CANARY

How (and Why) Gas Buyers are Engaging in the Market for Low Methane Intensity Natural Gas

February 2023

Verifiable Low Methane Intensity Gas aka Responsibly Sourced Gas (RSG) Helps Stop Methane Leaks

- RSG undergoes independent, **3rd-Party assessments** or scoring of environmental best practices
- Buyers use **Purchasing Power** to reduce methane emissions and other environmental impacts of natural gas production
- Verifiable Low Methane Intensity: Top Tier RSG uses continuous monitoring to measure and verify true methane intensities below 0.20% at each well
- Other Environmental Attributes can be verified: Low Water Usage, safety, seismic, land, community impacts
- Larger Volumes Available Now: 20%+ of US gas market is verified RSG. Project Canary is in all major US basins





The Big Picture Why is Demand For RSG Increasing?



Sources: Assessment of methane emissions from the U.S. oil and gas supply chain (July 2018), <u>AAAS / Science</u>; A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems (June 2020), <u>American Chemical Society</u>; <u>EIA</u> carbon intensity of fuel combustion (lower bound used for coal); lifecycle emissions for coal combustion not shown (generally ~5% increase)

- Natural gas is ~95% methane
- Methane is 82.5 times worse for the environment than CO2 in terms of global warming potential
- The measured leak rate along the full supply chain is ~2.4% (~1.4% for production)

For RSG, we focus primarily on methane reduction in gas production.





The Current EPA Reported Average of ~0.45% for Natural Gas Production Significantly Underestimates the Leak Rate in the U.S.

San Joaquin

1.4%

More likely, measured **leak rate for**typical natural gas production

Verifiable low methane gas with continuous monitoring

Permian







0.2%

An increasing number of academic studies show even higher basin-level rates.



Source: S&P Global Commodity Insights

- Combines monthly satellite-driven methane measurement with the cost of abatement at the wellhead
- Calculates the price of bringing the average methane intensity to zero using Methane Performance Certificates





The Cost to Stop the Leaks is Low

"Methane leaks in 2021 from fossil fuel operations, if captured and marketed, would have made an additional 180 billion cubic meters of gas available to the market, an amount similar to all the gas used in Europe's power sector."

"Based on recent elevated natural gas prices, almost all of the options to reduce emissions from oil and gas operations worldwide could be implemented at no net cost." – IEA Global Methane Tracker, Jul 2022

"More than 70% of the vented, fugitive and flared gas, representing a volume of ~80 bcm, could be economically captured and commercialized. "

- S&P Global Commodity Insights, Dec 2022

CO2

EPA estimates net compliance costs would come out to a little over **\$2 per ton of CO2e** abated

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EPA estimates net compliance costs would account for 0.2% of industry revenues and 0.3% of capital expenditures



NASCENT MARKET

The First RSG Purchase was Four Years Ago

Now: Project Canary has assessed or is monitoring >10bcf/d

In 2018, "...Southwestern Energy Co. publicly announced that it struck a deal to sell TrustWell[®] rated gas to utility New Jersey Natural Gas (NJNG) from a group of wells in West Virginia for a premium to local Appalachian index prices."



gas on the market.

Source: S&P Global Commodity Insights, company websites





Utilities Are Prioritizing RSG To Achieve ESG Targets and Signaling to the Market to Drive Increased Supply



- Largest gas producer in WY, 675 MMcfe/day across 3400+ wells
- · 88% lower methane footprint than US average
- Commitment to monitor 937 wells on 69 pads by YE22. Achieved RSG certification of 100% of production
- 1st Rockies producer to pursue Freshwater Attribute by TrustWell[®]





- Net zero by 2050 1st major energy provider to announce comprehensive, aggressive GHG reduction goals (gas and electricity)
- Public commitment to procuring 100% RSG by 2030 for gas distribution and power production
- Cost to customers is pennies per month for hundreds of thousands of tons of CO2e avoidance annually





Engagement in the RSG Market is Increasing with Unprecedented Speed Along the Full Supply Chain



CANARY

More than 25% of Today's US Natural Gas Volumes are Certified Low Methane Intensity (<0.2% production leak rate)

Early adopters and fast followers are taking advantage of low premiums and easy access to RSG today

Recent RFPs, Pilots, and Public Decarbonization Goals

Approved Legislative Cost Recovery

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- New York Power Authority (NYPA)
 - 3 x 30-day RFPs in 2022, \$0.00-\$0.05 premium/MMBtu
- Central Hudson Gas & Electric
 - 6-month pilot May-Oct 2022 for 20% of total volume, \$0.035/MMBtu
- Orange & Rockland PUC approved RSG pilot with cost recovery, \$100k/yr cap for premiums
- **ConEdison** Filed for permission to pilot RSG with cost recovery, \$800k/yr cap for premiums
- New York State Electricity & Gas and Rochester Gas & Elec (Avangrid) Filed for pilots with cost recovery, \$250k/yr cap
- **Xcel Energy** Early adopter, commitment to 100% RSG by 2030
- Southern Company Gas (NICOR, Virginia Natural Gas) Early adopter, 18BCF since 2019, nearly 1/3rd of customer demand
- Vermont Gas Services Already at ~20% RSG

Tennessee Natural Gas Innovation Act, HB2315 (2/2022)

BILL SUMMARY

This bill authorizes a public utility to request, and the Tennessee public utilities commission to authorize, a mechanism to recover the costs related to the use or development of infrastructure to facilitate use of innovative natural gas resources for natural gas utility customers, if the commission finds that the costs are in the public interest. For purposes of this bill, "innovative natural gas resources" include, but are not limited to, farm gas, biogas, renewable natural gas, hydrogen, carbon capture, qualified offsets, renewable natural gas attributes, RSG, and energy efficiency resources.

*Premium capped at 3% of annual cost of gas



Virginia Senate Bill 565 (4/2022)

SUMMARY AS ENACTED WITH GOVERNOR'S RECOMMENDATION:

Natural gas, biogas, and other gas sources of energy; definitions; energy conservation and efficiency; Steps to Advance Virginia's Energy Plan; biogas supply infrastructure projects; work group. Permits natural gas utilities to include in their fuel portfolios, submitted to the State Corporation Commission to monitor fuel prices and purchases, supplemental or substitute forms of gas sources, defined in the bill, that meet certain standards and that reduce emissions intensity. The bill amends provisions of the Code

*Defines RSG as natural gas with <0.2% methane intensity; no cap on premiums



<u>Case Study</u>: WGL is Incorporating RSG ("Certified Gas") into its Operations in Maryland and DC

Maryland

- State goal: 60% by 2031 and net-zero by 2050
- RSG purchases: WGL executed a 3-month pilot, starting in August 2021, for a baseload supply of RSG at <u>zero</u> <u>premium</u>
- **Regulatory treatment:** On 7/8/22 the MD PSC indicated that for future WGL RSG purchases:

"[WGL] will be required to justify why it is including this gas in its gas supply portfolio, identify the benefits attained by use of these acquisitions, identify the costs of these types of gas supply and cost comparisons to other gas supply procured, identify any premium WGL is paying for this gas supply, and provide a cost-benefit analysis relative to other carbon avoidance measures, and any other non-quantitative justification for the inclusion of carbon reducing measures."

Washington D.C.

- DC goal: 50% by 2032 and net zero by 2050. WGL published the <u>Climate Change Action Plan</u> (CCAP) in 2021–2022 to align operations with DC's goals.
- **RSG purchases**: part 1 of the CCAP, WGL noted that they have partnered with Project Canary & Chesapeake for certified gas at <u>zero premium</u> and that they expect to supply 20% of the district for \$27–270k per year. On 8/15/22 WGL put out an RFP for certified gas purchases from November 2022 through March 2023 (<u>docket link</u>).
- **Regulatory treatment:** WGL also noted in the <u>CCAP</u> that they will seek cost recovery for CG purchases: "*The future costs will be dependent on market conditions at that time. The incremental cost of CG will be billed directly to customers, subject to regulatory approval to do so.*"



Sample GHG Reduction Calculator: The Carbon Abatement is Significant When Procuring RSG Rather Than Typical Natural Gas

Realistic U.S National Average		Typical Upstream Producer		CANARY	
MMBtu procured methane	268,000,000	MMBtu procured methane	268,000,000	MMBtu procured methane	268,000,000
MMBtu per mcf	1.04	MMBtu per mcf	1.04	MMBtu per mcf	1.04
mcf procured	258,437,801	mcf procured	258,437,801	mcf procured	258,437,801
kg per mcf of methane	18.86	kg per mcf of methane	18.86	kg per mcf of methane	18.86
kg of methane	4,873,878,496	kg of methane	4,873,878,496	kg of methane	4,873,878,496
Methane Intensity ⁽¹⁾	1.38%	Methane Intensity ⁽¹⁾	0.45%	Methane Intensity ⁽¹⁾	0.20%
kg methane emitted	67,259,523	kg methane emitted	22,127,408	kg methane emitted	9,747,757
MT methane emitted	67,260	MT methane emitted	22,127	MT methane emitted	9,748
Methane GWP (20 year) ⁽³⁾	82.5	Methane GWP (20 year) ⁽³⁾	82.5	Methane GWP (20 year) ⁽³⁾	82.5
MT of CO2e emitted	5,548,910	MT of CO2e emitted	1,825,511	MT of CO2e emitted	804,190
EU ETS Price	79.56	EU ETS Price	79.56	EU ETS Price	79.56
Buyer Benefit of RSG	\$441,471,332	Buyer Benefit of RSG	\$145,237,670	Buyer Benefit of RSG	\$63,981,352

1.02mm tCO2e is the carbon abatement for one major east coast utility if sourcing RSG opposed to typical natural gas.

CO2e Abatement Equivalents

270,000 Gasoline-powered cars for one year



Natural gas-fired power plants in one year

3mm Barrels of oil consumed

Stated EDF methane intensity of natural gas of 1.38%. Ep ethane emission per unit of gross gas production; the o

attributes all methane emissions from natural gas wells to natural gas production.

2. TrustWell[®] cutoff for certified gas methane intensity that a best-in-class operator can achieve.

3. The Intergovernmental Panel on Climate Change (IPCC) has indicated a GWP for methane of 82.5 when considering impact over a 20-year timeframe.



There Are Three Main Ways Project Canary Can Support Utility Decarbonization Efforts



RSG Market Development – Cleaner Gas for Generation and Distribution

- Match-making: Connect gas producers to gas marketers and consumers
- RFI/RFP template language to support pilot efforts
- Cost (to customers) / Benefit (CO2e abatement) calculations
- State-level policy and regulatory support
- All at no cost to utilities





Fixed Asset Continuous Leak Monitoring

- Proven (upstream) technology can be used on compressor stations, city gate stations, and storage facilities
- Suite of sensors for various use cases and price points
- Hardware-enabled SaaS can be structured as CapEx or OpEx



Mobile Distribution System Leak Survey

- Handheld, high fidelity "lab in a box" for walking route investigations
- Dedicated vehicle survey tech package, sensor + anemometer for targeted deployment
- Passive, high frequency data collection with USPS or utility fleet vehicles heat map visualization (R&D/Beta)



Summary: Benefits of Buying Verifiable Low Methane Intensity or Responsibly Sourced Gas

Responsibly Sourced Gas (RSG) is geologic natural gas with low methane (GHG) emissions and ESG profiles with immediate, low cost, positive impacts.

Buying differentiated gas reduces methane emissions by 50%+

Verified gas drives O&G industry to improve and reduce leaks now

Reduced GHG achieved at very low cost - pennies per customer / month

Water and other environmental impacts also measured and reduced

Allows buyer to choose differentiated product with lower climate impact

Simple, low cost implementation – standard gas procurement contracts

Know and reduce the emission footprint of your gas supply chain.



CANARY

The Enabling Technology Behind the RSG Market

Platinum-Standard: Environmental Assessments, Continuous Monitoring & Quantification

Environmental Assessment Air, Land, Water and Community (TrustWell[®] by Project Canary)

- Robust review of environmental risks and risk-mitigation efforts
- Site visits and interviews for every asset assessed
- Assessment: Platinum, Gold, and Silver

Continuous Monitoring Technology & Web-Based Dashboard

- Canary X 24/7 real-time monitoring technology using high-fidelity methane detection
- Web-based dashboard with MLbased smart alerts

Quantification of Emissions Intensity

- ML-based regression and plume models used to localize and quantify total site emissions
- Hourly mass-value emissions profile by equipment









Dynamic Environmental Assessment

Evaluation Across Land, Air, Water & Community

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Holistic, independent review of environmental risks by a professional team with over 100 years of combined mechanical, chemical, petroleum and systems engineering experience



Dynamic evaluation to recognize and suggest risk-mitigation efforts





Qualitative & Quantitative Audit

- Site visits to every wellbore/facility assessed
- Asset level life cycle assessment of environmental impact
- Robust, multivariate audit:

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- 600+ data points evaluated across 26 core impact categories
- ~1,000 pages of customer-provided documentation for every wellbore



Operators Can Improve Their Score Over Time

Annual Assessments

Every year, assets are evaluated to produce a unique score

Customized Recommendations

All assessments include assetspecific recommendations to improve operations & reduce emissions



GOLO Received Silver with recommended improvements in water

STWELL®

PROJECT PROJECT

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Earned Platinum after replacing supply gas with compressed air on all wells

Farned Gold after introducing robust water stewardship program

*Illustrative





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Technical Analysis of Freshwater Use as Part of a Responsibly Sourced Gas ESG Strategy

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Keywords

program.



Responsible Sourced Gas, UOG, Water Stewardship, Water Stress, Water Sustainability

The Unconventional Oil and Gas industry has seen growth over the last ten

years that has drastically transformed the domestic energy outlook while

bringing up increased concerns over climate and environmental issues. The

rise of ESG and RSG can be seen as direct answers to these growing issues as

communities and operators have both begun to demand better practices to

limit the overall effects of UOG production. Few quantifiable metrics exist

that holistically try to determine the overall effect UOG production has on

local water resources. The FR2 metric/framework developed in this paper at-

tempts to use commonly kept data such as water withdrawn and flowback

volumes in conjunction with a new water stress index to quantify the effects

operators are having on local water supplies. Testing this framework on a

handful of operators from the Marcellus basin using open-source data re-

vealed the value added by these methods as well as their use in a general RSG

1. Introduction

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The development of the US Unconventional Oil and Gas (UOG) industry has had transformative impacts on the energy outlook both nationally [1] and internationally [2]. At the same time, the growing threat of climate change [3] and its relationship to fossil fuel use is receiving increased amounts of attention [4] casting doubt on the sustainability of current levels of natural gas extraction and

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·VERIFIABLE ENVIRONMENTAL ATTRIBUTES

Freshwater Metric (FR²) Validated by Academia

The FR2 metric addresses:

- How an operator offsets competitive water usage
- How an operator minimizes impacts in areas with water scarcity issues
- How water is stressed in a given geography

Ten companies have achieved Project Canary's Freshwater Attribute through participation in the program.

Project Canary and Colorado State University's partnership **highlights engineering rigor** and expertise alignment.



DIGITAL CANOPY FOR METHANE EMISSIONS

Top-Down (Satellite / Flyovers) and Bottom-Up (Facility-Level) Monitoring + Measurement Required



Satellite Resolution

(2,000m x 2,000m) Data from Pulse by GHGsat https://pulse.ghgsat.com/?lat=32.28&lng=-93.32&zm=12



Project Canary Facility-Level Resolution (.01m x .01m) Ppb and <1kg/hr detection 24x7x365





A Traceable Value Chain & Site-Level Quantification of Emissions

Project Canary Verifies Actual Performance Data. Others use Estimates

Accurate Emissions Profile

Machine-Learning-based regression and Gaussian plume models are used to localize emissions data at the equipment group level and serve up total site emission data. Tested within 3% of METEC controlled release data.

Actionable Insights to Reduce Risk

Trained models predict emissions and trigger smart alerts when actuals deviate from the forecast.





Academic Study: METEC Demonstrates Accurate Results

- 44 different methane releases spanning 3 days
- Release rates vary from 0.05 grams per second (g/s) to 0.85 g/s
- Emissions released from 3 different types of equipment
- > Algorithm left to determine:
 - Emission source (location)
 - Flux rate (g/s)
 - Release duration (minutes)
 - Cumulative predicted emissions within 3% of actual emission





High-Fidelity Quantification Data Relies on Strategic Site Prep

High-resolution drone imagery of well pad

2 Strategic Canary device placements(3 X's minimum)

Precise GIS mapping of on-site and offsite emission sources

Site emissions-performance data (30 days minimum)





Site-Specific Volumetric Methane Measurement

Project Canary's quantification algorithm leverages machine learning and long-term statistical analysis to measure persistent, short, yet cumulatively large emissions



•The Project Canary Model:

- Differentiates <u>off</u>-site emission events from <u>on</u>site emission events
- Utilizes historical data trends from real-time monitoring
- Understands relationship between elevated concentration and atmospheric conditions
- Calculates the emission rate from the well pad every 15 minutes utilizing real-time data
- Quantifies multiple emission sources simultaneously producing a holistic view of a facility's emissions profile
- Measures methane intensity



Climate Action With Facility-Level Continuous Monitoring

Quantifiable methane data unlocks targeted intervention







Project Canary - as a certified public benefit corporation - is working to drive a transparent approach to RSG assessments that enables public proof of performance and progress over time.