

Pipeline integrity in the age of Environmental Intelligence

Combining traditional expertise, modern measurement and digital decision-making



1. The expanding definition of pipeline integrity

For decades, pipeline integrity has been built on a simple principle: ensuring the safe, reliable and responsible transport of natural gas. Every inspection, leak survey, maintenance activity and engineering assessment is ultimately designed to answer one fundamental question: Is the asset performing as it should?

That objective has not changed. What has changed is the information available to answer it.

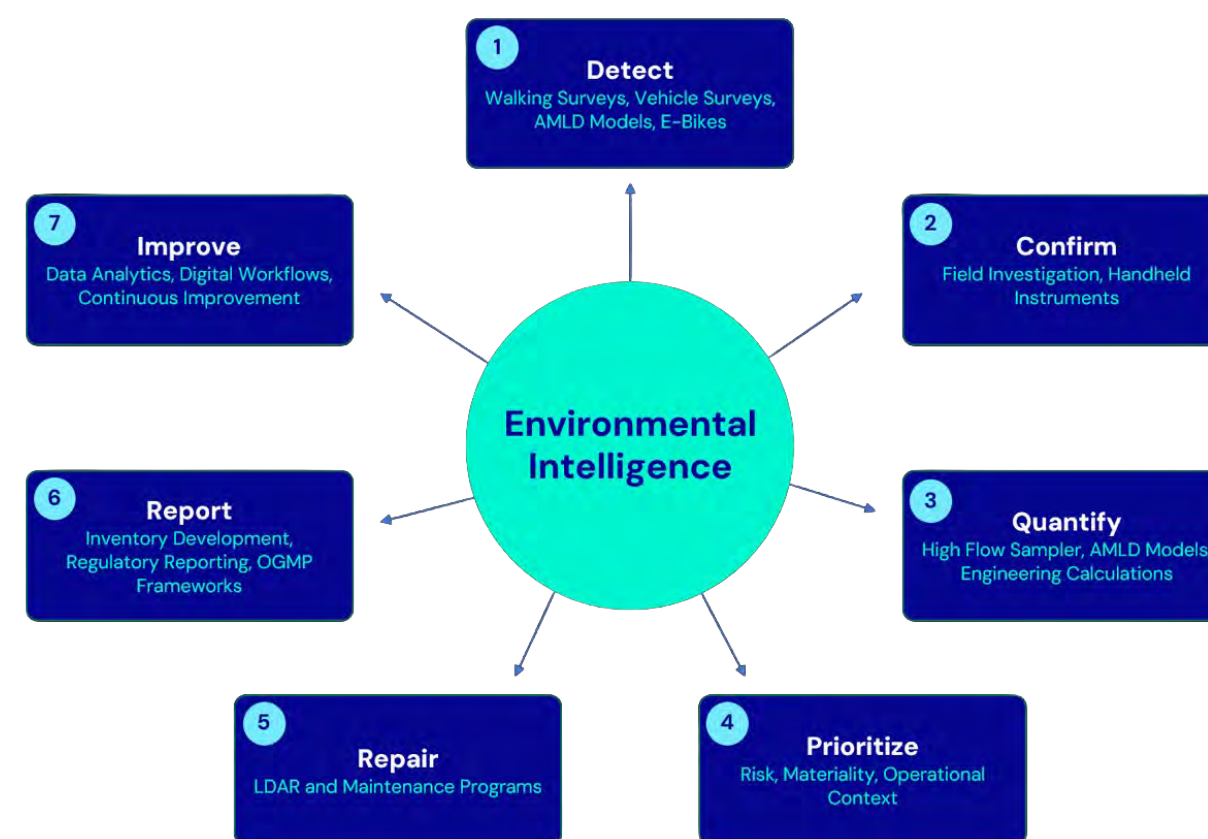
Pipeline operators are now expected to understand not only the condition of their assets, but also their environmental performance. Advances in measurement technologies, evolving regulations and growing expectations for transparent reporting are encouraging operators to move beyond traditional leak detection towards a more comprehensive understanding of methane emissions.

As a result, methane management is becoming an integral part of modern pipeline stewardship. Operators are no longer focused solely on identifying and repairing leaks. They also want to understand where emissions occur, how significant they are, and which actions can deliver the greatest operational and environmental benefit.

This evolution does not replace traditional pipeline integrity; it builds on it. Leak detection remains fundamental to pipeline management, but it is now part of a broader approach to understanding and managing methane emissions.

Advances in measurement technologies, digital asset information and emissions quantification have expanded the information available to operators. Survey programmes are more efficient, network coverage has improved, and measurements can increasingly be combined with operational and engineering data to provide a more comprehensive

Figure 1. Typical Environmental Intelligence workflow for integrated methane management.



view of pipeline performance.

This evolution is creating a new form of operational insight that turns measurements, engineering expertise and operational knowledge into informed decisions. We describe this integrated approach as Environmental Intelligence: combining traditional expertise, modern measurement technologies and digital decision-making tools to provide a more complete understanding of pipeline integrity while supporting informed, efficient and transparent methane management.

Rather than focusing solely on finding leaks, Environmental Intelligence helps operators prioritise actions, strengthen confidence in reporting and continuously improve methane management across their pipeline networks.

The future of methane management is therefore not defined by a single technology. Its value comes from combining multiple sources of information into a coherent view of pipeline performance that supports informed operational decisions.

2. Environmental Intelligence in practice

In practice, this means moving from individual methane surveys to an integrated methane

management programme. Detection becomes the starting point rather than the end of the process. Measurements are confirmed, quantified and prioritised, then translated into action. The resulting insights inform reporting, operational planning and future monitoring.

Environmental Intelligence considers the full lifecycle of methane information. Instead of treating detection, quantification, repairs and reporting separately, it connects them in a continuous process where knowledge from each stage strengthens the next. From initial indication through confirmation, quantification, corrective action and reporting, each stage enriches the understanding of pipeline performance. Methane management becomes an ongoing learning process rather than a series of disconnected field activities.

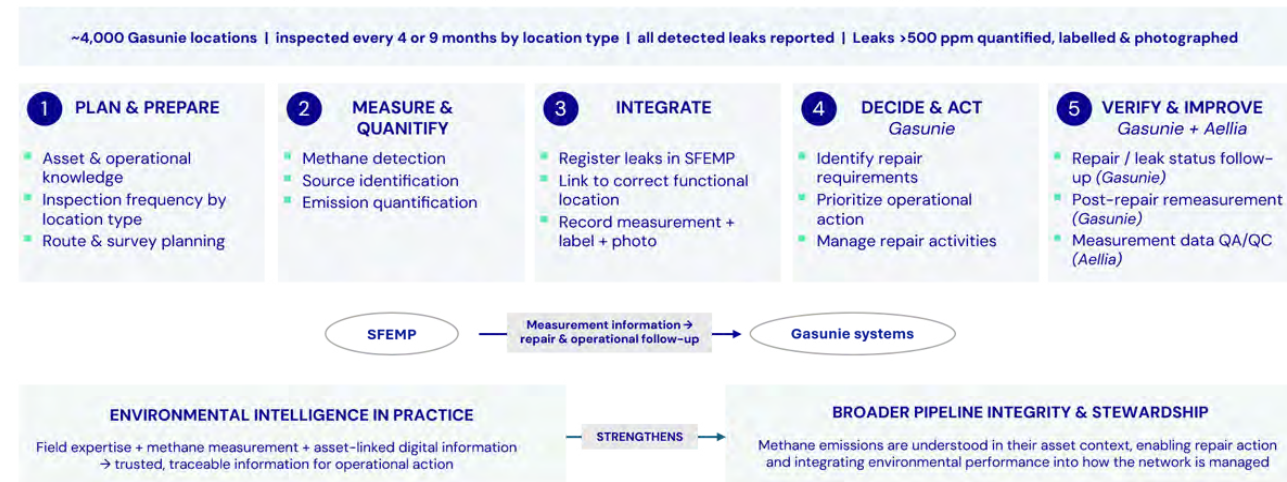
Figure 1 illustrates a typical Environmental Intelligence workflow. Although technologies, survey methods and operational practices differ across operators and pipeline networks, the underlying principle remains the same: each stage contributes information that adds context and value to the next.

This integrated workflow enables operators to understand emissions in their operational context, prioritise mitigation activities and improve methane →

Figure 2. Gasunie methane measurement and operational workflow

Environmental Intelligence in Action – Gasunie Case Study

A methane measurement and repair workflow supporting environmental performance within pipeline integrity management



management over time. Rather than simply documenting emissions, operators can learn from every survey, repair and measurement.

Delivering this approach increasingly relies on collaboration between pipeline operators, measurement specialists, digital solution providers and engineering experts. Their complementary capabilities create a more complete view of pipeline performance than any single technology or discipline can achieve alone.

Ultimately, Environmental Intelligence is realized not by introducing new activities, but by connecting existing ones in a continuous process of learning and improvement. The result is a more coordinated, transparent and adaptive approach to methane management that strengthens both pipeline integrity and environmental performance.

3. Selecting the right technology for the right application

Traditional walking surveys remain essential where close access, source confirmation and detailed investigation are required. Mobile technologies, including cars, quads, Advanced Mobile Leak Detection (AMLD) platforms and e-bikes, can broaden network coverage and support more frequent inspections. Direct measurement methods, such as underground high-flow sampling or suction methods, and engineering-based approaches provide information on emission magnitude to support repair prioritisation, reporting and methane inventories.

Digital technologies complete this picture by

bringing information from multiple sources into a coherent operational view. Integrating measurement results with asset information, repair records, operational context and reporting requirements improves traceability, supports decision-making and provides a more complete understanding of pipeline performance throughout the methane management lifecycle.

The strongest results are achieved when these technologies are used together rather than independently. Walking surveys, mobile detection systems, quantification methods and digital platforms each contribute complementary insights. Combined within an Environmental Intelligence framework, they provide a more reliable and actionable picture of methane emissions than any single technology can provide alone.

As methane management programmes mature, technology selection is becoming an exercise in strategic integration rather than individual tool selection. Success is not defined by deploying the newest sensor or most advanced technology, but by combining complementary technologies that generate trusted information to support operational objectives, regulatory compliance and environmental performance goals.

A growing range of methane detection and quantification technologies is giving pipeline operators new ways to detect, quantify and understand methane emissions across their networks. The challenge is no longer simply to detect emissions, but to determine which technologies are best suited

to different operational objectives and stages of the methane management lifecycle.

No single technology can meet every objective. Different tools operate at different scales, generate different types of information and support different stages of the methane management lifecycle. Selecting the right technology is therefore less about identifying the most advanced solution and more about choosing the right combination of complementary approaches.

The Gasunie case study provides a practical example of Environmental Intelligence in action. By connecting methane measurement and asset-linked information with repair and operational follow-up, the workflow illustrates how field information can support operational decision-making, as shown in *Figure 2*.

4. From data to decisions

Generating trusted information is only one part of effective methane management. Equally important is the ability to interpret that information and translate it into decisions that improve operational performance, optimise resources and strengthen environmental outcomes.

As methane management programmes mature, operators are moving beyond individual measurements to understand broader patterns across their networks. Survey results, quantification data, repair records, asset information, operational data and reporting requirements each provide valuable insights. Considered together, they can reveal recurring emission sources, improve survey strategies, prioritise mitigation and clarify the factors driving methane emissions.

Digital platforms support this transition by integrating survey results, emissions measurements, asset information, repair activities and reporting requirements within a common operational environment. They provide a consistent, traceable framework for managing methane information, strengthening quality assurance and confidence in operational planning and emissions reporting.

Rather than serving simply as repositories, digital methane management platforms support a continuous decision-making process. Field observations, measurement results and repair activities are linked through an integrated workflow,

allowing knowledge gained from one activity to improve future planning, monitoring and reporting. In this way, information is continuously transformed into actionable insight.

As measurement programmes expand, the ability to interpret information efficiently is becoming as important as the ability to collect it. The value of Environmental Intelligence is realised when data, technology and engineering expertise are brought together to support informed operational decisions, enabling operators to continuously improve methane management while strengthening the long-term integrity of their pipeline networks.

5. The next frontier

Pipeline integrity has always evolved alongside advances in engineering, inspection and asset management. Today, that evolution is increasingly shaped by the growing understanding of environmental performance. Methane management is no longer a parallel activity; it is becoming an integral part of how pipeline integrity is managed.

Regulatory frameworks and industry initiatives such as OGMP 2.0 are accelerating this transition by encouraging more robust measurement, improved quantification methodologies and greater confidence in emissions reporting. The next challenge for the industry is not simply to collect more measurements, but to interpret them consistently, integrate them with operational knowledge and translate them into informed decisions.

This is where Environmental Intelligence becomes increasingly important. By combining engineering expertise, complementary measurement technologies and digital workflows, operators can build a more comprehensive view of pipeline performance and continuously improve both operational and environmental performance.

Ultimately, the future of pipeline integrity will not be defined by any single technology, measurement method or digital platform. It will be defined by the industry's ability to build confidence in the information it collects and use that confidence to make better decisions. In that sense, Environmental Intelligence is not changing the purpose of pipeline integrity. It changes how confidently we achieve it. ●