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Orphan Oil and Gas (OOG) Well Plugging FRC Feedback
- Answers to questions -

General

Question: We understand that this framework is oriented towards orphan O&G well-plugging projects. However, of the 3+ million idle wells in the U.S., less than 5% are documented orphan wells, and perhaps ~20% if we include undocumented orphan wells. That still leaves out millions of unplugged abandoned (but not orphaned) wells. These wells technically have an operator, but in practice they often stay unplugged for years, primarily due to legal loopholes that allow them to indefinitely delay the plugging, or a lack of enforcement. That is the status quo today in most U.S. States. Until stronger, consistently enforced rules are in place, most of these projects are likely to be additional; they simply wouldn't happen without carbon finance. The sheer scale of abandoned wells speaks for itself. Will Sylvera also consider abandoned well-plugging projects as part of this framework?

- Sylvera's response: Sylvera's orphan oil and gas well plugging framework is currently scoped to the assessment of orphaned wells specifically. The decision to focus on this category was deliberate: orphaned, abandoned, and marginal wells each present distinct questions and uncertainties around additionality and carbon accounting, and conflating them within a single framework risked introducing ambiguity and inconsistency in how projects are assessed and compared against each other.

  However, this focus does not exclude expansion of the framework in the future to cover abandoned and marginal well-plugging carbon projects. As the methodology matures and the evidence base develops, Sylvera will consider whether and how to extend the framework to these additional well categories.

Question: 1. Carbon Accounting – Project Reporting – Monitoring – Ex-post Issuance Approach. It appears that Sylvera will penalize upfront crediting for this project type, where credits are issued after the project activity takes place (plugging the orphan well).

We are aligned with and in support of post-plugging monitoring and a permanence check to ensure no leakage has occurred, but we disagree with "best practice" being defined by Sylvera as leakage monitoring over a project's entire crediting period (as described in Permanence – Well Integrity Risk – Leakage Monitoring), for a number of reasons. Often, orphan wells are located on private land where a landowner is unlikely to agree to continuous monitoring equipment remaining in place for a crediting period of 20 years. They often want their land to return to its original use, e.g., crop fields or recreation. This length of monitoring could affect agreements between the project developer and landowner and may result in fewer landowners agreeing to orphan well plugging in the first place. Continuous monitoring would also incur high additional costs for the project developer in setting up the data systems and partnerships required to manage reporting over time, and favor project developers who may own and operate these systems or already have these partnerships in place.

We feel strongly that credit issuance should not be annual and linked to continuous monitoring of the well, noting that this structure of issuance does not align with current methodologies or registry processes for this project type, would require annual verification at high cost to the project developer, and would not support the high implementation costs of this project type. Issuance over time for orphan well plugging projects also means that the issuance is decoupled from the project activity itself, which is a divergence from how most, if not all, methodologies consider ex post crediting in carbon offset projects. We are concerned that the rating framework may send market signals regarding monitoring and credit issuance approaches that differ from current "best practices", causing unnecessary confusion and uncertainty around the quality of these projects. This interpretation may not be Sylvera's intent, but was a takeaway from the presentation and may need to be clarified.

Overall, we believe that high quality methodologies have sufficient safeguards in place regarding monitoring, quantification, and permanence; employing other mechanisms such as holding back portions of credits until after permanence checks, to ensure high integrity of these projects.

- Sylvera's response: OOG projects appear to be unique within the market in upfront crediting, which is a significant concern from two perspectives: 1) upfront crediting risks crediting for reductions that may never happen if the well plugging does not lead to permanent abatement of emissions, and 2) upfront crediting leads to crediting of emission reductions that are yet to occur, meaning retirements of credits that may see their effect 20–50 years later. Claiming emission reductions before they have been realized creates significant risks to the corporate buyers, and, more broadly, undermines progress toward emission abatement targets. For this reason, upfront crediting, although currently accommodated by registries, is considered to be a significant integrity risk to projects. However, this risk is expected to decrease as the project progresses further into its crediting period, since a greater share of emission reductions will already have been realized by then.

Carbon Accounting

Question: For measured flow rate due diligence - for wells measured flow rates (assuming multiple tests and increased testing times with stability of pressure and emissions), will the risk of a well that tests higher than historical production data be a conversation between Sylvera and the PD (an potentially external experts) to understand why that occurred, i.e., dewatering in a hydrodynamic reservoir?

- Sylvera's response: Sylvera will accommodate extra data and inputs from external experts in their assessment of project integrity and include that data accordingly in any project assessment.

Question: For projects where the methodology does not require more than one post-plugging leak verification but is enacted by the project developer outside of validation and verification and project documentation, will evidence of this verification be sufficient in achieving this best practice?

- Sylvera's response: Sylvera will accommodate extra evidence of verification beyond methodology requirements. Where there is clear evidence that the project conducts multiple post-plugging leak measurements and verification prior to issuing its credits, it would be assessed accordingly, regardless of the

methodology by which the project is being implemented. Sylvera's frameworks are methodology agnostic and take into account the evidence-based project-level approach and corresponding validation and verification.

Question: In lieu of ex-post issuance, should the PD adopt a developer-level buffer pool how will this impact the project rating?

- Sylvera's response: Developer-level buffer pools are considered to be a mitigation against ex-ante issuance concerns and potential non-permanence risks; however, if credits are still sold and retired prior to emission reductions being realized, integrity issues are still present and will be assessed accordingly.

Question: The use of "GWP values with scientific consensus" is a bit unclear and subjective. Does this mean that projects using GWP20 instead of GWP100 will be negatively scored? There is extensive research and discussions supporting the use of GWP20, so I think this deserves an extended analysis. Please read our white paper on "The GWP Choice for Methane-Originated Carbon Credits" for more context.

- Sylvera's response: Emission reductions are valued in CO2-equivalent terms using a GWP of 29.8 for fossil methane, consistent with the IPCC Sixth Assessment Report GWP value over a 100-year timescale (GWP100) to capture the long-term climate benefit that carbon credits are generally intended to represent. This also aligns with Sylvera's standard assessment approach to permanence at a 100-year timeframe. While methane's potency as a near-term super-pollutant could be captured by GWP20, carbon credits are denominated in tonnes of CO2-equivalent over the long term, making GWP100 the more appropriate measure of the durable climate benefit each credit represents.

Question: From our understanding of the framework, methodologies that base credit calculations on direct measurements are preferred. However, these methodologies have shown to have various issues: perverse incentives to artificially increase the leak flow before the measurement, high likelihood that one or two measurements are not representative of long term behavior, leak rate variability depending on weather and time, etc. Moreover, protocols using decline curve for credit calculations are typically much more conservative

than measurement based ones. Can you elaborate on this choice and potentially reconsidering this preference?"

- Sylvera's response: Sylvera considers projects that use direct measurement methods that assess the initial gas leak without opening the valve or risking well head manipulation (i.e., chamber-based methods), and aligned with the well's historical production data, to be more conservative and less likely to overstate initial emissions prior to plugging than those relying solely on historical production data or those that involve opening the valve to measure the initial leak. However, that said, Sylvera recognizes that direct measurements alone carry their own limitations, particularly around the temporal variability when only a limited number of measurements (with limited measuring hours) are taken. The most robust approach, in Sylvera's view, combines direct measurements, which are cross-checked and aligned with the well's historical production data, alongside evidence that the well has not been manipulated to artificially increase gas flow rates prior to measurements. To further reduce the risk and uncertainty in credit calculation, Sylvera's approach looks at whether the project applies a decline curve, using the measured gas leak flow rate as the starting point. This approach helps ensure that credited emission reductions are grounded in verified, site-specific data rather than assumptions that could lead to overestimation or underestimation.
- In addition to this, projects that apply an indirect method based on the wells' extensive historical production data and apply conservative extrapolation, using low- and high-probability scenarios to project production forward conservatively rather than assuming the leak continues at historical rates, could still score highly.

Question: I appreciate ratings agencies being methodology- and registry-agnostic, however, it's worth pointing out that project developers are limited by the methodology they're using if they want a specific registry's credits in the market. E.g., we cannot use AR6 if the registry uses only AR5 across their program. In this case, the project should not be negatively rated when following the word of the methodology.

- Sylvera's response: Methodology agnosticism is core to Sylvera's assessments to allow for parity between projects regardless of methodology. In requiring that projects meet specific quality standards, ratings agencies encourage registries to adopt methodologies with greater quality standards. However, in this specific case, use of the AR5 GWP value does not have a negative impact, or has a small impact on crediting volumes (28/30 relative to 29.8), which is accounted for through framework weighting.

Question: What data has been evaluated to determine that methane flow rates are correlated to methane leak rates?

- Sylvera's response: Methane flow rates that are synthetically produced through valve opening are considered to be a significant integrity risk to projects, unless there is data indicating that flow rate correlates to leak rate, as there is limited evidence that the modeled emissions would have occurred in the project crediting period. Sylvera considers any project focusing on the "potential-to-emit" rather than what is anticipated for a project over the crediting period to introduce higher integrity risks.

Question: How does Sylvera feel about the use of engineering studies to quantify baseline emissions as opposed to direct measurement?

- Sylvera's response: Engineering studies that quantify baseline emissions using "potential-to-emit" scenarios are considered an unconservative approach. Rather than measuring actual emissions from leaks, these studies estimate the maximum possible emissions under assumed conditions, which does not necessarily represent the actual present state of the well (i.e., specifically if the well was previously shut-in) and its current emission rates. This is analogous to projects that open the valve to measure flow rates prior to plugging, as both approaches introduce uncertainty around the accuracy of methane flow rates immediately before plugging activities take place, and therefore carry a higher risk of overstating baseline emissions.

Question: Why are credits issued up front? Why would a developer continue to monitor the well if they've already received the credits?

- Sylvera's response: Sylvera's position is that credits should not be issued up-front, prior to being monitored, verified, and realised. Up-front issuance is a practice relatively unique to oil and gas well plugging projects in the carbon markets, where claimed credits can be issued and retired years, or even decades, before the corresponding emission reductions are actually achieved. Sylvera considers this to be a significant integrity risk: credits that precede monitoring and verification introduce material uncertainty around whether the claimed climate benefit has genuinely been realized, and therefore undermine confidence in the credibility of those credits.

  On the other hand, continuous post-plugging monitoring is expected for confirming that a plugged well remains sealed over time. Although there are limited incentives for developers to continue monitoring the wells throughout the crediting period, Sylvera considers ongoing, or at least annual, monitoring to be a necessary requirement for a high-integrity permanence assessment.

Question: Just to clarify, verification of Emission Reductions is done for upfront issuance as well. How does Sylvera view verification of emission reductions if upfront issuance does not occur??

- Sylvera's response: High-integrity carbon projects are expected to monitor and verify plugged wells for potential leaks throughout the crediting period, and to issue credits only once the emission reductions have been realised. Up-front issuance is inconsistent with the carbon market standard: high-integrity projects under other project types are required to monitor and verify their climate impact before credits are issued. Up-front issuance departs from this principle by allowing credits to be claimed against reductions that are expected to occur over the next 20 years, rather than reductions that have already taken place. This introduces meaningful uncertainty around whether the credited climate benefit will ultimately be delivered, and raises questions about the real-world integrity of the credits being issued.

Question: If well manipulation and modeled baselines increase risk, then how are flow rates (manipulation) and decline curves (modeling) the "best" proxies?

- Sylvera's response: Direct measurement of wells in their unaltered state (using chamber-based methods that avoid any manipulation of the well prior to measurement) is considered the most reliable basis for quantifying initial emissions. When combined with historical production data for cross-validation and a decline curve model for projecting emissions over time, this approach minimises the uncertainty inherent in extrapolating results across a crediting period that can extend 20 years or more.
- Decline curves are considered to be the current best proxies, in the absence of better measurement and monitoring technology, well-suited to oil and gas well plugging projects because, once a well has been plugged, it is not possible to directly measure what emissions would have continued in the absence of the intervention. Modeling the decline from a verified starting point, rather than modeling the initial emission rate itself, provides a more defensible and conservative basis for credit calculation.
- The potential-to-emit approach, by contrast, is considered less accurate. It relies on estimating maximum possible emissions under assumed conditions rather than measuring actual leak rates, and the current approach is limited in its ability to account for the complexity of degrading orphan wells, with incomplete historical and present-day data. Applying this approach to extrapolate emissions over crediting periods of 20 or 50 years compounds those limitations and introduces material uncertainty into the real claimed climate benefit.

Question: From our understanding of the framework, methodologies that base credit calculations on direct measurements are preferred. However, these methodologies have various issues: perverse incentives to artificially increase the leak flow rate before the measurement or "cherry picking" sampling times to report artificially high baseline emissions, high likelihood that one or two measurements are not representative of long-term behavior, leak rate variability depending on weather, season and age of the well, etc. Moreover, protocols using decline curve for credit calculations are typically much more conservative than measurement-based ones. Can you elaborate on this choice and comment on the criteria that will determine a high or low score? For example, would a non-conservative

measurement-based project score higher on this category than a conservative decline-curve-based project?

- Sylvera's response: Sylvera's preferred approach combines direct measurements taken on unaltered wells with applied decline curves (derived from peer-reviewed research such as the Payne Institute decline curves, or from the well's historical production data), and supporting evidence that the well has not been manipulated prior to measurement. Where these elements are present together, this approach provides the most robust basis for baseline quantification and emission reduction calculations. That said, Sylvera recognises that not all projects will meet this standard, and that measurement approaches exist on a spectrum of reliability. Conservative indirect, model-based approaches that use a well's historical production data across multiple scenarios (low-leak and high-leak scenarios) to reduce uncertainty can still score higher than direct measurement approaches in which there is clear evidence that a well was altered or manipulated prior to measurement, without any supporting evidence that the measured leak rates correspond to historical production levels or fall below them. While direct measurement, when conducted correctly on an unaltered well, reduces the inherent uncertainty around baseline leak rates and the resulting emission reduction calculations, Sylvera's assessment explicitly accounts for the differing levels of uncertainty associated with each approach. The integrity of the measurement process itself is therefore as important as the methodology chosen.

Question: Carbon Accounting – Project Reporting – Pre-plugging leak test approach. It is not apparent in the slides, but during the presentation, Sylvera noted that "we also consider whether a project has altered a well's structure to determine flow rates as this can introduce the risk of artificially amplified emissions estimates." What impact does this have on the rating relative to other factors considered?

- Sylvera's response: The manipulation of well flow rates prior to measurement represents a significant integrity risk. Where there is evidence that a well was opened or otherwise altered before direct measurements were taken, and where this is not accompanied by supporting evidence that the measured flow

rate has been cross-checked against the well's historical production data, or that it is consistent with or lower than the natural baseline leak rate, there is an increased risk that emissions were artificially amplified in order to inflate emission reduction claims. In the absence of such supporting evidence, Sylvera considers this a material risk to credit integrity. Projects that cannot demonstrate that their measured flow rates reflect the well's genuine pre-plugging state, rather than a manipulated condition, will be assessed as carrying higher risk and scored accordingly.

Additionality

Question: Sylvera's additionality framework relies heavily on the 'orphan' status as the trigger for baseline credibility. However, that fails to address the strategic behavior of operators who may purposefully maintain wells in an 'idle' or 'inactive' state to avoid the financial burden of plugging, waiting until they can be legally classified as 'orphaned' to capture VCM financing. How does your framework account for this 'perverse additionality' where the prospect of carbon credit actually disincentivizes timely operator-led remediation? Furthermore, what specific due diligence is performed to ensure that an 'orphan' well wasn't artificially orphaned through the strategic offloading of liabilities by a solvent operator or through bankruptcy?

- Sylvera's response: Sylvera's additionality framework investigates both the volume claimed, the local policy and regulatory context, and the likelihood of plugging in the baseline scenario. Our ability to fully investigate potentially perverse actors, such as those using strategic offloading or bankruptcy, is limited; however, we conduct due diligence on historic well ownership and review any potential perverse action on a case-by-case basis to identify any potential red flags.

Permanence

Question: How will regulatory spacing affect Sylvera's assumption on subsurface communication? Regulatory spacing, i.e. standard setbacks, protects methane migrating to neighboring wells. Prior to drilling a well, reservoir studies are performed and regulatory

bodies oversee and approve the spacing unit ensuring that hydrocarbon are contained and their production is limited to that single well.

- Sylvera's response: Sylvera applies a standardized spacing assessment that examines the presence of orphaned, open, and active wells in the vicinity of the project well or wells. The proximity and status of surrounding wells is relevant to permanence: where orphaned wells are present in the immediate vicinity of a project well (50m, 300m, 1000m radiuses), there is a respective higher potential for lateral gas migration, and such projects will be scored slightly lower to reflect this risk. Alongside this proximity check, Sylvera's assessment also considers any reservoir studies conducted by the project developer or relevant regulatory bodies. Where such studies provide evidence that gas migration from the project well is not occurring, this is taken into account as a mitigating factor in the permanence assessment.

Question: Will jurisdiction come as a factor under well assessment in permanence? A reservoir and research in Colorado suggesting subsurface migration is not the same as reservoirs in Oklahoma and reservoir draw is dealt with prior to drilling of a well at a regulatory and scientific standpoint in certain jurisdictions.

- Sylvera's response: Sylvera's permanence assessment does not vary by jurisdiction or state. Migration dynamics across reservoirs are generally poorly characterized, and incorporating jurisdiction-specific data on migration risk would introduce a bias against regions where characterization is less developed, penalising projects not because of greater actual risk, but because of limited available data. Sylvera, thus, assesses the permanence risks of potential subsurface gas migration independently, on a consistent basis across all jurisdictions.

Question: Permanence – Anthropogenic Risk – Country Risk. Will Sylvera segregate conventional/unconventional exploration in the analysis?

- Sylvera's response: Sylvera will not segregate conventional/unconventional exploration, as the country risk assessment is not a major component of integrity scoring.

Safeguarding and Co-Benefits

Question: For inhabited structures, the state of Oklahoma has regulatory requirements, will these be factored in instead of the 1 km radius?

- Sylvera's response: Sylvera's Safeguarding and Co-Benefits assessment evaluates activities that go above and beyond what is required of carbon projects, with a focus on safeguards and positive outcomes for surrounding biodiversity and local communities. The assessment is standardized both within the specific project type and across other project types that Sylvera covers, and is conducted independently of any state-specific requirements. It is important to note that the Safeguarding and Co-Benefits assessment is not incorporated into Sylvera's Integrity Risk Rating. Rather, it serves as a complementary check that provides a broader context on the wider impacts and benefits of project activities.

Question: Sylvera's beyond-carbon benefits assessment is very comprehensive and robust, although would generally incur very high costs for the project developer to address all components. Is this assessment done for every project undergoing a letter rating or as an elective element?

- Sylvera's response: All projects undergoing a Rating undergo Sylvera's Safeguarding and Co-Benefit assessment. It is important to note that the Safeguarding and Co-Benefits assessment is not incorporated into Sylvera's Integrity Risk Rating. Rather, it serves as a complementary check that provides a broader context on the wider impacts and benefits of project activities.