VIEW POINT

ACHIEVING OGMP 2.0 LEVEL 5 WITH AN AI-DRIVEN METHANE MANAGEMENT FRAMEWORK

DIGITALLY INTELLIGENT, AI-DRIVEN, STRATEGICALLY VERIFIED BRIDGE TO OGMP 2.0 LEVEL 5

Infosys®
Navigate your next

Disclaimer and Scope

This white paper reflects professional experience and insights of Infosys' Services, Utilities, Resources, and Energy (SURE) Practice on the Oil and Gas Methane Partnership 2.0 (OGMP 2.0) framework. It is published as thought leadership and educational content to promote industry awareness of measurement-based methane emissions reporting.

Not a consulting engagement

This paper is not aimed at offering professional consulting services, technical advice, or legal counsel to any specific organization. It provides a general industry perspective and framework recommendations based on scientific publications and case studies.

Data sources and validity

The content has been compiled from publicly available sources including United Nations Environment Programme (UNEP) publications, OGMP 2.0 official documentation, company disclosures, and the latest analyst reports. Organizational Gold Standard statuses and certifications are subject to change and should be independently verified on the International Methane Emissions Observatory (IMEO) data platform[1]. Please note that OGMP 2.0 follows annual reporting cycles, typically with a May 31 submission deadline.

Regulatory compliance

This paper references regulatory frameworks, including the EU Methane Regulation (2024/1787), US Environment Protection Agency (EPA) methane reporting guidelines, and other regional standards. Regulatory requirements vary significantly by jurisdiction and are subject to change, reinterpretation, and variable enforcement. Organizations must consult qualified legal and compliance specialists to understand applicable region-specific requirements. Infosys is not responsible for regulatory compliance or legal implications.

Evolving OGMP guidelines

OGMP 2.0 technical documentation, including reporting templates and level definitions are subject to periodic revision as the framework and industry practices evolve. The Level 5 reconciliation methodologies, uncertainty quantification approaches, and reporting requirements described in the paper, are accurate as of March 2026. Refer to the UNEP's portal[1] for up-to-date information.

Third-party endorsements

References to company performance metrics, technologies, certifications, and analyses are based on cited publications. Infosys does not endorse or validate third-party claims, products, or services. It is recommended that organizations do their due diligence and competitive evaluation of any third-party data.

Data accuracy and limitations

While adequate care has been taken to compile and review information, the author does not guarantee its completeness, validity, or accuracy. Infosys is not liable for errors, omissions, or misinterpretations of third-party source materials.

Application and use

This paper is intended for informational and educational purposes only. Readers are responsible for evaluating the applicability, accuracy, and relevance of any content. They are also solely responsible for their decisions regarding strategy, investment, implementation, and compliance.

Infosys and the author are not liable for business decisions or operational outcomes resulting from the use of this document.

Engagement opportunity

Organizations seeking to implement the framework outlined in this paper can engage Infosys' Services, Utilities, Resources, Energy (SURE) Practice to develop tailored strategies, assess feasibility, build implementation roadmaps, and execute customized projects.

Foreword

Methane management is at a pivotal juncture. Once considered an aspiration, it is now a quantifiable, reportable, and closely monitored operational requirement. As expectations from regulators, investors, and society continue to rise, the oil and gas industry must transition from relying on estimates to leveraging transparent, verifiable, and empirical emissions data.

Concurrently, the leadership mandate has seen a fundamental shift. The question now is whether measurement, reporting, and verification (MRV) systems are robust enough to withstand an era of radical transparency. With better satellite-based monitoring, investor comparability, and stringent regulatory enforcement, intent alone is not sufficient. Companies must demonstrate their credibility through verifiable data and metrics.

The Oil and Gas Methane Partnership 2.0 (OGMP 2.0), a reporting framework run by the United Nations Environment Programme (UNEP), establishes a clear maturity pathway to improve the accuracy and transparency of methane emissions in the oil and gas sector. OGMP 2.0's Level 5 reporting represents the highest-level of granularity. It requires reconciliation of source-level emissions with independent and accurate site-level measurements across a representative sample of facilities. Progressing to this stage requires robust integration between bottom-up and top-down approaches, explicit quantification of uncertainty, and a fully auditable chain of evidence. Known as the Gold Standard performance in methane management, Level 5 goes beyond reporting. It evolves into an operational system embedded in asset management, day-to-day operations, and maintenance processes.

Artificial intelligence (AI) is driving this progression. As operators deploy satellites, aerial surveys, continuous monitoring systems, and onsite measurements, methane data is becoming increasingly scalable and complex. AI provides the analytical layer needed to integrate these datasets, align spatial and temporal signals, detect anomalies, reconcile discrepancies, and reveal materially significant gaps. When effectively applied, AI augments expert judgment by making reconciliation processes repeatable, verifiable, and economically scalable.

At the portfolio level, this transition demands robust digital architecture and disciplined execution. Technologies that remain peripheral to core decision making and operations will have to be discarded. Only those embedded within governance frameworks and operational workflows can become core infrastructure for sustained transformation.

This white paper is intended for organizations navigating the transition from Level 4 to Level 5. Drawing on Infosys' experience working with energy operators globally, it provides practical implementation insights and addresses real-world challenges. The paper also discusses scaling measurement programs, operationalizing advanced detection technologies, and embedding audit readiness into day-to-day operations.

Level 5 is positioned not as a compliance endpoint, but as a foundation for operational excellence, verifiable emissions reductions, and sustainable transparency.

The future will favor operators who can demonstrate effective methane control performance, not just claim it.

Sriram Sundar

Senior Vice President and Business Head – Energy Core, Infosys Ltd.

Dr Arunkumar Ranganathan

Vice President and Global Head – Domain and Process Consulting for Services, Utilities, Resources, Energy (SURE), Infosys Ltd.

Executive Summary

Methane control is the fastest way to reduce near-term global warming. It is responsible for approximately 30% of the rise in global temperatures since the Industrial Revolution, with atmospheric concentrations now exceeding 2.5 times pre-industrial levels. Over a 20-year period, methane is roughly 82.5 times more potent than carbon dioxide (CO_2)[2]. Together, these factors amplify the climate risk of uncontrolled methane, even as modern society increasingly depends on reliable energy supply.

The energy sector accounts for over 35% of human-generated methane emissions[3], with energy-related releases exceeding 120 million tons per year[4]. This underlines why rigorous measurement, effective abatement, and metric-based disclosure in the oil and gas industry are paramount in this decade[2].

The 2025 annual report of the United Nations Environment Programme (UNEP), highlights a steady improvement in methane measurement quality among the Oil and Gas Methane Partnership (OGMP) members. Key drivers of this progress are reporting maturity and adoption of advanced technologies.

Initially, OGMP members primarily relied on lower-confidence approaches: OGMP Levels 1 to Level 3. However, participants with over three years in the program now report approximately two-thirds of methane emissions at the highest assurance levels: OGMP Levels 4 and 5. This indicates a significant improvement in data reliability, program alignment, and progress toward the OGMP Gold Standard.

In 2025, 64 companies, representing 17% of global oil and gas production, achieved Gold Standard reporting. Another 50 companies (15%) are progressing along the Gold Standard pathway. In summary, 32% of global oil and gas production is either compliant or on track to achieve the Gold Standard status in the near future[5].

Reporting participation is also high. Of the144 eligible members, 137 submitted methane inventories in 2025. Reported methane emissions totaled 2.5 million metric tons, up from 2 million metric tons reported the previous year. The increase is due to broader coverage and improved transparency, not declining performance[5].

Figure 1[5] illustrates the percentage of oil and gas companies transitioning to OGMP Gold Standard.

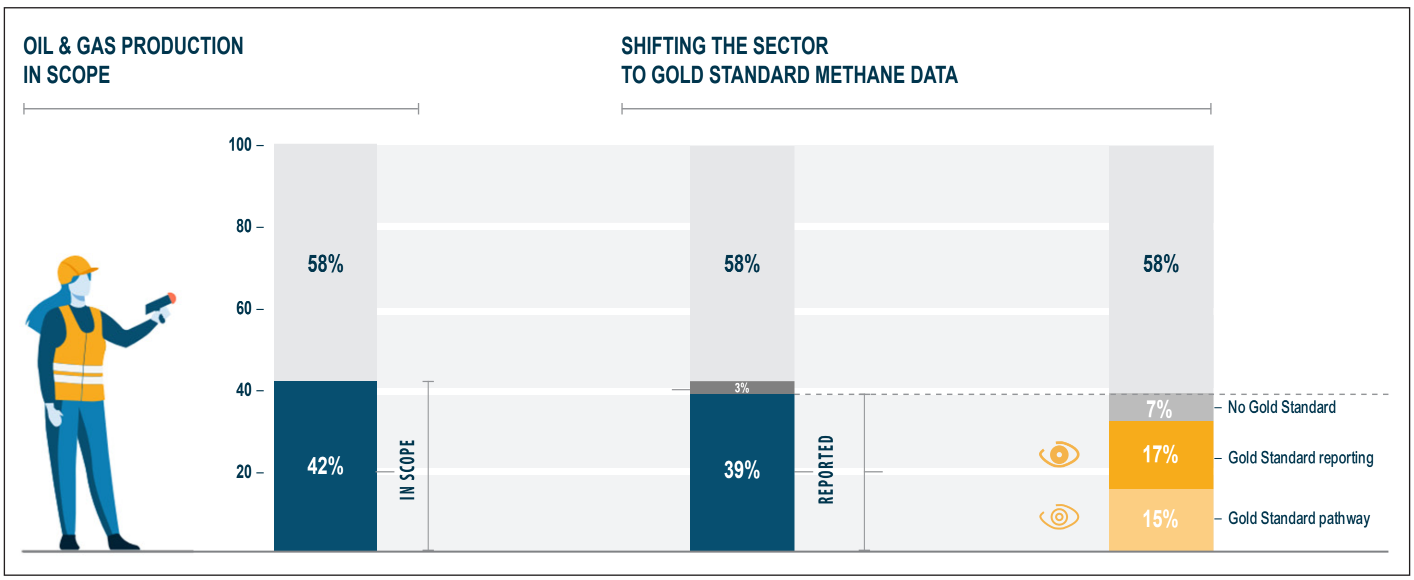


Fig 1: Percentage of oil and gas companies advancing toward OGMP Gold Standard

In the future, leveraging advanced analytics and artificial intelligence (AI) for integrating operational, sensor-based, and independent datasets can refine measurement accuracy. Additionally, it can accelerate anomaly detection and strengthen decision making for targeted methane mitigation.

Implementation maturity is advancing. Many organizations now report OGMP Level 5 coverage for about 50% of their emissions, embedding source-to-site reconciliation into their roadmaps. This also creates conditions for verified emissions reductions following the initial 'U-curve' discovery phase[6].

At the same time, tougher regulations are emerging:

- Europe's Methane Regulation (EU) 2024/1787 mandates measurement, reporting, and verification (MRV) as well as leak detection and repair (LDAR) programs, while banning routine venting and flaring. It also introduces import-facing transparency and performance requirements from 2027[7].
- In the US, the 2024 Subparts OOOOb/OOOOc of the Environment Protection Agency (EPA) define nationwide standards for new and existing sources, introduce the Methane Super Emitter Program, and limit routine flaring[8].

- Australia's Safeguard Mechanism enforces declining emissions baselines, decreasing by 4.9% annually through 2030. The mechanism also strengthens the National Greenhouse Energy Reporting (NGER) methods for fugitive methane[9].
- Across the Middle East, although national rules vary, the Oil & Gas Decarbonization Charter (OGDC) commits signatories to near-zero upstream methane emissions. Comprising over 50 companies representing around 40% of global oil output, the OGDC also aims to eliminate flaring by 2030, reshaping supplier expectations in regulated markets such as the EU[10].

This paper offers structured, implementation-focused guidance for oil and gas companies progressing from OGMP 2.0 Level 4 to Level 5. It addresses the defining elements of Level 5 reporting, including reconciliation rigor, measurement-informed inventories, uncertainty management, and independent verification.

OGMP 2.0 Framework: Context and Level 5 Requirements

The Oil and Gas Methane Partnership (OGMP) is the UN's flagship framework for methane accountability in the oil and gas sector. Its objective is simple yet demanding: to replace rough estimates with measured, verifiable emissions data that companies can leverage to plan and deliver tangible reductions.

Launched in 2014 as a voluntary initiative focused primarily on upstream operations, the program evolved into OGMP 2.0 in 2020. It expanded its scope across the entire value chain and embedded data-quality checks through the International Methane Emissions Observatory (IMEO) of the United Nations Environment Program (UNEP). This upgrade transformed OGMP into the widely recognized "Gold Standard" for measurement-based reporting, with clear expectations and timelines defined for both operated and non-operated assets[11].

For energy companies, OGMP is more than a disclosure tool. It represents strategic alignment with the regulatory policies and markets. Europe's Methane Regulation (EU) 2024/1787 stipulates frequent surveys, stringent measurement, reporting, and verification (MRV) processes, and bans routine venting and flaring. It also introduces import-facing transparency and performance obligations that will be phased in from 2027. In practice, this makes measurement-informed inventories, aligned with the OGMP approach, a de facto market standard for suppliers to the EU[12].

Moreover, IMEO's transparent public data infrastructure enables buyers and investors to distinguish between generic estimates and reconciled, measurement-based reporting[13]. Peer momentum also continues to build, with membership now spanning well over a hundred companies and a significant share of global production. This has prompted company boards and executive leadership to treat OGMP as a credible operating standard rather than a niche initiative[14].

OGMP classifies asset-level reporting into five tiers[14,15] enabling companies to progress methodically from high-level estimates to measurement-anchored inventories. This is typically achieved over approximately three years for operated assets and five years for non-operated assets[14].

- **Level 1:** A single consolidated emissions estimate per asset; an entry point where data availability is limited
- **Level 2:** Emissions totals by broad source categories, still largely factor-based
- **Level 3:** Emissions segregated by specific source types using generic factors and activity data
- **Level 4:** Source-level quantification using direct measurements, asset-specific emission factors, or engineering calculations based on operating conditions
- **Level 5:** Integration of top-down site-level measurements with Level 4 bottom-up inventory, including reconciliation of boundary gaps, quantification of uncertainty, and investigation of discrepancies. This process is repeated until the results are statistically and operationally credible

The Significance of OGMP 2.0 Level 5

OGMP 2.0 Level 5 is important for oil and gas companies seeking to effectively manage methane emissions. Key reasons include:

- OGMP 2.0 transforms methane accounting from a spreadsheet-based exercise into a measurement-informed system. Executives gain visibility into where emissions occur, understand why top-down and bottom-up estimates differ, and determine what solutions deliver the fastest reductions[15].
- Level 5 represents a credibility threshold for regulators, lenders, and premium buyers. Companies already operating at Level 5 are best positioned to align with strict MRV rules and import standards such as those under the EU trajectory[12].
- Recent disclosures indicate that more operators are embedding Level 5 across material assets. This is an essential step to shift from the discovery or the U-curve phase toward verified, sustained emissions reductions[16,17].

OGMP 2.0 Level 5 constitutes the highest standard of methane reporting. It requires source-level, measurement-informed methane inventories that are fully reconciled with top-down estimates. Unlike Level 4, Level 5 demands systematic uncertainty quantification, documented reconciliation protocols, and independent third-party verification.

Baseline: Typical Level 4 Maturity

Organizations at Level 4 typically have asset-level measurement programs in place, along with partial integration of bottom-up and top-down data. However, reconciliation is often ad hoc, uncertainty treatment remains inconsistent, and operational feedback loops are still limited.

At this stage, methane accounting transitions from generic estimates to a source-by-source inventory grounded in site-specific evidence. Operators begin with a comprehensive asset register, including equity interests with third-party operational control. They map all material emission sources across production, gathering and processing transport and distribution data within the reporting boundary[14].

Each source is then quantified using direct tests, company-specified emission factors, or engineering calculations linked to live operating data. These include duty cycles, throughput, pressure, or temperature histories. Generic defaults are replaced wherever feasible[15].

The outcome is a bottom-up baseline that indicates the actual equipment performance in the current reporting year. It is well documented to ensure repeatability, and is aligned with the standard OGMP reporting format for comparability across assets[14].

Because methane emissions are episodic, Level 4 practice incorporates time representativeness by capturing run-time fractions, as well as planned and unplanned events. Level 4 practices also apply uncertainty ranges at source level before aggregating asset totals[15,18].

Field efforts prioritize high-leverage emitters, including pneumatic devices, compressors, seals, tanks, dehydration units, and flares. They focus on combustion performance in line with the technical guidance followed across OGMP participants[19].

Data governance is treated as a core discipline. Activity data is time-stamped and traceable; measurement files and calculations are version-controlled; and quality assurance (QA) and quality control (QC) processes align with the IMEO review protocols. This ensures that datasets can withstand independent scrutiny while establishing Level 5 reconciliation against site-level measurements[15,18].

For non-operated ventures, companies report their equity share using the operator's measurement framework or through negotiated access to equivalent protocols. They also maintain consistency in boundaries and definitions used for operated assets[10].

Level 4 baseline typically contains:

- Asset and source registers with emission counts, operational status, and operating profiles[14,19]
- Measurement and methodology records, including on-site tests, company-specific emission factors, and engineering models linked to operating parameters[15]
- Process and flow context data, including gas composition, flow rates, and pressure as well as temperature traces for tanks, compressors, and flares[19]
- Temporal profiles and uncertainty aggregates from source to asset level[15,18]
- Equity-share treatment for non-operated assets through consistent boundaries and definitions[14]

Core Design Principles for Transitioning to Level 5

The first step in progressing from Level 4 to Level 5 is establishing a comprehensive measurement-based emissions framework. The transition should be guided by the following six principles:

1. **Measurement-first design:** A Level 5 program must be engineered, not improvised. It starts with measurement-first design, where direct readings at both source and site underpin the inventory. Reconciliation models are used only to bridge data gaps.
2. **Spatial and temporal alignment of datasets:** The program enforces spatial and temporal alignment, ensuring measurements correspond precisely with the asset boundary and operating conditions. This includes capturing run-time and snapshot reality.
3. **Quantified uncertainty at source and asset levels:** Uncertainty is quantified at the outset, with confidence ranges defined at the source level and aggregated at the asset level. This enables decision making with informed margins of error.
4. **Traceable reconciliation logic:** Level 5 programs also codify traceable reconciliation logic, making the 'compare and explain' process between top-down and bottom-up data explicit, repeatable, and corrective.
5. **Audit-ready documentation:** Audit-ready methodology documentation is consistently maintained, including version-controlled measurements, data registers, and change logs. This ensures a transparent, robust evidence trail.
6. **Digital readiness:** This is embedded through robust data architecture, with common identifiers, interoperable pipelines, automated lineage, and role-based workflows. Digital readiness enables scalable data capture, data traceability, and seamless evidence sharing.

Together, these principles transform Level 5 from a one-off reporting capability into a sustainable operating system.

OGMP 2.0 Reconciliation Framework and Protocol

The reconciliation framework is the most critical aspect of transitioning from Level 4 to Level 5. A robust framework aligns bottom-up, source-level inventories with top-down measurements. This is achieved through controlled chronological windows, asset boundary normalization, and uncertainty-weighted comparisons.

Persistent data discrepancies must trigger root cause analysis (RCA) rather than just inventory adjustments. Reconciliation requires a detailed analysis of why site-level measurements differ from source-level inventories. For example, higher top-down measurements may indicate missing sources such as undetected leaks or venting. The solution would then be to update the Level 4 inventory.

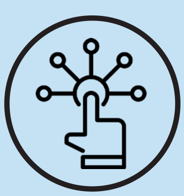
A reconciliation framework functions as an enterprise-wide playbook that makes Level 5 both feasible and repeatable. It defines the scope, covering operated and non-operated material assets, roles, and measurement standards. The framework establishes acceptance criteria for reconciled assets, including uncertainty overlap as well as materiality thresholds, and prescribes portfolio-level sampling logic.

The framework also embeds quality gates and data governance, ensuring source-level and site-level observations are comparable and can be translated into disclosures and regulatory filings. In short, the reconciliation framework is the design architecture that aligns technology choices, statistics, accountability, and reporting, enabling Level 5 scalability across assets.

Transitioning from Level 4 to Level 5 is less about deploying new sensors or the Internet of Things (IoT) devices, and more about statistically reconciling diverse data sets. OGMP defines a three-year timeline for this reconciliation. For operated assets, companies typically have three years after reaching Level 4 or Level 5 reporting to sustain Gold Standard status.

A reconciliation protocol, by contrast, is an on-the-ground procedure applied at a site or campaign. It involves defining physical boundaries, aligning time windows, scheduling top-down measurements, and synchronizing bottom-up activity data to the same time period.

Key features of Level 5 transition



Technology selection: Identifying and selecting appropriate top-down technologies, such as satellites, aerial light detection and ranging (LiDAR), drones, or continuous, ground-based monitors

Representative sampling strategy: Designing a statistically effective sampling methodology to include a representative subset of assets, without the need to cover all sites, each year

Vendor management: Establishing clear standards for third-party measurement providers to ensure data auditability

Statistical comparisons follow, triggering an RCA when deviations exceed defined thresholds. These include missing sources, boundary mismatches, intermittency, or methodology bias. The inventory is then corrected through auditable updates.

Finally, uncertainty, decisions, and outcomes are recorded and observations are incorporated into the framework. The framework defines the rules, while the protocol delivers real-world results through repetition[16,15].

Reconciliation protocol can be considered as a three-dimensional statistical process:

1. Spatial reconciliation ensures fenceline measurements align perfectly with the bottom-up equipment inventory.
2. Temporal reconciliation leverages statistical averaging or continuous monitoring to bridge the gap between annual averages and snapshot measurements, such as satellite observations.
3. Uncertainty overlap defines appropriate statistical thresholds.

The 2025–2026 OGMP Level 5 Landscape

In 2026, the transition to Level 5 is fundamentally a data science challenge. While companies adopt different reconciliation protocols, those aspiring for the Gold Standard must understand that reaching Level 5 can initially appear to be a setback before it demonstrates success.

As companies progress through the OGMP pathway, many encounter an important phenomenon: the methane U-curve.

During the transition from Levels 2 to 4, improved source inventories and company-specific methodologies typically lead to lower reported emissions intensity.

However, in the first year of Level 5 reporting, the intensity may temporarily increase. This is because site-level measurements and reconciliation processes uncover previously undetected, underestimated, or intermittent sources. The emissions intensity declines again when leak detection and repair (LDAR) programs, maintenance fixes, and operational changes address these gaps[6].

This pattern, observed across recent OGMP 2.0 disclosures, reflects a shift to measurement-informed inventories rather than a deterioration in performance. Organizations should proactively plan communications, budgets, and key performance indicators (KPIs) to accommodate an initial increase in emissions intensity before the expected reduction[6].

OGMP data indicates that an increasing number of organizations are reaching Level 5 and adopting reconciliation protocols. This is making the 'U-curve' more visible across portfolios, reinforcing the need for disciplined uncertainty management and systematic gap analysis[20].

In summary, the 'U-curve' is a data-quality effect, which indicates that companies are beginning to measure what actually matters[20,6].

Table 1 lists a few key global companies that successfully implemented the protocol to achieve OGMP Gold Standard reporting and advance on the Gold Standard pathway.

Table 1: Selected few companies that achieved OGMP 2.0 Level 5 Gold Standard and Gold Standard Pathway

Company	OGMP 2.0 Status	Methodology	Technology	Strategic Takeaway
BP[21,22]	Gold Standard	Continuous monitoring systems (CMS) baseline: 24/7 tracking for episodic events	Fixed sensors, CMS, Gas Cloud Imaging (GCI), drones, and flare analytics	Resolution of the 'snapshot problem' through time-series data
Cheniere Energy [23,24]	Level 5/Gold Standard	Quantification, Monitoring, Reporting and Verification (QMRV) protocol: Multiscale lifecycle validation across the entire liquefied natural gas (LNG) value chain	Aerial LiDAR, stack tests, and periodic measurement campaigns	Global benchmark for LNG supply chain transparency
Conoco Phillips[25]	Level 5 Gold Standard (97% coverage)	Statistical sampling of vast asset inventories through representative sub-sampling	Aerial systems, drones, optical gas imaging (OGI), and continuous monitors	Proven Level 5 scalability approach without 100% annual coverage
Devon Energy[26]	Gold Standard	Aerial monitoring: Basin-wide helicopter surveys to identify super emitters	LiDAR via Bridger tools, OGI	Highest efficiency in cost per ton (CPT)
Eni[27,28]	Gold Standard	LDAR integration: Direct measurement campaigns, rapid repair workflows	Infrared (IR) imaging, OGI, global campaign logistics	Direct measurement leader combining Level 5 with abatement
Equinor[29,30]	Gold Standard	Protocol transparency: Industry alignment, real-time monitoring	Satellites, drones, OGI, flare monitors	Leading through transparency and open-source methodology
Shell[31,32]	Gold Standard	Multiscale, tiered, integration: Satellite screening, high-resolution ground imaging	Satellites, drones, video imaging spectro-radiometry (VISR) flares and Fourier transform infrared (FTIR) spectroscopy	Advanced data orchestration across diverse sensors
TotalEnergies [33,34,35]	Level 5/Gold Standard	Continuous real-time monitoring	Airborne Ultralight Spectrometer for Environmental Applications (AUSEA) drone spectrometers and satellites, ground sensors	Protocol-first approach ensuring data auditability
Woodside Energy[36,37,38]	Gold Standard pathway	Hybrid screening methods: Top-down aerial screening for materiality, ground-based OGI, high-flow sampling	Aerial LiDAR or Bridger tools, drone sensors and continuous monitors	Rapid transition from pilot to routine measurement

OGMP 2.0 Reconciliation Protocol

While several pathways to Level 5 exist, organizations must subjectively design their reconciliation protocols. A robust Level 5 program is anchored in a well-defined reconciliation protocol that treats measurement as an engineering discipline rather than a one-off exercise.

Spatial reconciliation ensures the fenceline of site-level measurement aligns exactly with the asset boundary and equipment inventory that underpins the bottom-up estimate. It then addresses temporal reconciliation by resolving the 'snapshot problem'. This is achieved through aligning flyovers, satellite passes, or short-duration surveys, with operating schedules and episodic events. Intermittent releases are neither counted twice nor missed.

With scope and timing established, the protocol applies an uncertainty framework. It calculates 95% confidence intervals for both bottom-up and top-down datasets, ensuring the estimates are statistically consistent. If they are not, a disciplined gap-analysis workflow is initiated. Boundaries and time windows are validated, missing sources or misclassified vents are investigated, and method biases and detection limits are assessed. The inventory is then updated or measurements are repeated until the numbers match.

The focus then shifts to operationalizing data insights. Findings are incorporated into the RCA, and integrated with maintenance and LDAR programs. Fixes are prioritized based on impact and verified through follow-up measurements. A continuous feedback loop then uses Level 5 evidence to refine Level 4 emission factors. This helps manage the familiar 'U-curve', where measurements initially reveal higher emissions before sustained mitigation drives reductions.

Given the volume and complexity of raw data generated, robust data governance is essential. This includes rigorous lineage and version control, standardized metadata, and automated systems that convert raw sensor inputs into report-ready datasets.

In practice, these principles appear in different deployment models:

- A midstream approach that relies on high-frequency monitoring at point-source terminals (e.g., Cheniere)
- A basin-wide model using aerial LiDAR to scan several well pads and reconcile snapshot measurements against component-level inventories (e.g., Devon and ConocoPhillips)
- A continuous-monitoring approach that enables near real-time reconciliation at complex sites (e.g., BP)

A common factor across all three models is evident: align space and time, quantify uncertainty, investigate discrepancies systematically, and translate measurements into repeatable operational decisions that facilitate sustained reductions in methane emissions.

Role of Advanced Analytics and AI

The UNEP's International Methane Emissions Observatory (IMEO), launched in November 2021 at the G20 summit, is a key implementation partner of the Global Methane Pledge. It specializes in data reconciliation and enables organizations to optimize their methane emissions reporting.

IMEO defines four distinct stages of data validation, comprising data quality, data integration, data analytics, and implementation review. Ensuring data credibility is fundamental to IMEO's reporting methodology, with its stringent validation processes throughout the lifecycle.

Advances in measurement techniques continue to refine the OGMP framework. It leverages artificial intelligence (AI), along with several independent data sources, including satellite observations and academic research to provide accurate methane measurements[1].

OGMP-driven methane reconciliation is data-centric. The 'data

swamp' created at Level 5 through manual engineering efforts can be challenging to manage[1]. For instance, reconciling several bottom-up inventory points with top-down plume measurements is neither scalable nor manually possible. AI is transforming the way companies identify, measure, and manage methane emissions across their operations.

Advanced analytics and AI can play a critical role in Level 5 maturity by enabling anomaly detection, measurement prioritization, uncertainty propagation, and pattern recognition across large and complex datasets.

These capabilities support both operational mitigation and verifiable reporting, while ensuring regulatory compliance.

Leveraging AI can make Level 5 affordable, scalable, and reliable:

- Computer vision can auto-attribute plumes to the right facility and exclude neighbors, solving the spatial alignment problem.
- Using historical operating data, predictive models can resolve temporal gaps by determining whether a snapshot plume was a singular occurrence or a persistent issue.
- In the absence of hardware, virtual sensors estimate real-time emissions from process signals including pressure, flow, and temperature.
- AI-driven reconciliation engines quantify uncertainty overlap, prioritizing only those sites with material discrepancies for human RCA.
- Predictive maintenance models harness Level 5 data insights, including super-emitters, to forecast component failures and ensure proactive prevention. Operational teams transition from reactive leak detection to proactive prevention, while continuously improving the underlying inventory and reducing measurement costs.

OGMP 2.0 Level 5 Technical Architecture

Figure 2 depicts a five-layer, AI-powered architecture that transforms heterogeneous methane data into reconciled, audit-ready insights for OGMP 2.0 Level 5 Gold Standard compliance.

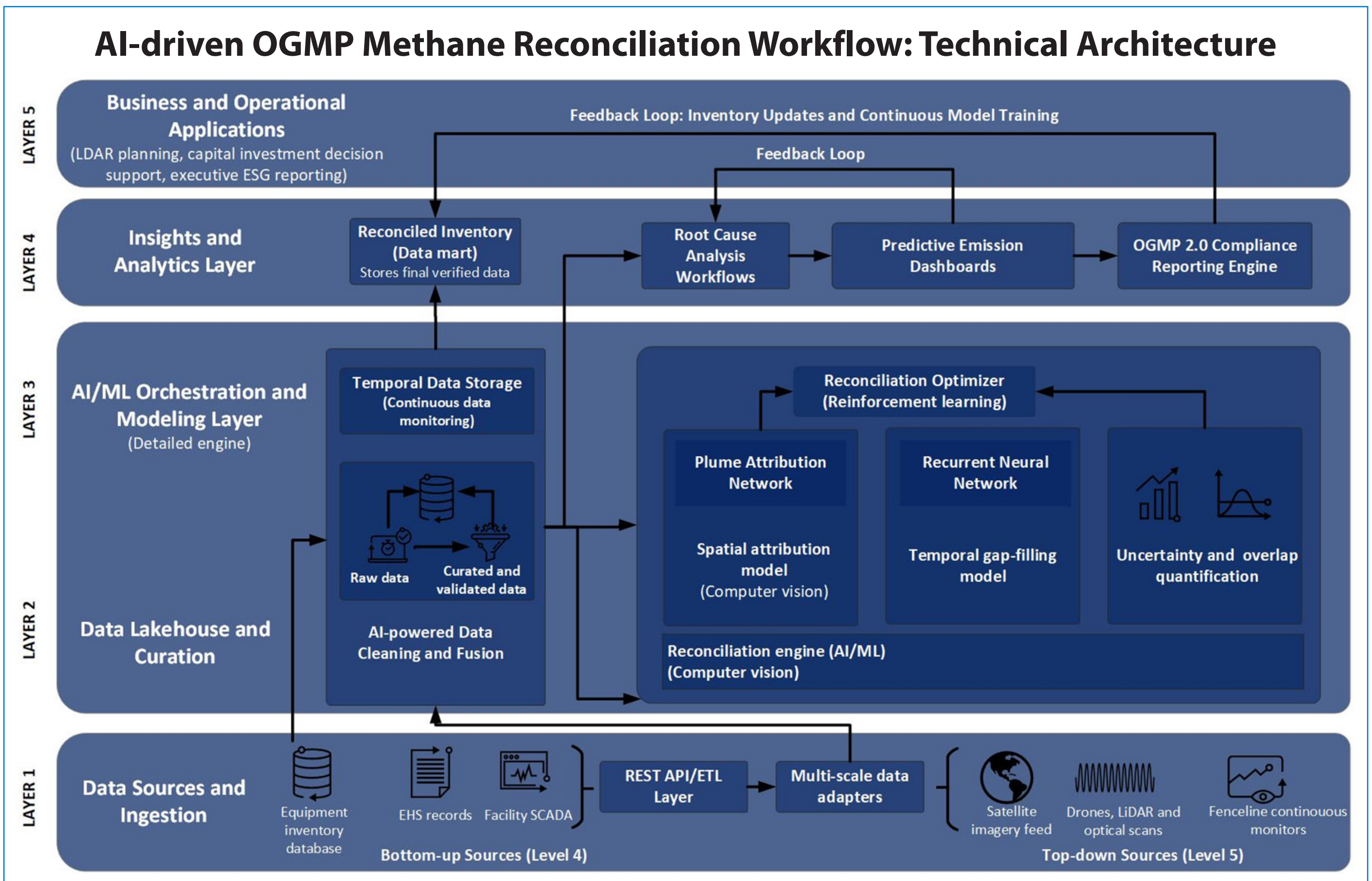


Fig 2: AI-driven OGMP 2.0 five-layer framework for methane reconciliation

Layer 1: Data Sources

Data is initially captured through the extract, transform, load (ETL) or extract, load, transform (ELT) ingestion layer. This includes Level 4 bottom-up sources, such as equipment inventories, Environment, Health and Safety (EHS) logs, or Supervisory Control and Data Acquisition (SCADA) software for continuous emission monitoring system (CEMS) streams.

Data is also extracted from Level 5 top-down inputs, including satellites, aerial LiDAR, fenceline measurements, or continuous sensors. These inputs are normalized using representational state transfer (REST) protocols and streaming adapters, which are then subjected to quality checks.

Layer 2: Data Curation

Curated outputs are stored in a lakehouse architecture that separates raw data from conformed, time-series data. This enables efficient feature retrieval, training, and reporting.

Layer 3: AI/ML Orchestration

A central AI/ML reconciliation engine then performs three key tasks:

- Spatial attribution, based on computer vision, to map detected plume pixels to the correct assets
- Temporal gap-filling using probabilistic models, such as hidden Markov models (HMM), and long short-term memory (LSTM) to detect persistence in snapshot observations
- Bayesian uncertainty quantification to generate 95% confidence intervals and analyze bottom-up and top-down overlap

Layer 4: Analytics and Insights

The insights layer transforms reconciled data into a verified inventory and data marts. This automatically triggers RCA workflows for discrepancies and powers predictive dashboards along with OGMP compliance reporting services.

Layer 5: Business Applications

Lastly, business applications operationalize these insights. For example, LDAR scheduling, capital expenditure (capex) prioritization, as well as executive environment, social and governance (ESG) reporting. This completes the feedback cycle from RCA workflows and regulatory filings. Data ingestion, emission factors, and model performance through ML operations (MLOps) are continuously monitored and improved.

Implementation Considerations

AI is not a 'set-and-forget' solution. Automated outputs still require expert human oversight. This makes it imperative for organizations to have qualified teams for interpreting signals and translating them into decisive action. Data quality and integration also pose challenges, especially when embedding AI pipelines into legacy SCADA/CEMS networks and heterogeneous sensor systems. This demands a robust cost-benefit analysis.

While satellite-assisted analytics can reduce reliance on ground measurements, building underlying platforms, data engineering, and processing capacity can be capital-intensive. The decision involves a strategic trade-off: higher upfront investment against long-term returns in compliance readiness, operational efficiency, and penalty avoidance.

It also includes the compounding advantages of a cleaner, continuously improving data estate.

Academic and industry teams are collaborating to scale AI-driven methane monitoring. Researchers at Kyoto University and Geolabe have developed a method that automatically detects global methane emissions using multispectral satellite imagery, reducing the need for human oversight[39,40].

Simultaneously, open science initiatives are bridging the gap between laboratory and the field. The Python Emission Localization and Quantification (pyELQ) is an open-source Bayesian inversion toolkit developed by Shell. It helps detect, localize, and quantify methane emissions from concentration and wind measurements, through continuous data monitoring[41].

The Artificial Intelligence for the Methane Cycle (AI4CH4) project, by the European Space Agency (ESA), is developing an end-to-end deep learning AI framework for automatic methane plume detection and quantification. They leverage Earth observation (EO) satellite imagery and Sentinel data, helping operationalize research advances into scalable monitoring workflows[42,43].

On the commercial front, several companies offer satellite-based methane measurement services to support methane inventory reconciliation and monitoring. For example, GHGSat operates the world's largest fleet of satellites dedicated to methane monitoring, surveying more than 4 million sites annually. In 2024 alone, it detected over 20,000 emissions that exceeded the 'super-emitter' threshold of 100 kilograms per hour. These observations enabled scalable, data-driven analytics, leading to effective mitigation[44,45,46,47].

Currently, there are significant advancements in AI-driven methane reconciliation, and several off-the-shelf solutions are available. However, it is imperative for energy companies to carefully evaluate their build-versus-buy strategy for long-term data security and auditability. Emissions data will become a gold mine in the future and organizations must ensure this data remains securely internal.

OGMP 2.0 Level 5 Operationalization and Governance

Level 5 reporting requires formal governance frameworks for aspiring organizations, including defined data ownership, change management, reconciliation sign-off workflows, and integration with LDAR as well as mitigation programs. A sample governance model for a typical energy enterprise could include:

- **Establishing an enterprise methane charter:** Mandate Level 5 reporting and measurement-informed inventories through a board-approved risk and ESG charter that defines targets, accountabilities, and funding guardrails.
- **Setting up a cross-functional methane steering committee:** Include Health, Safety, and Environment (HSE) representatives, climate specialists, operations, digital, and data teams, as well as finance, and legal teams. They oversee policies, budgets, and change-management rules for inventories, methodologies, and technology upgrades.
- **Creating a data governance office:** Assign data ownership for operated assets and non-operated joint ventures (NOJVs), maintain a single master asset and source register, define quality gates and lineage, as well as manage access and retention policies.
- **Designating a reconciliation authority:** Empower a cross-functional panel to authorize Level 5 reconciliation when bottom-up and site-level estimates meet predefined uncertainty or overlap criteria. Document all decisions with the supporting rationale.
- **Automating the control loop:** Configure reconciliation outcomes to automatically trigger RCA workflows, update LDAR and maintenance plans, as well as revise Level 4 factors and assumptions.
- **Strengthening compliance and assurance:** Map internal controls to OGMP 2.0 submissions and local regulations, including MRV, LDAR, venting, flaring, and importer transparency. Use audit-ready evidence packs and version-controlled methodologies.
- **Deploying lakehouse with MLOps:** Input data from land sensors and EO into a governed lakehouse framework. This enables model versioning, role-based approvals, and reproducible pipelines corresponding to implementation plans and company factsheets.
- **Defining a consistent operating rhythm:** Conduct quarterly reconciliation reviews via dashboards for detection-to-repair time, uncertainty ranges, and closed data gaps. Provide annual methodology updates that are approved through formal change control process.

Key Challenges and Mitigation Strategies

Common challenges include managing NOJVs, optimizing measurement costs, addressing data gaps, and overcoming organizational resistance. These can be mitigated through phased rollouts, risk-based measurement design, and strong alignment between sustainability and operations teams.

Table 2 outlines the challenges involved in achieving OGMP 2.0 Level 5 and explains the mitigation strategies that could help overcome them.

Table 2: OGMP 2.0 Level 5 challenges and mitigation strategies

Title	Challenge	Mitigation strategy
NOJVs	Limited control over methodologies, data access, and reporting timelines can be challenging. Inconsistent data quality and disclosure across partners add to the complexity.	• Establish a NOJV engagement plan defining minimum measurement standards, data-sharing clauses, aligned asset lists and boundaries. • Set clear expectations for Level 5 reconciliation. • Escalate unresolved issues to venture governance bodies for decision making.
Measurement cost optimization	Uniform deployment of site-level measurements across large portfolios can be expensive and disruptive.	• Adopt a risk-based, stratified design to address super-emitters, throughput, and complexity. • Apply a fit-for-purpose technology mix for screening versus quantification. • Justify sampling frequency and coverage through recognized protocols.
Data gaps and misalignment (space, time, uncertainty)	Snapshot measurements can miss intermittent emission sources. Mismatched boundaries and poorly defined uncertainty lead to discrepancies between bottom-up and top-down inventories.	Apply a documented reconciliation protocol: • Align fencelines and time windows. • Compute 95% confidence intervals and conduct gap analysis for missing sources, methodology bias, and wind data. • Re-measure or adjust inventories based on the findings.

Title	Challenge	Mitigation strategy
Organizational resistance and change fatigue	Level 5 may initially increase disclosed methane emissions (the 'U-curve'), leading to skepticism. Budgets and accountabilities can become fragmented.	• Normalize the 'U-curve' through executive communications and KPIs. • Link Level 5 adoption to regulatory and market drivers. • Establish a formal reconciliation authority. • Define responsibility matrix (Responsible, Accountable, Consulted, and informed – RACI) charts to ensure shared ownership across operations, HSE, and data teams.
Execution risk across large portfolios	Scaling Level 5 across operated and non-operated assets within program timelines is complex.	Adopt a phased approach: • Year 1: Baselining and pilots • Years 2–3: Expanding Level 5 coverage to high-materiality sites • Years 4–5: Closing NOJV gaps Track progress through stepwise reviews and standard templates.
Sustainability and operations alignment	Disconnected targets and field realities can slow mitigation and verification efforts.	Close the loop: • Link Level 5 reconciliation to RCA workflows. • Define LDAR and maintenance plans • Update Level 4 factors. • Deliver validated emission reductions. • Maintain audit-ready evidence for disclosures.
Manual errors and digital misalignment	Reliance on spreadsheet-driven processes, inconsistent master data, and siloed systems often lead to transcription errors and version drift.	• Implement a governed lakehouse with MLOps framework using robust master data management for assets and sources, role-based approvals, automated lineage and version control. • Replace manual uploads with application programming interfaces (APIs) and workflow automation.

Illustrative Roadmap: OGMP 2.0 Level 4 to Level 5

A typical transition roadmap spans 24–36 months and includes four key phases: (1) Reconciliation pilot, (2) Uncertainty framework deployment, (3) Asset-wide scaling, and (4) Independent verification readiness.

Table 3 illustrates the scope, key actions, technologies, and AI impact associated with each phase.

Table 3: Phase-wise transition from OGMP 2.0 Level 4 to Level 5 (Gold Standard)

Phase	Scope/Actions/Exit Gate	Digital Inserts	AI Enablement
Phase 1: Reconciliation Pilot (Months 0–6)	**Scope:** Select 3–5 high-materiality sites across asset classes. **Actions:** • Define Level 4 baselines. • Conduct top-down measurements. • Align space and time. • Analyze gaps. **Exit gate:** • Generate pilot report validating bottom-up and top-down overlap. • Trigger RCA and LDAR workflows.	• Deploy a governed lakehouse for raw and curated zones along with MLOps sandbox. • Ingest Level 4 data from SCADA, EHS, and inventory systems, as well as Level 5 data from satellites, aerial surveys, and fenceline measurements via APIs. • Implement data lineage and role-based access control (RBAC) in line with predesigned OGMP reporting templates.	**Objective:** Demonstrate end-to-end Level 5 reconciliation at limited number of sites or on a lower scale • Version 1 reconciliation engine incorporating computer vision plume attribution for spatial alignment • Bayesian ELQ leveraging wind and concentration data for uncertainty bands • Automated lineage, RBAC, and evidence logging **Exit criteria:** • Validate and correct bottom-up and top-down overlap. • Complete RCA and LDAR workflows.
Phase 2: Uncertainty Framework Deployment (Months 7–12)	**Scope:** Standardize emission uncertainty methodology. **Actions:** • Implement CI calculations. • Integrate and automate digital sign-off criteria and workflows. • Publish methodology documentation. **Exit gate:** • Finalize enterprise-wide uncertainty and reconciliation (U&R) playbook. • Implement governance-approved workflows.	• Execute automated CI computations. • Implement version-controlled digital methodology library. • Integrate digital sign-off workflow with immutable evidence.	**Objective:** Ensure Level 5 results are reproducible. • Temporal gap-filling through HMM, and LSTM to analyze emission persistence • Automated escalation workflows when datasets fail overlap threshold • Dashboards for monitoring uncertainty width, overlap rates, and reconciliation cycles
Phase 3: Asset-wide Scaling (Months 13–24)	**Scope:** Implement Level 5 across all remaining operated assets, and NOJVs. **Actions:** • Apply risk-based sampling. • Introduce a mix of technology. • Integrate RCA and LDAR. • Update emission factors. **Exit gate:** • Ensure about 80% emissions coverage under Level 5. • Track the progress of NOJV plans.	• Launch CI/CD pipelines. • Leverage master data management (MDM) for assets and sources. • Use API-based integration with LDAR and computerized maintenance management system (CMMS). • Operationalize partner sandboxes for NOJVs.	**Objective:** Rationalize Level 5. • AI-driven risk scoring to optimize measurement frequency • Computer vision models for prioritizing super-emitter detection • Virtual sensors or ML estimators to supplement limited hardware • Heatmap-based monitoring for Level 5 coverage

Phase	Scope/Actions/Exit Gate	Digital Inserts	AI Enablement
Phase 4: Independent Verification Readiness (Months 25–36)	**Scope:** Prepare for external assurance. **Actions:** • Build comprehensive evidence packs. • Use version control for data and methodologies. • Map controls to OGMP 2.0, MRV, and LDAR requirements. • Address data gaps. **Exit gate:** Generate traceable, audit-ready Level 5 reporting	• Implement version-locked pipelines. • Generate automated evidence reports. • Provide regulatory-grade reporting extracts.	**Objective:** Demonstrate robustness of Level 5. • Bias and variance diagnostics • Model robustness testing • Automated uncertainty and overlap reporting • Continuous monitoring of data quality (DQ) rules • Real-time alerts generation

While the strategy for transitioning to Level 5 is inherently subjective and time-bound, the above roadmap provides a phased approach to achieving Level 5 Gold Standard within a three-year period. It is critical for organizations to select appropriate technologies, protocols, and proven partners for methane reconciliation.

Conclusion

This white paper is experience based and evidence-driven, drawing on datasets and open protocols from multiple independent sources. Each recommendation is grounded in methodologies that are already influencing policy, assurance, and market best practices.

Progressing to OGMP 2.0 Level 5 is not just a reporting exercise but an operational transformation. Organizations that embed reconciliation, advanced analytics, and governance into daily operations will achieve both regulatory compliance and emission reductions.

Even where OGMP 2.0 adoption is not mandatory for energy companies, it serves as the most credible framework, enforcing measurement-informed inventories, reconciliation, and transparent performance. OGMP 2.0 ensures close alignment with regulatory trends, buyer expectations, and changing financial requirements.

With the integration of AI, methane management has evolved from pilot programs to actual production. Technologies including computer vision plume attribution, Bayesian ELQ, temporal gap-filling, and predictive maintenance ensure achieving Level 5 is faster, cheaper, and more reliable. However, they must operate within governed, digital workflows, supported by role-based approvals and immutable evidence.

Studies[48] demonstrate that each technology has its merits and limitations based on emission levels and operating conditions. For example, satellites are less effective for low offshore emissions. Aerial surveys are suitable for bottom-up estimates, but involve safety concerns. Drones and laser OGI offer higher spatial resolution, but at greater cost, complexity, and effort.

As improved detection methods uncover new emission sources, differences among methodologies become harder to interpret at lower emission levels. Consequently, data reconciliation becomes more complex for organizations, who may need to adopt tailored solutions to reconcile data.

The right technology choices are vendor-agnostic, interoperable, auditable, and anchored in a lake house and MLOps data framework, with clearly defined ownership, lineage, and change control mechanisms.

Additionally, cross-functional collaboration remains essential. Measurement providers, data science teams, assurance partners, and technology platforms, all play a distinct role in digitally orchestrating a portfolio-wide program that translates insights into verifiable emission reductions.

About the Author

Dr. Rakesh Bohra

World Economic Forum Fellow, Principal Consultant at Infosys

Dr. Rakesh Bohra is a World Economic Forum Fellow and Principal Consultant at Infosys. He specializes in digital strategy and transformation across energy and environmental engineering, advanced data analytics, and generative AI platforms. With expertise in digital operating models, data platforms, and AI-enabled measurement, monitoring, reporting, and verification (MMRV) architectures, Dr. Bohra helps organizations achieve OGMP 2.0 Level 5 Gold Standard through AI powered validation engines and measurement governance frameworks.

His work integrates renewable energy engineering, climate science, methane integrity, cloud and edge sensing, IoT sensors, data engineering, and model governance to deliver investor-grade actionable insights.

Contributors

Sriram Sundar

Senior Vice President and Business Head – Energy Core, Infosys

Dr. Arunkumar Ranganathan

Vice President and Global Head – Domain and Process Consulting for Services, Utilities, Resources, Energy (SURE), Infosys

Vilas Torgal

Industry Principal – Infosys TOPAZ

Document Classification

Thought Leadership/Industry Analysis

Intended Audience

Energy sector professionals and climate action leads, chief experience officers (CXOs), regulators, investors, and organizations interested in AI-driven, measurement-based methane reconciliation and emissions reporting frameworks.

References

1. UNEP | EYE ON METHANE DATA PLATFORM: Setting the global standard for methane emissions data
2. European Commission | Methane emissions
3. iea | Global Methane Tracker 2025
4. iea | Global Methane Tracker 2025 – Key Findings
5. UNEP | From measurement to momentum: Data is driving action – now the pace must match the promise
6. Environmental Defense Fund | Leveling Up 2025: Lessons from OGMP 2.0 company disclosures
7. iea | EU regulation on the reduction of methane emissions in the energy sector
8. United States Environmental Protection Agency | Rulemakings, Policy, and Laws to Address Methane Emissions from the Oil and Gas Sector
9. Anthesis | Safeguard Mechanism Reporting FY24: Decarbonisation or Delay?
10. International Association of Oil & Gas Producers | OGDC: Leading technical experts team up to help oil and gas companies meet OGDC methane emissions and flaring goals
11. OGMP | Mineral Methane Initiative OGMP2.0 Framework
12. HERBERT SMITH FREEHILLS KRAMER | The new EU Methane Regulation – a land-shift for EU producers and importers of oil, gas and coal
13. Climate & Clean Air Coalition | Global Methane Status Report 2025
14. European Union | EUR-Lex: Access to European Union law
15. S&P Global | EU Methane Emission Regulation: Key Provisions for Fossil Energy Importers and Third-Country Producers
16. LinkedIn – OGMP | Getting to gold: How OGMP 2.0 is setting the standard for methane mitigation
17. Industrial Decarbonization | A Guide to OGMP 2.0 Level 4 and Level 5 Reporting and Measurement Framework – Insights from OGMP 2.0 Advisors
18. UNEP IMEO | An eye on methane – The road to radical transparency
19. UNEP | OGMP 2.0 – New technical guidance documents & news related to OGMP 2.0, OGMP_Transmission systems_FINAL_Approved_Formatted
20. Climate & Clean Air Coalition | Guidelines & Tools – Oil and Gas Methane Partnership (OGMP) 2.0 Framework
21. bp | bp Sustainability Report 2025
22. bp | BP deploys continuous methane measurement for new major oil and gas projects
23. CHENIERE | ENERGY SECURED BENEFITS DELIVERED – 2023 CORPORATE RESPONSIBILITY REPORT, Cheniere-OGMP-2025-Gold-Standard-Report.pdf
24. CHENIERE | GOLD STANDARD REPORTING CERTIFICATE FOR 2025 REPORTING YEAR
25. ConocoPhillips | Emissions reduction targets and performance, 2024 Sustainability Report
26. Devon | Reducing methane emissions, Customer Stories - Devon - Highwood Emissions Management , DVN_2025_Sustainability Report.pdf
27. eni | Eni confirms UN Gold Standard for Methane Emissions Reporting
28. eni | Annual Report 2025
29. EXPLICIT emissions data | Emissions monitoring campaign for Equinor ASA
30. equinor | Why are methane emissions important?
31. Shell | Reducing methane emissions
32. INDUSTRIAL DECARBONIZATION network | CASE STUDY: The Road to the Gold Standard: Achieving OGMP 2.0 Level 5 in Practice
33. TotalEnergies | More Energy, Less Emissions: Sustainability & Climate 2025 Progress Report
34. TotalEnergies | COP29: TotalEnergies deploys continuous, real-time methane emissions detection equipment on all its operated upstream assets
35. TotalEnergies | AUSEA: The Innovative Technology for Reducing Methane and CO2 Emissions
36. Woodside Energy | 2025 Climate and Sustainability Summary: Delivering Energy Sustainability
37. THE AUSTRALIAN Pipeliner | WATCH: Bridger Photonics helps Woodside manage methane emissions
38. Woodside Energy | Understanding Methane and Woodside's Response
39. PHYS.ORG | Global methane emissions automatically detected in satellite imagery using AI
40. nature communications | Automatic detection of methane emissions in multispectral satellite imagery using a vision transformer
41. Shell | Open sourcing code to improve methane emission localisation and quantification
42. European Space Agency – eo science for society | AI4CH4: An End-to-End AI Framework for Methane Plume Detection and Quantification using Satellite Imagery
43. c.core | AI4CH4: An End-to-End AI Framework for Methane Plume Detection and Quantification using Satellite Imagery
44. COMPRESSOR TECH2 | Exxonmobil, GHGSat launch satellite methane monitoring partnership
45. HYDROCARBON PROCESSING | GHGSat satellites deployed to monitor methane at scale across Exxonmobil's onshore operations
46. NEWSWIRE | GHGSat Successfully Launches Two New Satellites, Unlocking Unprecedented Daily Global Methane Monitoring Abilities
47. European Space Agency – earth online | GHGSat Overview, Mission Background
48. CONNECTSCI WOODSIDE | Methane emissions measurement insights from an Offshore Measurement, Monitoring, Reporting and Verification study

For more information, contact askus@infosys.com