AG. Total thermal conductivity changes depending on how much CO_2 is present in the air.

Different gases in natural gas emissions have different thermal conductivities, meaning they carry heat differently. Methane has a higher thermal conductivity than air at room temperature—it transfers heat more easily. Gases like ethane and propane do the opposite. This principle is how TC sensors detect methane. The trouble starts when these gases mix. The thermal conductivity of different gases can cancel each other out, making them harder to detect using TC sensors.

Close-proximity solutions based on TC technology typically detect methane concentrations only down to 50 ppm and only under ideal environmental conditions. The photoacoustic sensor technology at work in Nubo Sphere and Sentry beats this by at least a factor 5, delivering methane-specific accuracy down to 0.5 ppm (Nubo Sphere) and 10 ppm (Nubo Sentry). With 99% methane selectivity and negligible cross-sensitivities compared to TC sensors, these sensors precisely and quickly detect even short-lived emission peaks independent of actual gas compositions. This is especially important for emissions monitoring of tanks, where methane concentration can be as low as 40 – 60 % in emissions rich in ethane, propane, butanes, CO_2 and water.

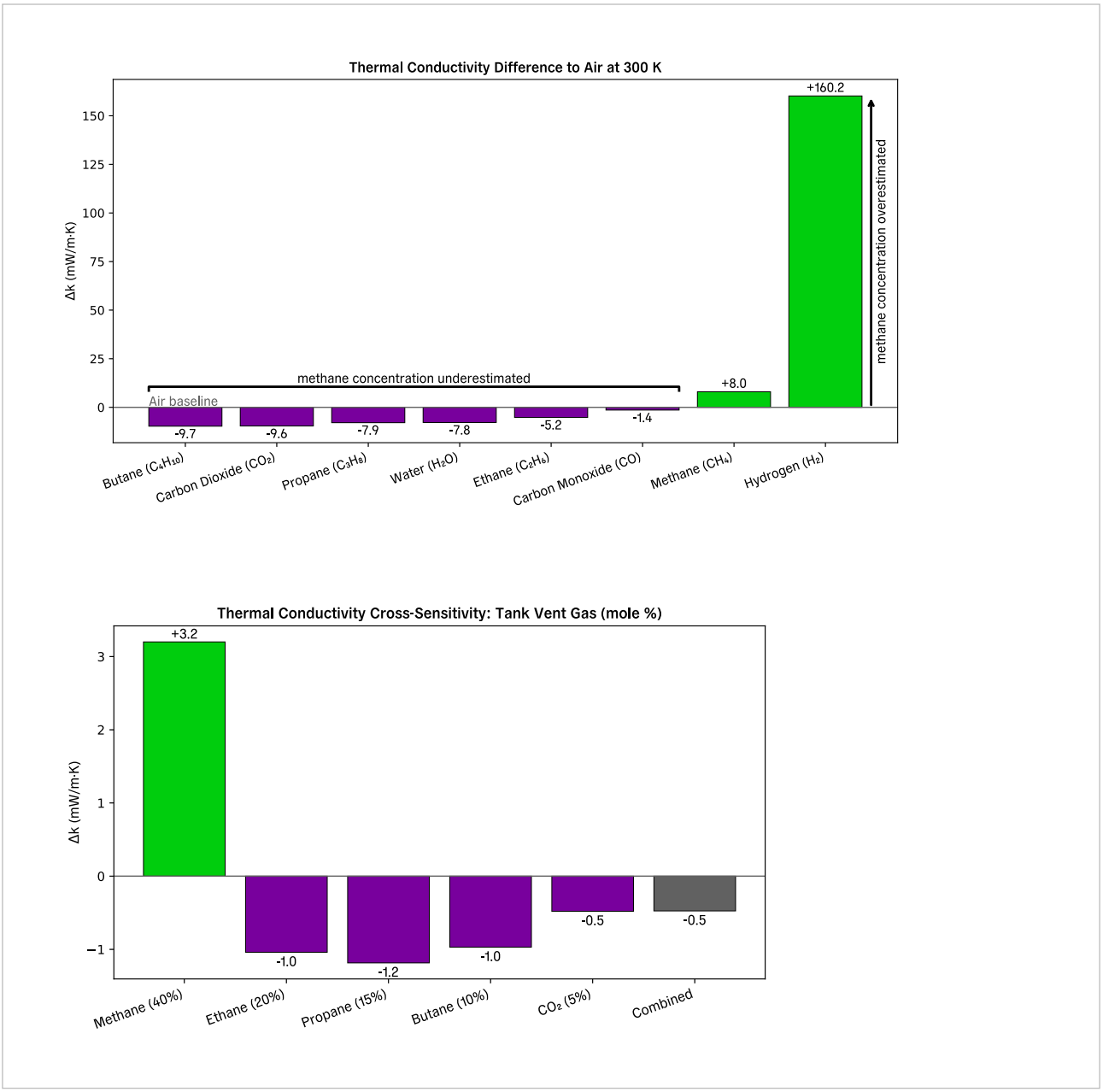

Figure 8: **Top:** The thermal conductivity of different gases. **Bottom:** TC sensors fail when presented with a mix of gases as present in tank vent gas that cancel each other's thermal conductivity out.

NDIR

NDIR sensor technology is another option for detecting methane. These sensors tune infrared light to the narrow absorption band of a specific gas. The light then passes through other gases while being absorbed only by the target gas—in this case, methane.

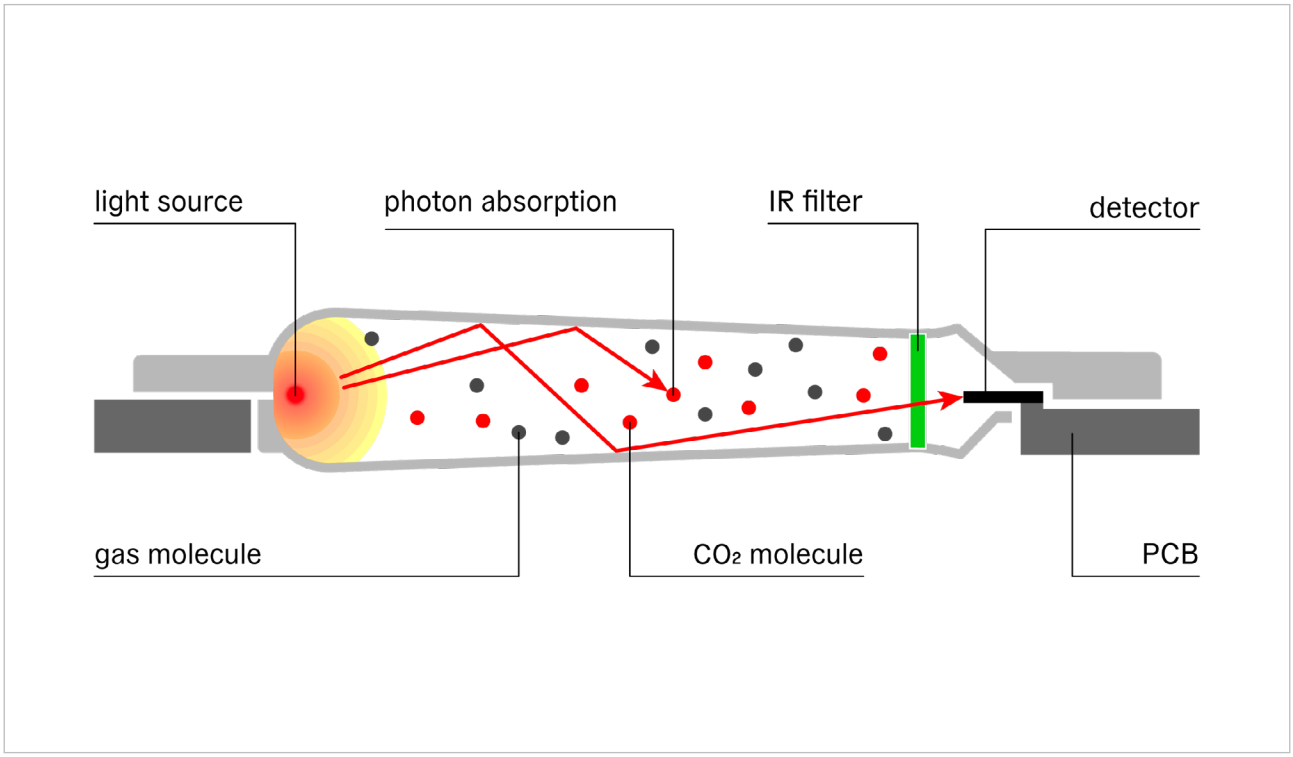

Figure 9: Working principle of NDIR sensors. Infrared light tuned to a specific gas passes through an optical chamber to a detector that measures IR light not absorbed by the target gas.

NDIR sensors do not have TC and MOx sensors' weaknesses, but they do have limitations. First, the optical cavities in these sensors are key to their functioning, which leaves them vulnerable to anything that changes the optical cavity. If corrosive chemicals enter the optical cavity—as may happen in industrial settings—the sensor will not function optimally. Direct mechanical stress, such as that caused by an impact, can also damage the optical cavity of NDIR sensors. Finally, because NDIR sensors work by measuring IR that is not absorbed, the sensor signal actually decreases as methane concentrations increase. Small changes in offset, therefore, produce an outsized impact on sensor output.

By designing for battery-powered operations over long timeframes in hazardous zones, Sensirion built a sensor that delivers reliable and quick emission detection at a reduced total cost of ownership. For oil and gas operators, that means improved safety, minimized product loss and meeting regulatory requirements with confidence.

Conclusion

Nubo Sentry is a close-proximity monitoring solution the oil and gas industry can rely on for continuous, highly accurate emissions data from critical locations, even in the most challenging sites and environments. It delivers the right sensor technology in a low-cost, rugged and intrinsically safe package. With a detection limit below 10 ppm, it detects both small and large emissions. With five-year battery life and wireless connectivity, it installs quickly and integrates seamlessly into operations.

Whether retrofitting legacy platforms or future-proofing new assets, operators can rely on Nubo Sentry for efficient offshore monitoring. As a standalone solution, it offers low-cost coverage; combined with other solutions from Sensirion Connected Solutions, it maximizes coverage across even the most complex sites. It enhances safety in hazardous zones, simplifies reporting and enables smarter, data-driven decisions.

Works cited:

Riddick, S. N., Mubua, M., Laughery, C., & Zimmerle D. J. (2025). Assessing the Potential Impact of Fugitive Methane Emissions on Offshore Platform Safety. preprints.org.

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About us

Sensirion Connected Solutions specializes in advanced sensor-based IoT solutions for continuous emissions monitoring in the energy sector. Its end-to-end platform combines proprietary methane sensing and optical gas imaging technologies with powerful data analytics, root-cause diagnostics, and expert field support. Designed to simplify methane mitigation, the company‘s solutions empower operators to reduce emissions efficiently, meet ESG goals, enhance operational safety, and ensure regulatory compliance. With offices in Boston, Midland, Calgary, Chicago, and Switzerland, Sensirion Connected Solutions is a subsidiary of Sensirion Holding AG, a global leader in high-performance digital microsensors for environmental and flow sensing applications.