RESIDUAL — CUR8

WHITE PAPER

Orphaned Oil & Gas Well Plugging:

An Introduction to Quality

Executive Summary

Carbon credit markets have long been dominated by CO_2. Yet superpollutants, which comprise the most potent global warming gases, but are only now receiving significant regulatory attention. The implementation of the EU Methane Regulation, the US Clean Air Act, and the Global Methane Pledge (Launched at COP26). Commercially, orphaned oil and gas well (OOGW) plugging represents a popular route into the methane abatement market - the narrative for the credit is compelling. However, substantial reform is needed to ensure that this project type delivers the level of environmental integrity expected of high-quality, additional carbon credits.

Orphaned oil and gas wells represent a large and under-addressed source of methane emissions in the United States. According to the IOGCC, 29 responding states reported 141,959 documented orphan wells as of December 31, 2023, while state estimates suggest a further 250,000 to 740,000 undocumented orphan wells. Because these wells have no solvent operator responsible for plugging them, and public programs remain insufficient relative to the scale of the problem, credit-financed plugging can provide a near-term mechanism for directing private capital toward permanent methane abatement.

Orphaned Oil and Gas Well Plugging in numbers

142,000
Documented orphaned wells[1]
US alone; est. >740,00 including undocumented

28×
Methane warming potency[2]
GWP_{100} vs CO_2 (IPCC AR6)

~10 yrs
Methane atmospheric lifetime[2]
vs 1,000+ years for CO_2

CUR8 is now offering superpollutant credits of several method types in portfolios with high-quality nature-based and durable engineered removals. Orphaned oil and gas well (OOGW) plugging is one of the most accessible avoided methane pathways, leading our diligence team to explore the project type's risks with the support of Residual Carbon, experts in the development space of this methane abatement pathway. These risks, as well as mitigations and remedies, are outlined in the paper to instruct current and future projects.

Orphaned Oil and Gas Well Plugging in a Net Zero Portfolio

Superpollutants are greenhouse gases that have a higher global warming potential, driving near-term warming at much smaller concentrations than carbon dioxide. There are many gases and particles classified as superpollutants, but most impactful culprits are methane, nitrous oxide, hydrofluorocarbons (refrigerants, HFCs), ozone-depleting substances, and black carbon.

These short-lived climate pollutants account for roughly 45% of current warming above pre-industrial levels[2], yet less than 0.5% of voluntary carbon credits address them. The like-for-like principle within the v2.0 SBTi Corporate Net-Zero Standard leaves room for a gradual transition approach to durable CDR from less-durable credits. This provides a gap for near-term impact superpollutant abatement credits to contribute to an SBTi claim[3], such as those from plugging orphaned oil and gas wells.

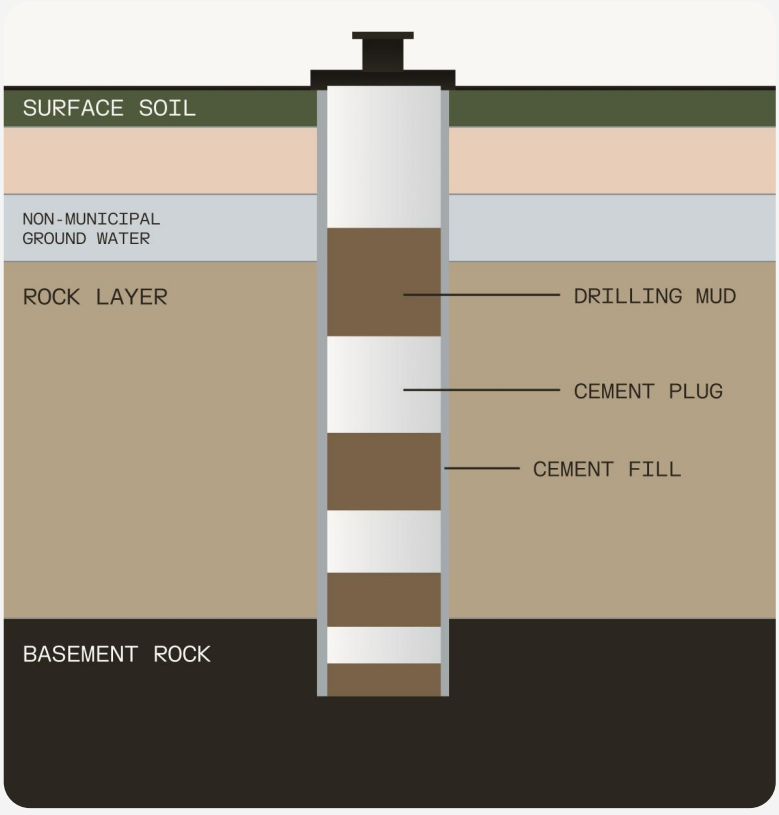
[1] Interstate Oil and Gas Compact Commission (IOGCC). 2024. *Idle and Orphan Oil and Gas Wells: State and Provincial Regulatory Strategies — Supplemental Information on Orphan Well Plugging and Site Restoration.*
[2] IPCC AR6 WGI (2021), Chapter 6.4.3. Short-lived climate forcers account for approximately 0.5±0.1°C of current warming.
[3] Science Based Targets initiative, Corporate Net-Zero Standard V2.0: Draft for Public Consultation (London: SBTi, March 2025).

A credible net-zero portfolio may use superpollutant abatement for immediate climate impact, nature-based removals to bridge near-term issuance gaps, and engineered CDR to provide long-term durability. Including superpollutant credits in a stacked portfolio is particularly attractive because they can deliver rapid warming benefits at comparatively low cost, while still meeting rigorous standards for monitoring, verification, and environmental integrity.

Orphaned oil and gas well projects are a useful case to consider because they illustrate both the promise and the current limitations of superpollutant crediting. In principle, OOGW plugging offers a compelling baseline narrative, relatively low technological complexity, and the potential for cost-effective methane abatement. However, the opportunity is conditional: if projects must demonstrate robust additionality, conservative measured baselines, regulator coordination, annual issuance, and credible post-plug monitoring so that OOGW credits could become an economically compelling addition to diversified net-zero portfolios.

What Is Orphaned Well Plugging? The Method in Simple Terms

An orphaned oil or gas well is a borehole drilled into the earth by an operator who has since terminated operations. With no solvent owner, most orphan wells are never formally sealed. Over time, the unplugged well can passively leak methane through the wellbore and other fissures in the earth.



The diagram illustrates the basic mechanisms of oil and gas well plugging

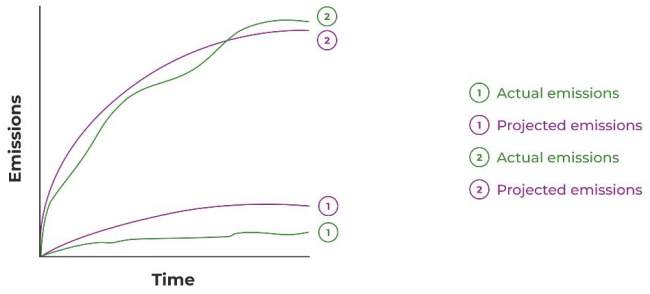
Plugging a well means permanently sealing it. A crew is mobilised to the site, the wellbore is opened, and a series of cement and steel plugs are installed at prescribed depths to isolate each subsurface formation. The well is then cut at surface level, the site is cleared, and the land may be restored to its pre-drilling condition. It can take as little as three months to begin issuing methane abatement credits from the time of well selection (including approvals and contracting).

The carbon credit (equivalent) claim is direct: methane that would have continued leaking from the unsecured well infrastructure is now prevented from reaching the atmosphere.

The credit volume should be a function of the pre-plug emission rate and ongoing reference scenarios (i.e. dynamic baselines). As a result, the complexity and quality risk lies almost entirely in how precisely the pre-plug emission rate is measured and setting a proper baseline.

Dynamic Baseline

Nearby well emissions are projected and actual emissions checked in order to compare. The proportion with which they differ will inform the counterfactual of the project well.



While the counterfactual methane emissions from the leaking orphaned well could continue for decades, the emission reduction credits are issued up front at the time of plugging under most current methodologies. The cumulative avoided methane emissions, the orange credit volume in the chart above, represent the issued tonnes for the defined project lifetime.

Current Standards in the Sector

The OOGW crediting landscape is still relatively young and is currently shaped by a small number of methodologies. While the sector is promising and some projects are high-quality, we believe that existing methodologies must improve to reach the same integrity as more mature VCM methods. They currently differ materially in how they define eligible wells, how they treat abandoned versus orphaned wells, how they quantify baseline emissions, and whether credit volumes are derived primarily from measured leak rates, decline curves, reservoir/pressure-based calculations, or “potential to emit” assumptions. This methodological diversity is a signal that the sector is still nascent, and buyers should not assume that credits issued under different OOGW methodologies are equivalent without reviewing the well-level additionality evidence and carbon accounting approach.

STANDARD / PLATFORM	METHODOLOGY	SCOPE
ACR	Plugging Orphaned Oil and Gas Wells in the U.S. and Canada, v1.0 (inactive)	U.S. and Canada; currently inactive, with v2.0 in development and updated publication planned for 2026. (ACR)
BCarbon	Methane Emissions Elimination through Well Plugging (MEEWP), v2.1	U.S. and Canada; leaking abandoned and orphan oil and gas wells. (BCarbon)
CarbonPath	Methane Emission Removal Via Permanent Decommissioning of Orphaned and Abandoned Oil and Natural Gas Wellbores, v1.4 (inactive)	U.S. and Canada; orphaned wells, including some “abandoned” wells where the operator of record is not solvent. (CP)
Open Carbon Protocol	Plugging Orphaned Oil and Gas Wells in the United States, v1.0	U.S. orphaned wells; approved through OCP and proposed by Tradewater. (OCP)

No existing OOGW methodology fully aligns with our quality framework, but the sector is likely to evolve significantly and existing high-quality projects going beyond methodology requirements may meet quality standards. ACR has already made its methodology inactive while it revises key requirements, and we expect future versions of other methodologies to address similar gaps. In particular, stronger methodologies should require coordination between project developers and state regulators, move away from full upfront crediting toward annual issuance, and use measured leak rates as the foundation for baseline setting. Until these standards mature, project developers can still exceed current methodology requirements by designing projects around the highest available integrity principles rather than relying only on minimum compliance.

Quality: What Constitutes Quality

There is a wide quality spectrum across OOGW credits, driven primarily by three risk factors.

First, measurement integrity:

Current methodologies allow for the well-head to be opened in order to estimate the remaining methane left in the well ("potential to emit"). This is ostensibly the same as how much it would have produced if it were operational. However, opening the wellhead alters the pressure conditions governing flow between the reservoir and wellbore, potentially resulting in a methane flow rate greater than the pre-existing passive leak rate..

The highest integrity projects therefore would:

1. Measure the emission rate of the initial leak without any well or machine manipulation
2. Set-up a control group of wells that are ineligible for VCM plugging (e.g. have work orders to be plugged already or have solvent operators)
3. During annual issuance, submit a monitoring report that compares the predicted emission from the control group wells to the monitored emission over the course of the year
4. Adjust the predicted emission from the project well proportionally to the control group's variability

Note: in some wells it is impractical or unsafe to measure the leak; these cases are inherently subject to higher quality risks because the actual emission rate of the well cannot be determined

Second, regulatory additionality:

Government investment in orphaned well remediation is scaling in the United States and the EU; therefore, the boundary between VCM activity and government-funded or mandated plugging must be clear for each well selected. Regulatory additionality checks must be project-specific and developers should inform the well's regulator of the measured emissions and intent to plug before executing the project activity. Further additionality risks arise from wells that participate in O&G emission labels (such as EO100, MiQ or Project Canary). Certification, advertisement, and support from these programs may lead to financial additionality and double-counting concerns if not accounted for properly.

Third, issuance schedule:

Emission mitigation should be representative of the counterfactual. Upfront crediting for decades of future emission is standard practice because of practical financial limitations that developers face, but it does not represent the actual schedule for prevented emission. Retroactive annual issuance solves this problem and introduces an opportunity to consider reversal risks and dynamic baselining.

Appendix

The checklist below translates Residual Carbon's technical experience and CUR8's deep diligence models into a pre-purchase screen.

Quality Factor	Sub-factor	High-Integrity Attributes	Risk Factors
Additionality	**Regulatory Additionality**	• Targets wells with no regulatory work order; explicit regulatory coordination on each well where the state is informed of the extent of the leak is given the opportunity to address it • Excludes wells already prioritized or queued for state-funded plugging • Annual issuance with ability to halt if regulatory mandates expand	• Wells with solvent operators legally responsible for plugging • No verification of state queue or overlap with public funding
	Financial Additionality	• No offsetting product revenue • Transparent cost reporting to support impact-per-dollar review	• Carbon revenue stacked on top of public plugging funds for the same well • Opaque or undisclosed project economics
	Alternative Scenario	• Government confirmed absence of any state-funded pathway for the targeted well • Public-funding pace far below the scale needed (no realistic alternative actor) • Elasticity of public funds: redirected dollars plug a different well, not none	• Plausible non-project actor or funding pathway for the same well • Project intersects with active state plugging trajectory • No documentation of alternative-scenario screening
Carbon Accounting	**Baseline / Project Scenario**	• Repeated chamber method measurements or the leak rate; stable or increasing trend required • Reservoir and production-history validation of physical plausibility • Dynamic baseline of nearby, geographically similar wells	• Single-point or short-window leak measurements with no trend test • No reservoir cross-check; baseline not anchored to physics • Flat or increasing leakage assumed and extrapolated upfront
	MRV	• Annual issuance tied to modeled avoidance, not full upfront crediting • Raw data, calibration, weather, GPS, and photos archived under version control • Two-stage post-plug verification • Continuous IoT checking for immediate reversal detection	• Full upfront issuance with no post-plug holdback • Sparse documentation; no traceable methodological audit trail • No defined leak threshold, scan protocol, or VVB site visit
	Leakage	• Wells have no solvent operator and no productive function • Government verified absence of active work orders or scheduled intervention • No effect on hydrocarbon supply, pricing, or operational decisions	• Wells tied to active operations or solvent operators • Plugging displaces production or maintenance to another site • Activity influences commodity supply or market behavior
	Durability	• 10-year continuous IoT methane monitoring (NDIR sensor, hourly sampling) • Horizontal-leakage screening • 2.5% project-wide discount in lieu of buffer pool for residual reversal risk • Use of a standard 100 year GWP for methane to CO2e conversion	• No long-term post-plug monitoring or only a short verification window • Wells in actively repressurized reservoirs (EOR, CO_2 injection) • No buffer pool, discount, or defined corrective-action plan
Enironmental & Social Safeguards	**Environmental**	• Plugging executed under PA DEP standards with formal completion sign-off • Site restored to baseline (backfill, drainage, erosion control, reseeding) • Emergency response plan; subcontractor solvency and bonding verified	• No regulatory compliance or DEP oversight • No surface restoration plan or post-plug environmental monitoring • Inadequate fluid and materials handling protocols
	Social	• Work on private land with explicit consent and Land Access Agreements • Defined grievance mechanism with response window; independent government escalation	• No landowner consent or executed land access agreement • No grievance channel or stakeholder communication framework
Ex-Ante / Delivery Risks	**Financial Viability**	• Plugging fully funded upfront via bond or escrow • Annual issuance avoids over-crediting and reduces buyer integrity exposure • 2.5% discount absorbs low-probability reversal costs without new capital outlay	• Project depends on future credit sales to complete fieldwork • Full upfront crediting with no holdback for permanence • No financial reserve for monitoring or corrective response
	Operational Capacity	• Certified general contractor with legacy-well track record (e.g., WSP) • Clear division of roles: developer manages oversight, contractor executes fieldwork • Wells with logistical constraints screened out at selection	• Inexperienced developer managing technical fieldwork directly • No certified contractor or DEP-compliant procedures • No screening for site access or downhole variability