

Case study

LUMEN Terrain continuous monitoring technology reduces biogas emissions with low cost and high reliability



LUMEN Terrain sensor installed for continuous monitoring at perimeter of biogas lagoon.

LUMEN Terrain forms a site-wide wireless network that's fully scalable to meet any project needs.



Roeslein Alternative Energy (RAE) owns, operates, and develops renewable energy production facilities—converting agricultural and industrial waste into valuable renewable natural gas (RNG) while eliminating emissions.

RAE has projects that capture and sell RNG produced from the anaerobic conversion of manure, where impermeable synthetic covers are installed on manure lagoons, turning them into anaerobic digesters. Biogas (which contains methane and small amounts of hydrogen sulfide) is captured, and impurities removed to create pipeline-quality RNG, which is injected into a national pipeline.

RNG is in high demand as a clean, renewable, and reliable source of baseload power instead of coal or natural gas, and it can also be used as a transportation fuel.

Challenge

A valuable commodity, methane is also a greenhouse gas, so leaks are a concern for stakeholders. Since RAE is committed to clean, sustainable, and safe operations, they already employed standard emission-inspection methods such as AVO (audio, visual, olfactory)—but they wanted a more robust monitoring program.

Their operations are also sensitive to even small leaks, as biogas with lower emissions intensity during production can be sold for a higher price.

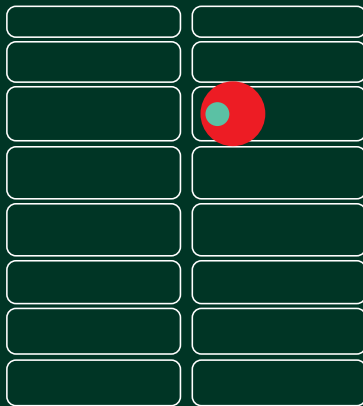
RAE needed a sensitive and reliable quick-detection solution that would meet both their environmental and business requirements.

Solution

After careful evaluation of emission-monitoring alternatives, RAE chose LUMEN Terrain—a low-cost, safe, and effective continuous-monitoring solution.

LUMEN Terrain is an IIOT system that combines existing sensor technology with innovative methodologies and advanced analytics.

Sensors are rugged, all-weather devices with no moving parts and no required or scheduled maintenance during their projected life. They're solar-powered and untethered from the grid—which speaks equally to the system's availability, reliability, and cost-efficiency (LUMEN Terrain is less expensive than competing technologies). Each node collects data from its specific location and transmits to the cloud via the base station. Sensors monitor and record emissions of methane



V19—leak detected and repaired

- High level spike detected by Terrain system August 24
- Estimated volume of gas lost during spike: 413 scf
- Operations notified, identified, and repaired leak

Lost gas potential without monitoring:

- 24 hours: 6 mmBtu
- 1 week: 40 mmBtu

- detected leak location
- actual leak location



Avitas uses historical weather data and proprietary analytics to model each site and optimize the quantity and placement of sensor nodes to ensure the ideal balance of cost and performance for each system.

and correlate H₂S levels—24 hours a day, either continuously or on a set cycle. The system also collects local environmental data including temperature, humidity, wind speed and direction.

The cloud-based system requires no software downloads, and includes an advanced, intuitive desktop application. All raw data is post-processed in the cloud and available to operators via a user-friendly dashboard, which displays current and historical emission trends for each site, any anomalies or unexpected events, wind conditions, and allows the user to see the most likely area of a leak.

The entire solution is easy to deploy, manage, and use. With the propriety LUMEN positioning technology, there is nothing for operators to configure or adjust. Units are placed at optimal locations around the area to be monitored, and data is automatically sent to the highly secure cloud. Operators in any setting can define alerts across thresholds and time periods. When a high level is detected, the system will automatically alert operations and indicate the area of origin.

For RAE, sensors are placed on the perimeter of the lagoons where they detect and report airborne biogas.

Successful pilot program drives application on additional sites

During a pilot program, RAE's lead site operator received a Terrain alert of elevated emission readings from lagoon V19. During installation, Avitas software used historical wind data and plume dispersion modeling to optimize placement of the six-sensor system and maximize probability of detection. As a result, within days of installation, the system detected a leak and identified the new cover attachment design as suboptimal and allowing leakage.

The easy-to-understand dashboard reported which sensors were recording spikes, along with wind direction and source location in the southeast corner of a lagoon cover. Upon inspection, the operations team found a leak near the edge of the lagoon—quickly repairing it to prevent biogas emission, H₂S exposure, and costly product loss.

LUMEN Terrain is a particularly effective emissions-reduction tool, given the technology and design of biogas operations. The size and design of lagoons and covers (often the size of two football fields) make it difficult to inspect for leaks using traditional audio/visual/olfactory (AVO) methods, as operators must regularly walk around to visually inspect for damage and potential leak points.

As a continuous monitoring system, Terrain supplements RAE's rigorous inspection processes with 24/7 actionable monitoring observations, so the operators can address potential issues on a real-time basis.

Terrain also provides the data necessary to make operational and engineering design changes to permanently reduce emissions, and it can provide predictive analytics to effectively ensure a robust and safe leak-detection and repair program.

Benefits

By installing LUMEN Terrain, RAE now has autonomous, efficient, cost-effective, and continuous emissions monitoring. The system protects personnel, revenue and the environment, supporting RAE's commitment to responsible operations—and creating real value for its operations.



Efficient

Manual lagoon inspections are time-consuming and ineffective since only perimeters are inspected with handheld instruments, and can allow leaks to go undetected. LUMEN Terrain, on the other hand, autonomously monitors for leaks across entire lagoon covers, not just perimeters. Autonomous alerts enable operators to inspect by exception, only investigating when their attention is needed.



Cost-effective

Biogas trades for up to 40 times the price of natural gas, so a single 100 scfh leak can cause an operator over \$5,000 a month. RAE's LUMEN Terrain system paid for itself within weeks.



Safe

Biogas has a typical H2S content of more than 2,500 ppmv, while the OSHA peak exposure limit is just 50 ppm. LUMEN Terrain correlates detected biogas to expected H2S levels, providing an early warning for RAE operators if a hazardous situation is developing.

Contacts

Gage McCoy

Avitas Sales Lead

Gage.Mccoy@bakerhughes.com

+1 432.553.7606

Joe Guehring

EHS&P Instrumentation Division & Business Development Director

Pioneer Industrial Corporation

jguehring@pioneerindustrial.com

+1 314.308.0871

Baker Hughes 