

**HONEYWELL
EMISSION SUITE
UPSTREAM
OIL AND GAS
VERTICALS**

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INTRODUCTION

According to the Intergovernmental Panel on Climate Change (IPCC), human activities, principally through emissions of greenhouse gases, have caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 in 2011–2020.¹

Though carbon dioxide (CO₂) remains the primary greenhouse gas influencing long-term warming, reducing methane, can in the short term contribute significantly to limiting warming to 1.5°C above pre-industrial levels.² Methane is a greenhouse gas that is about 27–30 times more potent than carbon dioxide, and climate scientists around the globe have called for urgent action to address it.³ To catalyze methane reductions, both voluntary and mandatory reduction efforts are being implemented by governments and private entities globally.⁴

For example, Global Methane Pledge (GMP), spearheaded by the United States and European Union in 2021, has grown to 150 countries with many having developed national methane action plans or are in the process of doing so and substantial new financial resources being directed to methane action.⁵ In 2022, the US through the Inflation Reduction Act (IRA)'s "Waste Emission Charge" put a price on methane starting in 2024 at \$900 and escalating to \$1500 per metric ton post 2026.⁶ Facility categories covered by the law involve most of the oil and gas value chain from production (on and off-shore), gathering and boosting, gas processing, transmission, storage, liquefied natural gas (LNG) but not refineries or natural gas distribution.⁷ The Global Methane Initiative (GMI), a voluntary, multilateral partnership that aims to reduce global methane emissions, found the Oil and Gas sector represents the greatest near-term opportunity, with the largest methane emission reduction potential of 35 percent resulting from no-cost activities.⁸

Industry-leading companies participate in voluntary reduction initiatives such as the Oil and Gas Climate Initiative (OGCI)⁹ and programs that require comparisons of traditional "bottom-up" emission factor with "top-down" facility-level emission quantification techniques. For example, under voluntary disclosures such as the United Nations' Oil and Gas Methane Partnership 2.0 framework (UN OGMP2.0) this reconciliation of "bottom-up" versus "top-down" is a criterion for their gold standard or Level 5 reporting.¹⁰ As another example, the Gas Technology Institute in their "Veritas" project recently published an open-source set of standards for establishing methane intensities along the natural gas value chain which requires a similar contemporaneous measurement with uncertainties for determining more credible facility-wide and value chain methane intensities.¹¹



UPSTREAM OIL AND GAS VERTICAL'S KEY CHALLENGES

1

Measurement to Identify and Prioritize Abatement Strategies & Prove Reductions

As identified by the quotes on the right from the International Energy Agency (IEA), mitigating methane fugitive and vented losses is a key opportunity for the upstream verticals but a barrier is “incomplete information” on “actual emissions levels” to help identify the optimal abatement strategies.

Major drivers for uncertainty in atmospheric methane emission estimation methods include deficiencies in sampling procedures, resulting in unrepresentativeness of the samples and therefore resulting in unrepresentative emission factors; poor understanding of temporal and spatial variability of emissions; presence of episodic high-emitting sources; difficulty using top-down approaches in attributing emissions to particular sources.¹⁵ Top-down methods tend to measure atmospheric methane concentrations, normally by airborne or satellite sensors, to infer emission releases.¹⁶ Bottom-up approaches can use activity data (e.g. the number of facilities or the extent of operations) multiplied by emission factors (e.g. default values or leak rates for particular types of equipment).¹⁷ For example, typical leak detection and repair (LDAR) programs use a “bottom-up” method estimate where surveys are conducted on thousands of points at a facility through periodic testing using wand-based sniffers or optical gas imaging cameras.¹⁸

IEA indicated, **some of the largest emitting events** are the result of accidents and unpredictable **process failures** and these might contribute a large level of emissions from oil and gas operations, **but these are often not included in bottom-up inventories**.¹⁹ Honeywell’s own experience from piloting their continuous monitoring systems indicate large intermittent process events tend to drive the emission profiles at a facility rather than fugitives.²⁰ The lack of an early warning system to pinpoint releases near its beginnings for timely response can de-leverage reduction efforts.²¹

ZERO-ROUTINE FLARING AND MONETIZING GREEN PREMIUM PRODUCTS

Some companies have teams dedicated to evaluating dozens of methane measurement technologies from drone aerial surveys, point sensors, satellites, cameras and even balloons to enhance their measurement rigor.²² Based on Honeywell’s customer engagements, many indicate **challenges with integrating the data** from these various technologies and **harmonizing the information** for use in **reconciling the results** for gold standard reporting or **compiling asset grade data (AGD)** for certification of green premium products (e.g., Responsibly Sourced Gas). Further, Upstream Oil and Gas verticals have pressures to reduce their routine flaring and may soon be under mandatory or participate in voluntary **zero-routine flaring initiatives** (e.g., World Bank Zero Routine Flaring by 2030).²³

“IN THE OIL AND GAS SECTOR, EMISSIONS CAN BE REDUCED BY OVER 75% BY IMPLEMENTING WELL-KNOWN MEASURES SUCH AS LEAK DETECTION AND REPAIR PROGRAMMES AND UPGRADING LEAKY EQUIPMENT.”¹²

“VERY LARGE LEAKS ARE A MAJOR SOURCE OF EMISSIONS BUT DWARFED BY THOSE FROM NORMAL OIL AND GAS OPERATIONS.”¹³

“INCOMPLETE INFORMATION ABOUT ACTUAL EMISSIONS LEVELS AND A LACK OF AWARENESS OF THE COST-EFFECTIVENESS OF ABATEMENT IS A KEY BARRIER TO REDUCING METHANE EMISSIONS.”¹⁴

DIGITAL PLATFORM TO BRING EVERYTHING TOGETHER

2

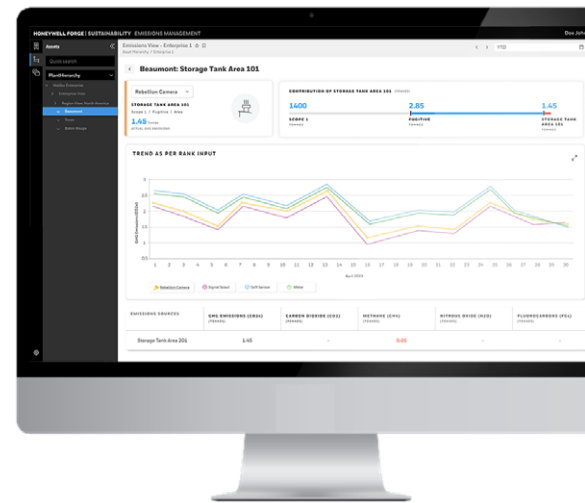
Honeywell is an end-to-end solution provider for helping a customer in their sustainability journey

Honeywell has outcome-based offerings enabled by enterprise emissions management software-as-a-service, **Honeywell Forge Sustainability⁺ for Industrials | Emissions Management**, **Honeywell Versatilis™ Signal Scout™** gas detectors, **Rebellion** cameras, and **Flare Gas Recovery Systems**, as well as services, **Emissions 360**.

These integrated offerings can help you achieve your goal to **Measure, Monitor, Report and Reduce** emissions. The **enterprise-level technology agnostic**, near real-time emissions monitoring, accounting and visualization framework, **Honeywell Forge Sustainability⁺ for Industrials | Emissions Management**, does not replace your existing systems. Instead, it **unifies** and **integrates** with both Honeywell and **third-party measurement devices** or other data sources (e.g., historians) to foster rapid “reconciliation” or comparisons between measurement methods for verification, enabling auditability and helping instill confidence for stakeholders in your emission profiles.

The platform makes it easier to:

1. Integrate data from multiple and disparate sources
2. Make the data available for existing workflows, and create and deploy new, improved workflows
3. Perform greenhouse gas calculations, including methane, for emission inventories, intensities, tracking against targets and key performance indicators, as well as select reporting standards published by agencies and sustainability disclosure frameworks (e.g., UN OGMP 2.0.)



SENSING AND REDUCTION ENABLING TECHNOLOGIES

3

HONEYWELL VERSATILIS™ SIGNAL SCOUT™ GAS DETECTORS

Honeywell Versatilis™ Signal Scout™ gas detectors are new innovative gas leak detection technology for methane emissions monitoring across industries. Communication is based on **LoRaWAN® protocol for large area coverage**. The compact and aerodynamic design is coupled with easy installation and commissioning for **quick deployment in the field** and has **Hazardous Area Certifications**. Although Versatilis™ Signal Scout™ gas detectors can pinpoint and quantify emissions at a component level (i.e., “**Bottom-Up**”), under the “Gas Technology Institute’s Veritas protocol”, the point sensor can be defined as “**Top-Down**” because it can take methane measurements at spatial scales greater than the component scale (i.e., site-level).²⁴



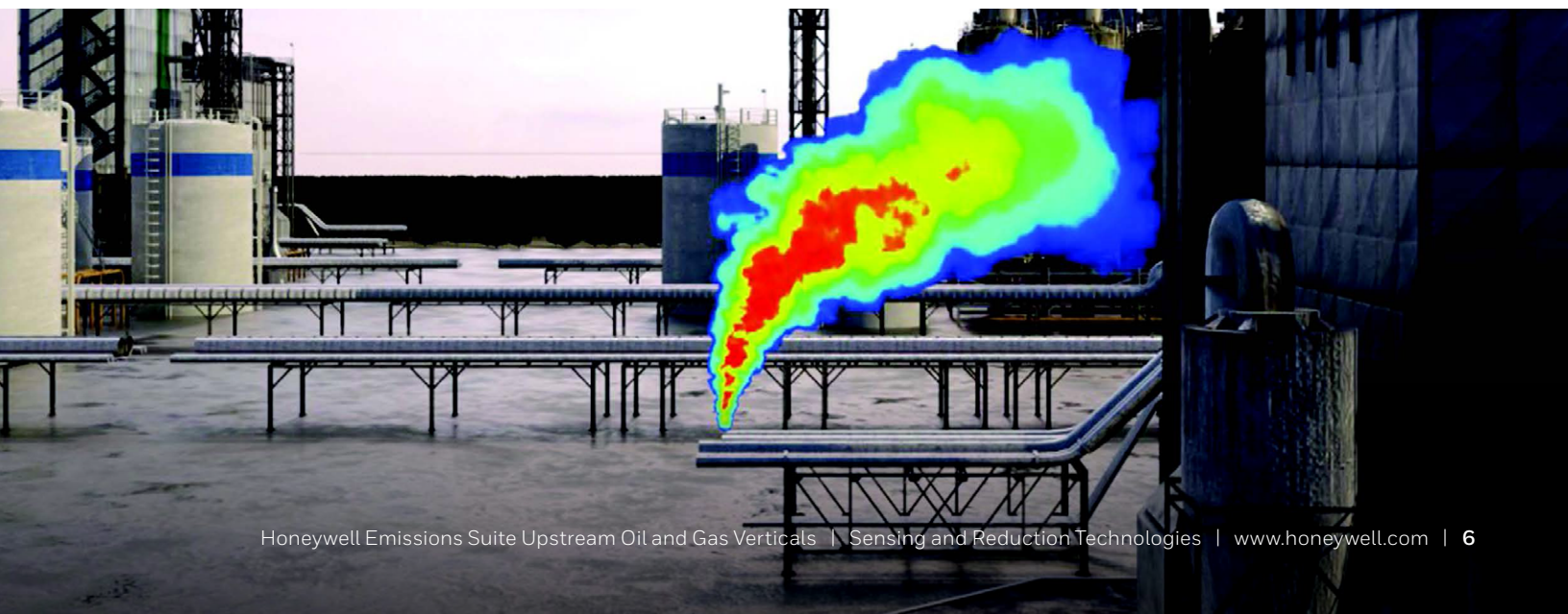
REBELLION GAS CLOUD IMAGING

Honeywell has a decade of experience in advanced hyperspectral gas imaging systems for the oil and gas, petrochemical and power industries. Rapid visual verification of gas leaks, as well as the size and direction of the plume, provides the visualization of data you need to help with your environmental monitoring efforts. Rebellion cameras provide wide area/site level coverage and monitors 20+ gases (including methane). **Unlike optical gas imaging cameras where extensive operator experience and training is required to be effective at finding leaks,**²⁵ Rebellion is an unmanned 24/7 monitoring system that has been tested to have a 90% Probability of Detection (POD) < 4 kg CH₄/h @ 100 meters.²⁶



FLARE GAS RECOVERY SYSTEMS

Pre-engineered, modular systems for **flare avoidance** can help you **enhance profitability** by recycling gas and reducing the need for flaring. Can help you in your efforts to meet emissions regulations, reduce risk, extend equipment life, and reduce costs and sized based on anticipated flare gas composition and flow rates. **Skid-mounted for ease of installation.**



SERVICES

The **Emissions 360** services program by Honeywell is a tailored, outcome-based program aimed at assisting customers in addressing their Greenhouse Gas (GHG) emissions issues. This service offers enhanced support for integrated plant assets and is designed to provide the physical location, duration, and size of GHG emissions to help organizations prioritize corrective actions that improve site productivity and profitability, while reducing maintenance costs. For the Upstream Oil and Gas verticals, the Emissions 360 services can include help with compliance reporting and support on leak management.



SUMMARY

A business can't manage what it can't measure. Honeywell has tools to help you **Measure, Monitor, Report & Reduce** your emissions. Continuous sensing helps lower measurement uncertainty by providing more accurate estimates. It can also help identify emissions from unplanned emissions to address them more quickly as well as spot process failures. It also helps verify and compare emissions in order to ensure accuracy in reporting to stakeholders and regulatory authorities. With a baseline firmly established, your business can measure progress against your reduction goals at the asset, site, or enterprise level. Honeywell offers an integrated unique set of products to help you in your efforts to optimize processes and reduce emissions, including leak management services, flare reduction design and monitoring, as well as custom options to help you meet your specific sustainability journey (e.g., carbon capture, clean hydrogen & hydrogen-ready burners, renewable fuels, energy storage, process optimization & energy efficiency tools.)

Visit our [website](#).

Footnotes:

1. SYNTHESIS REPORT OF THE IPCC SIXTH ASSESSMENT REPORT (AR6) Summary for Policymakers p. 4 chrome-extension://efaidnbmnnnibpajpcglclefindmkaj/https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf
2. IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. p57 https://www.ipcc.ch/sr15/download/
3. Environmental Protection Agency https://www.epa.gov/inflation-reduction-act/tackling-climate-pollution
4. Three states in the US (California, New Mexico, Colorado) have varying degrees of regulating methane emissions. For example, both the state of New Mexico and Colorado regulate the venting and flaring of natural gas and New Mexico recently imposed gas capture requirements. New Mexico: https://www.srca.nm.gov/nmac-home/nmac-titles/title-19-natural-resources-and-wildlife/chapter-15-oil-and-gas Colorado: https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=6271&fileName=2%20CCR%20404-1. California: https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1371
5. About the Global Methane Pledge. https://www.globalmethanepledge.org/
6. Questions Regarding OAR's Implementation of the Inflation Reduction Act: The Inflation Reduction Act establishes a waste emissions charge for methane from applicable facilities that report more than 25,000 metric tons of CO2 equivalent per year to the Greenhouse Gas Reporting Program (GHGRP) petroleum and natural gas systems source category (GHGRP Subpart W) and that exceed statutorily specified waste emissions thresholds. https://www.epa.gov/inflation-reduction-act/questions-regarding-oars-implementation-inflation-reduction-act#:~:text=The%20Inflation%20Reduction%20Act%20establishes,W)%20and%20that%20exceed%20statutorily
7. Clean Air Act Section 136(d) Applicable Facility. chrome-extension://efaidnbmnnnibpajpcglclefindmkaj/https://www.govinfo.gov/content/pkg/COMPS-8160/pdf/COMPS-8160.pdf
8. Global Methane Initiative Global Methane Emissions and Mitigation Opportunities. chrome-extension://efaidnbmnnnibpajpcglclefindmkaj/https://www.globalmethane.org/documents/gmi-mitigation-factsheet.pdf
9. The Oil and Gas Climate Initiative is a CEO-led organization bringing together 12 of the largest oil and gas companies worldwide to lead the industry's response to climate change. It aims to accelerate action towards a net zero emissions future consistent with the Paris Agreement. OGCI members are Aramco, bp, Chevron, CNPC, Eni, Equinor, ExxonMobil, Occidental, Petrobras, Repsol, Shell and Total Energies. https://www.gti.energy/veritas-a-gti-methane-emissions-measurement-and-verification-initiative/
10. The United Nations Oil and Gas Methane Partnership 2.0 framework. https://ogmpartnership.com/
11. The Gas Technology Institute's Veritas Protocols. https://www.gti.energy/veritas-a-gti-methane-emissions-measurement-and-verification-initiative/
12. Global Methane Track 2023 Overview. https://www.iea.org/reports/global-methane-tracker-2023/overview
13. Ibid
14. IEA (2023), Global Methane Tracker 2023, IEA, Paris https://www.iea.org/reports/global-methane-tracker-2023, License: CC BY 4.0
15. Improving Characterization of Anthropogenic Methane Emissions in the United States. Washington (DC): National Academies Press (US); 2018 Mar 27. 4. Addressing Uncertainties in Anthropogenic Methane Emissions. https://www.ncbi.nlm.nih.gov/books/NBK519298/
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20. Honeywell International Inc. comment in response to EPA's Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review (Dec. 6, 2022). Comment ID Number: EPA-HQ-OAR-2021-0317-2340 https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0317-2340
21. IEA Global Methane Tracker https://www.iea.org/reports/global-methane-tracker-2022/strategies-to-reduce-emissions-from-fossil-fuel-operations
22. For example, Exxon Mobil, Chevron all have methane measurement technology evaluation programs Chevron chrome-extension://efaidnbmnnnibpajpcglclefindmkaj/https://www.chevron.com/-/media/shared-media/documents/chevron-methane-report.pdf, Total Energies https://totalenergies.com/sustainability/climate-and-sustainability-energy/reducing-our-scope-1-and-2-emissions#toward, ExxonMobil https://corporate.exxonmobil.com/what-we-do/delivering-industrial-solutions/methane/detection-technology
23. Launched in 2015, the Zero Routine Flaring (ZRF) Initiative commits governments and oil companies, to end routine flaring no later than 2030. https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030
24. The Gas Technology Institute's Veritas Protocols. https://www.gti.energy/veritas-a-gti-methane-emissions-measurement-and-verification-initiative/
25. Detection Limits of Optical Gas Imaging for Natural Gas Leak Detection in Realistic Controlled Conditions https://pubs.acs.org/action/showCitFormats?doi=10.1021%2Facs.est.0c01285&href=/doi/10.1021%2Facs.est.0c01285
26. The Rebellion Camera was tested at Colorado State University's Methane Emissions Technology Evaluation Center (METEC) https://energy.colostate.edu/metec/where-blind-controlled-release-testing-determined-the-system-was-able-to-detect-leaks-at-a-90%-pod-at-3.7-kg-ch4-h. Graphical results can be found on page 5 of Honeywell International Inc. comment in response to EPA's Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review (Dec. 6, 2022). Comment ID Number: EPA-HQ-OAR-2021-0317-2340 https://www.regulations.gov/comment/EPA-HQ-OAR-2021-0317-2340

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Honeywell Sustainability

855 S Mint Street
Charlotte, NC 28202
800-582-4263
www.honeywell.com

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