Vaulted Deep Isometric Standard Project Verification Report

Company / GHG Removal Supplier	Vaulted Deep
Facility Name	Great Plains Facility
Production Facility Address	7513 KS-14 Hutchinson, KS 67501
Greenhouse Gas Removals	684.31 tonnes
Removal Method	Biomass Geological Storage
Removal Period	3/16/2024 – 5/31/2024
Verifier/Validation and Verification Body	Kevin McCabe 350Solutions, Inc.

ISSUED: JULY 05, 2024

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ISOMETRIC STANDARD VERIFICATION REPORT		
Company: Vaulted Deep	Company Contact: *Jose Ubillus Adriana Ovalle	Verification Team: *Kevin McCabe Lily Schacht
Removal Method: Biomass Geological Storage		
Report Date: July 05, 2024		
Document No: 350VR-VAULTED-ISO2404		
Rev: Final V2.1		

** primary contact/lead author*

1. KEY PROJECT DATA

TABLE 1. VAULTED TECHNOLOGY VERIFICATION SUMMARY

Verification Summary	
Title	Great Plains Biomass Sequestration (01P4)
Location	Great Plains Facility 7513 KS-14 Hutchinson, KS 67501
Reporting Period	March 16, 2024-May 31, 2024
Project Proponents	CDR Supplier: Vaulted Deep Feedstock Supplier: Redacted –woody waste supplier Regulatory Agency: Kansas Department of Health and Environment (KDHE)
Legal Ownership of the CDRs	Vaulted Deep
Removals in Reporting Period	684.31 tonnes
Removal Method	Biomass Geological Storage: Underground injection of mixed woody waste
Validation and Verification Report Date (Title)	December 22, 2023 (350VR-VAULTED-ISO2304)
GHG Removal Supplier	Vaulted Deep
Verification Type	Isometric Standard CDR Verification; Isometric Standard V1.0.0 Biomass Geological Storage Protocol V1.0 Biomass Feedstock Accounting Module V1.0 Biomass or Bio-oil Storage in Salt Caverns Module V1.0.2

1.1. EXECUTIVE SUMMARY

350Solutions was contracted to perform a project verification of the green house gas (GHG) statement of Vaulted Deep's biomass geological storage process for March 16, 2024-May 31, 2024. The validation process (VP) for the Great Plains Facility, which remains valid for this verification period, was concluded on December 22, 2023 and included observation of operations, review of data collection and handling procedures for adherence to the *Isometric Standard V1.0.0, Biomass Geological Storage Protocol V1.0, and Biomass Feedstock Accounting Module V1.0.* Further details and findings can be found in validation

and verification report 350VR-VAULTED-ISO2304. 350Solutions Inc. declares that we are an impartial verifying body, free from any conflicts of interest, capable, and qualified to complete this verification for the current operational period according to the *Isometric Standard V1.0.0, Biomass Geological Storage Protocol V1.0, Biomass Feedstock Accounting Module V1.0*, and *Biomass or Bio-oil Storage in Salt Caverns Module v1.0.2* utilizing a reasonable level of assurance.

In June 2024, 350Solutions conducted a verification of the greenhouse gas removal claims and reviewed other administrative details to verify compliance with the requirements of the *Isometric Standard V1.0.0*, *Biomass Geological Storage Protocol V1.0, Biomass Feedstock Accounting Module V1.0*, and *Biomass or Bio-oil Storage in Salt Caverns v1.0.2*. The verification for the current output audit period did not include a site visit of the Great Plains Facility (validation remains valid through 12/22/2028), therefore, a review of the GHG statement, the supporting documents, and ongoing monitoring documents that were submitted between June 18-June 25, 2024 and a review of the submitted documents was conducted.

350Solutions affirms that Vaulted Deep has the appropriate equipment, procedures, and protocols in place and documented to quantify GHG removal through the injection of mixed woody wastes in permitted Class I and V wells, via measurement of injected biomass, determination of biomass C content, and appropriate emissions calculations in accordance with the requirements of the applicable Isometric standards, protocols and modules. Eligibility criteria determinations are as follows:

Eligibility Criteria		
Criteria	**Eligibility Status**	**Rationale**
Validated against approved protocols	Eligible	The following Isometric Approved Protocols/Modules were used: Biomass Geological Storage, Biomass Feedstock Accounting, Biomass or Bio-oil Storage in Salt Caverns
Boundaries	Eligible	Project Boundaries are defined geographically at the point of ownership of the biomass until it is emplaced onsite during the specified time period
Baseline	Eligible	See Biomass Feedstock Accounting Protocol Requirements
Additionality	Eligible	Project not required by regulation. Carbon finance supports financial viability
Leakage	Eligible	Upstream considerations include pre-processing or sorting. There are no downstream consideration given that emplacement is the final fate.
Default emission factors, proxies and models	Eligible	Carbon content proxies meet the calculation requirements in the Biomass Geological Storage Protocol, all other factors are literature cited.
Uncertainty	Eligible	Sensitivity analysis provided, with carbon content found as a listable parameter.
Durability and monitoring	Eligible	Operating permits require monitoring of decommissioned wells for several years.
Risk of reversal	Eligible	Risk Assessment Questionnaire score indicated a Low (5%) risk.

Environmental and socioeconomic impacts	Eligible	All necessary permits required, meetings with public held.
Life cycle assessment (LCA) Policies	Eligible	See Biomass Geological Storage Protocol Requirements
Documentation	Eligible	PPD completed appropriately
Eligibility	Eligible	Project is registered
Project crediting	Eligible	Period is complete and removals verified
Stakeholder input process	Eligible	Community engagement meeting prior to operations, ongoing input managed through KS Dept. of Health and Env.
Regulatory compliance	Eligible	Maintenance of permits meet requirements
Biomass Geological Storage		
System boundary and GHG emission scope	Eligible	Project Boundaries are defined geographically at the point of ownership of the biomass until it is emplaced onsite during the specified time period
Baseline	Eligible	Assumes 100% decomposition of all biomass carbon to CO_2 within 15 years
Net CDR calculation	Eligible	Calculation method follows protocol and is reflected in LCA document
Calculation approach	Eligible	Removal is for only the specified time frame.
Calculation of CO2e removal	Eligible	Calculation method follows protocol and is reflected in GHG document
Calculation of CO2e stored	Eligible	Calculation method follows protocol and is reflected in GHG document
Calculation of CO2e counterfactual	Eligible	Calculation method follows protocol and is reflected in GHG document
Calculation of CO2e LCA emissions	Eligible	Calculation method follows protocol and is reflected in GHG document
Biomass Feedstock Accounting		
Eligibility criteria for biomass feedstocks with potential market leakage impacts	Eligible	Meets EC4: project pays a 3rd party provider for feedstock.
Counterfactual storage eligibility	Eligible	Decomposition or burned on site by feedstock provider.
Dedicated feedstock eligibility	Eligible	Biomass is diverted from landfill to feedstock provider for recycling.
Biomass or Bio-oil Storage in Salt Caverns		
Salt Cavern Characteristics	Eligible	Appropriate design and permitting meets all requirements.
Permit for Operations	Eligible	Permit obtained.
Operations and Monitoring	Eligible	Monthly compliance reports specify required measurements and frequency. All reports completed and submitted on time.
OVERALL ELIGIBILITY	**ELIGIBLE**	
Eligible Period	**3/16/2024 to 5/31/2024**	

By adhering to the requirements of the Isometric standards, protocols and modules, the quantity of 684.31 tonnes of removals has been verified with a reasonable level of assurance.

Verifier Information		
Verification Body	**Lead Verifier**	**Verification ID No.**
350Solutions, Inc.	Kevin McCabe	VS-Vaulted-ISO2401

Signed: Kevin McCabe (Lead Verifier)

Kevin McCabe

Lily Schacht (Peer Reviewer)

Lily R Schacht

2. MEANS OF VERIFICATION

2.1. VERIFICATION OBJECTIVES

A planned series of verification activities were conducted by 350Solutions to independently verify the claimed removals of the GHG statement submitted by Vaulted Deep for operations conducted at the Great Plains production facility for the time period March 16, 2024 to May 31, 2024. The verification was conducted following the specifications of the *Isometric Standard V1.0.0*, with guidance from the *Biomass Geological Storage Protocol V1.0, Biomass Feedstock Accounting Module V1.0*, and *Biomass and Bio-oil Storage in Salt Caverns Module V1.0.2*. The verification was conducted with a reasonable level of assurance and discrepancies between the claimed removals of the project and the removals estimated by the verification process for the reporting period are less than the materiality threshold of 5%.

2.2. VERIFICATION TEAM DETAILS

350Solutions is an accredited inspection & verification body by ANAB under ISO 17020 for completion of ISO 14034 Technology Verifications and were the first accredited entity in North America for ISO 14034. 350Solutions Technical Lead for the Vaulted Deep verification is Kevin McCabe. Kevin McCabe is an Advanced Mechanical Engineer and Lead Technology Verifier with more than five years of verification experience. Complete verifier qualifications are attached as Appendix 4.

2.3. AUDIT PROCESS FOLLOWED

The specific verification activities conducted are summarized in Table 2. The list of all the files that were reviewed are listed in Appendix 1. A summary of the findings including conversations, observations, and completed Methodology Compliance Checklist, Isometric standard, protocol, and module checklists are attached to this report as Appendix 2. A summary of changes that have occurred between the initial project validation (December 2023) as well as the previous reporting period (March 2024) can be found in Appendix 3.

TABLE 2. VERIFICATION ACTIVITIES

Date(s)	Verification Activity	Verification Tasks	Documents Reviewed
June 18, 2024	Validation Report Review	- Review of Validation Report - Review of prior Verification Report - Identification of major and minor process steps, measurements, and calculations - Review of Standards/Protocols/Modules required for Verification - Generation of a checklist of verification issues, recommendations, and opportunities for improvement	350VR-VAULTED-ISO2304.pdf 350VR-VAULTED-ISO2401.pdf Biomass or Bio-oil Storage in Salt Caverns v1.0.2 — Isometric.pdf
June 18-25, 2024	Submitted Document Review	- Verify changes to the system - Review of measurements and calculations	- File List provided in Appendix 1

Date(s)	Verification Activity	Verification Tasks	Documents Reviewed
		- Review of durability/permit requirement monitoring data - Review of new well documentation	

3. TECHNICAL ASPECTS

3.1. PROJECT DETAILS

The Vaulted process as shown in Figure 1 utilizes sustainably sourced biomass feedstock; mixed woody waste (e.g. which meets the requirements found in the *Biomass Feedstock Accounting Module* see Appendix 3 of validation report 350VR-VAULTED-ISO2304 for evidence), which is processed into a slurry through the addition of recovered brine. The biomass is delivered via dump truck and unloaded into the slurry mixing area where every 10th load is sampled for analysis. The biomass is mixed with a saturated recovered brine from the well to produce a slurry. The produced slurry is pumped to a slurry processing unit where particles are ground until all the particles are able to pass the screen. Once the slurry particles have been appropriately sized, the biomass slurry is pumped into the salt caverns. As the slurry is pumped into the well, brine within the cavern is displaced and recovered in a brine tank. Excess brine not used for subsequent batches is gravity fed into a Class 1 well for geological storage. Additional description and photos of the Vaulted Deep Process can be found in validation report 350VR-VAULTED-ISO2304.

During the current reporting period, Vaulted has undertaken the process of opening another well. The new well was put into operation on May 16, 2024. Details on the procedures used to open the new well were provided to KDHE in compliance with the permit requirements. The new well was connected to the feedstock processing equipment via new runs of piping with two additional booster pumps to get the slurry to the new well.

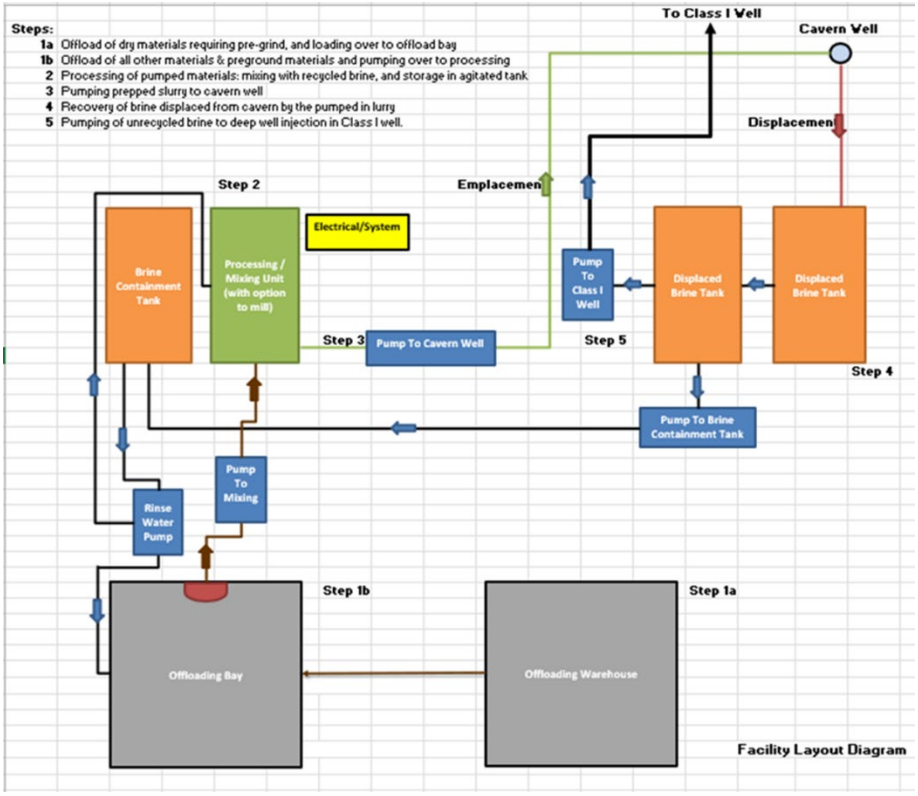

FIGURE 1. VAULTED DEEP PROCESS AT THE GREAT PLAINS FACILITY

3.2. PROTOCOLS AND MODULES APPLIED

The verification was conducted following the specifications of the following standards, protocols, and modules:

- *Isometric Standard V1.0.0*
- *Biomass Geological Storage Protocol V1.0*
- *Biomass Feedstock Accounting Module V1.0*
- *Biomass and Bio-oil Storage in Salt Caverns Module V1.0.2*

3.3. APPLICABILITY OF APPLIED PROTOCOL AND MODULES

The Vaulted project takes mixed woody waste and generates a slurry to be pumped into salt caverns. The mixed woody waste was assessed under the eligibility criteria of the Feedstock Module and was found to be eligible as a meeting the criteria EC4 and exemption C1. As the feedstock has been deemed an eligible biomass feedstock, its storage underground in salt caverns makes both the Underground Storage Protocol and Storage in Salt Caverns Module applicable to this project.

3.4. PROJECT BOUNDARY

The boundaries of the project include the delivery of mixed woody waste product from the feedstock supplier to the biomass processing site (Great Plains Facility), the processing of the feedstock onsite, and then the underground storage in one of the ~60 salt caverns onsite. Continuous monitoring is conducted primarily onsite, with samples sent to an offsite laboratory.

3.5. BASELINE SCENARIO

The feedstock supplier has attested that all the biomass provided to the supplier is diverted from landfill. The supplier processes the wood waste for other commercial purposes. As the product ages it loses its commercial value and is typically burned to clear space for the newer incoming wood waste. All the biomass that is provided to the Vaulted project only comes from the excess piles otherwise fated to be burned. It is assumed that 100% of the carbon content of the burned biomass is released as carbon dioxide.

3.6. LEAKAGE

Only feedstock that was ultimately fated for incineration is diverted to the Vaulted project. Upstream considerations for leakage include energy usage for the sorting of material to meet Vaulted's usage specifications. There are no downstream considerations as both fates are end of life via either combustion or emplacement.

3.7. ADDITIONALITY

This project is not required by any public policy or law. The project does not generate any additional income beyond that generated from the sale of CDR removals.

3.8. DURABILITY

Vaulted has provided literature that shows that storage in salt caverns lasts on the order of ~10,000 years when the cavern walls remain intact. Through proper operation of the wells and adherence to the requirements of the permits including closure and abandonment requirements, then well integrity should last for 1000+ years.

4. MONITORING

4.1. MONITORING PLAN

Vaulted has developed a detailed monitoring plan that is continually updated as improvements to the measurement system are made. Details on certain aspects of the monitoring plan are outlined in the following sections. Calculations of the removals have been automated using VB macros.

4.2. DATA COLLECTION AND STORAGE

Vaulted has two primary methods of data collection and storage. They use both continuous online collection from digital sources and analog data collection from documents or hand written records. The digital records are stored in a database stored onsite (with cloud backup). The documents and handwritten records are stored as a physical record onsite in filing cabinets, collated and organized by batch. The physical record is then digitized and stored on computers onsite as well as virtually. The categorizations of measurements by method collection can be found below:

Batch collected records	Digital measurements

Distance between feedstock source and processing site Feedstock Characteristics (mass, moisture, C-content, etc) Electricity use Fuel use Water use Brine Characteristics (salinity, conductivity, C-content, etc).	Well Monitoring (temperature, pressure, flow, etc) Return gas monitoring

4.3. REVERSALS

The Vaulted project was scored using the risk of reversal checklist and it was determined that the project has a "very low" risk of reversal. This means that the Vaulted project is required to keep a 2% buffer pool.

Vaulted has provided documentation and established protocols to reduce reversals from the project which can occur via a few routes. The reversal pathways and the corrective measures are listed below.

Reversal Pathway	Corrective Measures
Decomposition of the feedstock onsite	Emplacement of the feedstock as soon as it arrives on site. Reduced onsite storage residence time.
Feedstock entrained in return brine as solid or liquid	All returned brine is either used to emplace more feedstock or returned underground in a Class 1 well.
Feedstock decomposes underground and escapes as gas	Both the enclosure that contains the return brine tank as well as the brine tank headspace itself has gas sensors. Escaped gasses would be quantified and subtracted from the buffer pool. The return brine would be sampled for microbes, any found would be killed with biocide pumped down the well.
Salt cavern integrity failure	Adherence to requirements of the permits will reduce the risk of cavern containment failure. Additional monitoring is prescribed to verify that well brine remains contained. Any breaches are to be reported KDHE.

4.4. UNCERTAINTY ASSESSMENT

Vaulted has provided a sensitivity analysis examining 5 separate variables. Carbon content was identified as the only parameter contributing to a >1% change in Removal.

4.5. MODULE SPECIFIC CRITERIA

The modules listed in Section 3.2 have additional requirements. The Vaulted process has been found to meet all the requirements of the listed modules. Further details of the findings can be found in the module specific checklists in Appendix 2.

5. CREDITING DETAILS

5.1. PROJECT START DATE

Vaulted Deep began the storage of mixed woody waste in salt caverns at the Great Plains Facility on August 22, 2023, hosted the validation site visit on November 29, 2023, and with the validation report being issued on December 22, 2023.

5.2. CREDITING PERIOD

The 5-year crediting period for project number 01P4 runs from December 22, 2023 to December 22, 2028, while the removals for this reporting period occurred between March 16, 2023 and May 31, 2023.

6. IMPACT ASSESSMENT

6.1. ENVIRONMENTAL

Vaulted has provided the environmental impact risk assessment prior to receiving their permit to operate. Minor issues with the site were addressed. The permit issued by KDHE indicates operating parameters which are designed to limit environmental risk. The permits also prescribe monitoring practices and reporting frequencies to mitigate any impacts from breaches or spills.

6.2. SOCIAL

The social impacts were considered and given the remote nature of the location and its prior ownership history, the impacts were found to be small, with employment opportunities being the greatest benefit.

6.3. STAKEHOLDER ASSESSMENT

Prior to operation, the project held several public open meetings with local and state government officials as well as local landowners invited to attend. The meetings provided an opportunity for the public to hear about what was to occur onsite as well as an opportunity for open questions about the project.

7. GHG STATEMENT

7.1. ACCURACY OF THE STATEMENT

The values represented in the GHG statement have been crossed referenced with the presented evidence. The calculations have been duplicated and the difference between the submitted removals and the verified number is less than 0.1%. The total verified number of removals for the reporting period is 684.31 tonnes of CO_2e.

7.2. CONCLUSION/OPINIONS

350Solutions has reviewed the documentation of the technology, the instrumentation, the procedures, performance and collected data and has found that the data presented in the greenhouse gas removal statement indicates that the claims fall within the 5% materiality threshold for greenhouse gas emissions and removals as required by the Isometric Standard V1.0.0 and:

☒ ***Continues to meet the requirements of the Isometric Standard V1.0.0, Biomass Geological Storage Protocol V1.0, Biomass Feedstock Accounting Module V1.0, and Biomass or Bio-oil Storage in Salt Caverns Module v1.0.2 for Validation***

☐ ***Meets the requirements of the Isometric Standard V1.0.0, Biomass Geological Storage Protocol V1.0, Biomass Feedstock Accounting Module V1.0, and Biomass or Bio-oil Storage in Salt Caverns Module v1.0.2 with minor modifications for Validation***

☐ ***Does Not Meet the requirements of the Isometric Standard V1.0.0, Biomass Geological Storage Protocol V1.0, Biomass Feedstock Accounting Module V1.0, and Biomass or Bio-oil Storage in Salt Caverns Module v1.0.2 for Validation***

350Solutions has reviewed the documentation of the technology, the instrumentation, the procedures, performance and collected data and has found that the data presented in the greenhouse gas removal statement indicates that the claims fall within the 5% materiality threshold for greenhouse gas emissions and removals as required by the Isometric Standard V1.0.0.

7.3. SUMMARY OF VERIFICATION FINDINGS

A summary of specific findings and any identified issues associated with each requirement of the *Isometric Standard V1.0.0, Biomass Geological Storage Protocol, Biomass Feedstock Accounting Module*, and *Biomass or Bio-oil Storage in Salt Caverns Module v1.0.2* are summarized below.

TABLE 5. VERIFICATION FINDINGS

Isometric Standard Section Ref.	Verification Topic	Changed since Project Validation? (Y/N)	Final Findings
2.1.	*Validated against approved Protocols*	Y	Acceptable - *Biomass Geological Storage — Isometric Protocol V1.0, Feedstock Accounting Module V1.0,* and *Biomass or Bio-oil Storage in Salt Caverns Module v1.0.2*
2.5.1	*Boundaries*	Y	Acceptable - Geographical boundaries remain the same, while temporal boundaries become Mar 16, 2024-May 31 2024.
2.5.2	*Baseline*	N	Acceptable – See Biomass Feedstock Accounting Module Requirements
2.5.3	*Additionality - Financial*	N	Acceptable – It has been stated that no other income streams indicated, project pays a fee for biomass feedstock.

2.5.3	*Additionality - Environmental*	N	Acceptable – Project is net negative relative to the counterfactual case where feedstock is burned by 3rd party supplier for lot space. Project only buys feedstock that have been onsite for several years and would otherwise be burned.
2.5.3	*Additionality - Regulatory*	N	Acceptable – There are no regulatory requirements calling for disposal of biomass wastes in salt caverns in the local, state, nor national jurisdictions.
2.5.4	*Leakage*	N	Acceptable – Pre-processing energy usage at supplier could be a source of leakage.
2.5.5	*Default Emission Factors, Proxies, and Models*	N	Acceptable – Carbon content measurement of every delivery batch is cost prohibitive, therefore a conservative determination of content is made following instructions in the Biomass Geological Storage Protocol. Conservative values for items such as transportation fuel efficiency, equipment sizes for embodied carbon calculation were used. Default emission factors citations include literature citations.
2.5.6	*Common Calculation Factors*	N	Acceptable – All non-metric values are converted to the equivalent metric basis. All emission factors are properly cited.
2.5.7	*Uncertainty*	N	Acceptable - Sensitivity analysis provided. Carbon content was identified as the only parameter contributing to a >1% change in Removal.
2.5.8	*Durability and Monitoring*	N	Acceptable – Peer reviewed literature indicating durable removal of >1000 years provided. Operating Permit requires monitoring of the injection well for several years following decommissioning prior to abandonment.
2.5.9	*Risk of Reversal*	N	Acceptable – Risk Assessment Questionnaire score was 2 which indicates a Low (1-3) – 5% risk. Observations match the responses provided in the submitted questionnaire.
2.5.10 3.7	*Environmental and Socioeconomic Impacts*	N	Acceptable – The site has all required operations and environmental permits. The project hosted a community engagement meeting prior to opening with no objections, there were queries on job creation of which there were a few jobs openings created.
2.5.11	*Life Cycle Assessment (LCA) Policies*	N	Acceptable – See Biomass Geological Storage Protocol findings for details
3.1	*Ownership*	N	Acceptable – Feedstock acquisition contract states transfer of rights to “monetization of environmental benefits and attributes”.
3.2	*Documentation*	N	Acceptable – PPD completed appropriately and submitted.
3.3	*Eligibility*	N	Acceptable – Project registered with Isometric.
3.4	*Project Crediting*	N	Acceptable – Project period is complete and all removals have been verified.
3.5	*Stakeholder Input Process*	N	Acceptable - The project hosted a community engagement meeting prior to opening with no objections, there were queries on job creation of which there were a few jobs openings created.

			Ongoing input is primarily managed through the KDHE permit reporting and feedback process.
3.6	*Regulatory Compliance*	Y	Acceptable – Maintenance of well operation permits meets requirements. Ongoing permit reporting requirements completed.
Biomass Feedstock Accounting Module			
2.1	*Eligibility Criteria for Market Leakage*	N	Acceptable – Meets requirements of EC4 – pays third party for feedstock, third party diverts feedstock from landfill.
2.2	*Counterfactual Storage Eligibility*	N	Acceptable – Alternative fate of feedstock was burning to make space for newer material.
2.3	*Dedicated Energy Feedstock Eligibility*	N	Acceptable – Material has already fulfilled it's primary use, and is being diverted from waste streams.
3.0	*Counterfactual Definition*	N	Acceptable – Counterfactual case requires no additional input energy or materials emissions, however, assumes 100% emission of the carbon contained in the material.
3.1	*Counterfactual Energy Definition*	N	Acceptable – No energy associated
3.2	*Counterfactual Replacement Definition*	N	Acceptable – Material meets exemption C1 as indicated by affidavit by supplier indicating only material that would otherwise be burned is sent.
4.0	*Replacement Calculation for Manure*	N	Not Applicable – only mixed woody waste was used, no manure stored.
Biomass or Bio-oil Storage in Salt Caverns Module*			
1.0, 2.2	*Salt Cavern Characterization – Cavern Dimensions*	Y	Acceptable – Cavern dimensions determined by sonar, confirmed by addition of new well by KDHE to the Class V Permit.
1.0, 2.2	*Salt Cavern Characterization – Integrity*	Y	Acceptable – Cavern integrity determined by sonar, confirmed by addition of new well by KDHE to the Class V Permit.
1.0, 2.2	*Salt Cavern Characterization – Permeability*	Y	Acceptable – Cavern permeability determined by pressure testing, confirmed by addition of new well by KDHE to the Class V Permit.
1.0, 2.2	*Salt Cavern Characterization – Porosity & permeability*	Y	Acceptable – Cavern porosity and permeability characteristics measured during well log, confirmed by addition of new well by KDHE to the Class V Permit.
1.0, 2.2	*Salt Cavern Characterization – Subsurface Features*	Y	Acceptable – Cavern subsurface features measured during well log, confirmed by addition of new well by KDHE to the Class V Permit.
1.0	*Salt Cavern Characterization – Temperature, pH, conductivity/Cl- conc.*	Y	Acceptable – Brine characteristics measured prior to emplacement, confirmed by addition of new well by KDHE to the Class V Permit. Brine periodically tested and monitored.
1.0	*Salt Cavern Characterization – Brine TOC*	Y	Acceptable – Brine TOC measured prior to emplacement, confirmed by addition of new well by KDHE to the Class V Permit. Brine TOC periodically tested and monitored.
1.0	*Salt Cavern Characterization –*	Y	Not Applicable

	$\delta^{13}C$ analysis (where applicable)		
1.0, 3.1.3	*Salt Cavern Characterization – Surface Subsistence*	Y	Acceptable –Survey needed for new well.
1.0	*Salt Cavern Characterization – Displaced Brine Injection location*	N	Acceptable – Class I well onsite for gravity fed injection.
1.0, 2.3	*Emplacement Infrastructure*	Y	Acceptable – New well added to KDHE permit granted for current operations.
1.0	*Emplacement Monitoring*	Y	Acceptable – New well added to KDHE permit granted for current operations with current monitoring practices.
1.0, 3.2	*Well Closure and Post Closure Requirements*	N	Acceptable – KDHE permit outlines closure requirements and abandonment monitoring requirements. Monitoring report provided.
2.1	*Permit for Operation*	N	Acceptable – KDHE permit for Class V and Class I wells onsite.
3.1.1	*Injection Pressure*	N	Acceptable – Pressure is continuously monitored and reported to KDHE monthly.
3.1.1	*Volume monitoring*	N	Acceptable – Monitoring of injected material measured daily and reported monthly, confirmed by sonar quarterly.
3.1.1	*Injectate monitoring*	N	Acceptable – Chloride content (conductivity), pH, and temperature measured continuously, TOC measured once per month, while all values are reported monthly.
3.1.1	*Sampling Frequency*	N	Acceptable – Samples taken every 10th batch.
3.1.1	*Safety Monitoring*	N	Acceptable – Monitoring of well pressure and volatile gas return triggers process shutdown.
3.1.2	*Mechanical Integrity*	Y	Acceptable – Mechanical integrity testing (MIT) of the new well was conducted as required every 5 years per the KDHE permit.
3.1.3	*Well Pressure Monitoring*	N	Acceptable – Well pressure measured continuously with safety interlock. Daily pressure reported to KDHE monthly.
3.1.3	*Sonar Survey*	Y	Acceptable – Sonar surveys conducted for new well as required and reported to KDHE.
3.1.3	*Fill Volume*	N	Acceptable – Cavern volume tracked based upon volume of emplaced material. Estimate volume reported monthly, verified by sonar quarterly.
3.1.3	*Return Brine Monitoring*	N	Acceptable – Chloride content (conductivity), pH, and temperature measured continuously, TOC measured once per month, while all values are reported monthly.
3.1.3	*Volatile Gas Monitoring*	N	Acceptable – Gas monitors measure total LEL%, however, measurement does not include speciation. Escaping gas measured by tedlar bag sampling, <1% carbon containing gasses.
3.3	*Reversal Risk*	N	Acceptable – Total output is discounted 2% as insurance against future reversals.

3.3.1	*Attribution of Reversals*	N	Acceptable – No reversals occurred during the output period.
3.4	*Calculation of CO_2e, Storage Monitoring, Project*	N	Acceptable – Justification provided for exclusion based upon quantification of immateriality.

7.4. VERIFICATION ISSUES

Findings of the greenhouse gas removal statement review and on-site validation of operations has not revealed any major concerns, however, there are minor concerns which are provided for consideration for improvement of future operations and GHG Removal Credit calculations.

In general, Vaulted Deep has complied with all requirements of the Isometric Standard. All requirements have been addressed and were implemented to be in compliance with the *Isometric Standard V1.0.0*, *Biomass Geological Storage Protocol V1.0*, *Biomass Feedstock Accounting Module V1.0*, and *Biomass or Bio-oil Storage in Salt Caverns v1.0.2* for the time period under review. The following items are those that did not require immediate action and are recommendations for improvement of future GHG removal claims, as well as monitoring and recordkeeping procedures. Addressing these recommendations to improve future data quality is suggested but is not required for this verification.

- Reporting period was less than 30 days after well opening, some documents have not been generated yet.
- Water usage and salt additions were found on monthly KDHE reports but not in GHG statement calculations
- Vented gas analyze by LEL% monitor and not a speciated analytical instrument
- Energy usage at feedstock supplier for sorting or particle sizing prior to delivery not included

7.5. RECOMMENDATIONS & OPPORTUNITIES FOR IMPROVEMENT

Based on the above Verification findings and issues, as well as on-site observations, 350Solutions has the following recommendations for improvements prior to the next verification.

Recommendations for improving the quality of data, accuracy, and verifiability of the GHG Removal claims in the future include:

- For next verification include yet to be completed documents related to well change including SW-12 monitoring plan once the well is full and closed, AR-05 brine characterization, etc.
- Edit the Emplacement worksheets which currently capture energy usage to include the following: Batch #, Emplacement date and time, water used, salt added, Front end loader run time.
- Install speciated gas analyzer and gas totalizer on returned brine tank vent, analyzer should measure CO2, CH4, N2, O2, and VOCs.
- Include energy usage at feedstock supplier for sorting or particle sizing prior to delivery

8. REVISION HISTORY

Original date of issue: June 28, 2024

Version	Date Issued	Noted Changes
Draft Versions (v1.0)	June 28, 2024;	NA
Final Version v2.0	June 28, 2024	Final edits
Final Version v2.1	July 05, 2024	Typo edits

References

[1] Isometric , *Isometric Standard, Version 1.0.0, Edition 04 Oct 2023.*
https://science.isometric.com/standard

[2] Isometric , *Biomass Geological Storage, Version 1.0, Edition 14 Nov 2023.*
https://science.isometric.com/protocol/biomass-geological-storage

[3] Isometric , *Biomass Feedstock Accounting, Version 1.0, Edition 04 Dec 2023.*
https://science.isometric.com/module/biomass-feedstock-accounting

[4] Isometric , *Biomass or Bio-oil Storage in Salt Caverns, Version 1.0.2, Edition 06 Mar 2024.*
https://registry.isometric.com/module/salt-cavern-storage

See Appendix 1 and Table 2 for list of specific files reviewed during the VVP.

APPENDIX 1: DOCUMENTS SUBMITTED FOR REVIEW

...\05-2024 Verification\AR-5 Support Data\2024 AR -05 Final Report - Part 1 4.4.24.pdf
...\05-2024 Verification\AR-5 Support Data\2024 AR-05 Drill Out, Completion, and Testing Plan.pdf
...\05-2024 Verification\AR-5 Support Data\2024 AR-05 Final Report - Part 2 (Cavern Int. Test) 4.16.24.pdf
...\05-2024 Verification\AR-5 Support Data\AR-05_Monitoring Requirements.xlsx
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...\New Well photos\AR-05 Displacement Pump 1.jpg
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...\New Well photos\SW-12 Wellhead 1.jpg

APPENDIX 2: ISOMETRIC STANDARD METHODOLOGY V1.0.0 VVP CHECKLIST

Measurements – Net CO2 Calculation

Parameter	Notes	Parameter Description	Required by the protocol	Required for Output Audit Verification?	Applicability	Equation	Parameter Type	Units	Data Source	Measurement Method	Monitoring Frequency	QA/QC Procedures	Required Evidence	Reference in Protocol	Evidence, Documents, or Files Reviewed	Verifier Findings and Notes
CBiomass, n	lab	%wt of C in the biomass injectant	Yes	Yes	Carbon Emissions Calculation	Eq. 3 (Biomass Geological Storage)	Measured	wt%	Analytical determination of carbon content of biomass	ASTM D5373, NREL Laboratory Analysis Procedure for Determination of Carbon and Hydrogen in Biomass, or equivalent	Minimum one sample per injection batch	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	7.3.3 (Biomass Geological Storage)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls and Batch Tracker packets	One batch tracker was initially missing the carbon content data, however, was provided upon request.
mInj, n	weight ticket	total mass of biomass injectant	Yes	Yes	Carbon Emissions Calculation	Eq. 3 (Biomass Geological Storage)	Measured	kg	direct mass measurement	Calibrated Weigh Scale	Each Biomass delivery	Scales must be calibrated annually by certified entity	Weigh scale tickets for each delivery of biomass (arrival and departure weights) or equivalent; Calibration records for scales	7.3.3 (Biomass Geological Storage)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls and Batch Tracker packets	
CBiomass, p	duplicative with injection batch - done / measured as one	%wt of C in the biomass injectant	Under certain conditions	Under certain conditions	Carbon Emissions Calculation (if biomass production batches are not blended prior to injection)	Eq. 4 (Biomass Geological Storage)	Measured	wt%	Analytical determination of carbon content of biomass	ASTM D5373, NREL Laboratory Analysis Procedure for Determination of Carbon and Hydrogen in Biomass, or equivalent	Minimum one sample per injection batch	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	7.3.3 (Biomass Geological Storage)	NA	
mInj, p	duplicative with injection batch - done / measured as one	total mass of biomass injectant	Under certain conditions	Under certain conditions	Carbon Emissions Calculation (if biomass production batches are not blended prior to injection)	Eq. 4 (Biomass Geological Storage)	Measured	kg	direct mass measurement	Calibrated Weigh Scale	Each Biomass delivery	Scales must be calibrated annually by certified entity	Weigh scale tickets for each delivery of biomass (arrival and departure weights) or equivalent; Calibration records for scales	7.3.3 (Biomass Geological Storage)	NA	
mfuel, k	might be 0, sometime uses a diesel powered front loader	mass of fuel used in biomass processing	Yes	Yes	Carbon Emissions Calculation	Eq. 3 (Energy use Accounting)	Measured	gal	fuel usage records	fuel meters fuel container weight fuel purchases or utility bills equipment hours of operation (handling equipment only)	Each batch	Appropriate calibration and maintenance of scales or meters	Operator logs, plant data systems, or plant records	7.3.5.1 (Biomass Geological Storage); 3.3 (Energy Use Accounting)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Tonnage Tracking Columns N-P
EFfuel, processing	might be 0, sometime uses a diesel powered front loader	fuel emission factor for processing	Yes	Yes	Carbon Emissions Calculation	Eq. 3 (Energy use Accounting)	Estimated	CO2e/unit (tonnes)	Argonne National Laboratory GREET Model, California Air Resources Board modified GREET model (CA-GREET), Ecoinvent database, US Federal Life Cycle Inventory database or LCA Commons, or from similar databases used in common LCA practices or tools	N/A	Each batch	N/A	Choice and ratinoale for EF choice	7.3.5.1 (Biomass Geological Storage); 3.3 (Energy Use Accounting)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Emission Factors Tab
kwh, k	processing	Electricity usage for biomass processing	Yes	Yes	Carbon Emissions Calculation	Eq. 2 (Energy use Accounting)	Measured	kwh	Electricity usage records	electricity meters OR utility bills OR equipment time of use and power rating	Each batch	Appropriate calibration and maintenance of meters	Operator logs, plant data systems, or plant records	7.3.5.1 (Biomass Geological Storage); 3.2 (Energy Use Accounting)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls and Batch Tracker packets	Tonnage Tracking Columns H-M
EFelectricity, processing		electricity emission factor	Yes	Yes	Carbon Emissions Calculation	Eq. 2 (Energy use Accounting)	Estimated	CO2e/kwh (tonnes)	Argonne National Laboratory GREET Model, California Air Resources Board modified GREET model (CA-GREET), Ecoinvent database, US Federal Life Cycle Inventory database or LCA Commons, or from similar databases used in common LCA practices or tools	N/A	Each batch	N/A	Choice and rationale for EF choice	7.3.5.1 (Biomass Geological Storage); 3.2 (Energy Use Accounting)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Emission Factors Tab
Fj, processing	n/a - processing site is the same as supplier site	Quantity of fuel used in transport of biomass to processing site	Under certain conditions	Yes	Carbon Emissions Calculation (if applying energy usage method)	Eq. 2 (Transportation)	Measured or estimated	gal	vehicle or fleet management records	fuel flow meters, fleet management system data, vehicle on board diagnostics, miles traveled & vehicle type, or similar	All deliveries for a batch	verify instrument calibrations as appropriate	meter, management system, OBD or other data records or logs, shipping documents	7.3.5.2 (Biomass Geological Storage); 3.2 (Transportation)	NA	
Fj, injection	n/a - using distance/mass method	Quantity of fuel used in transport of processing to injection site	Under certain conditions	Yes	Carbon Emissions Calculation (if applying energy usage method)	Eq. 2 (Transportation)	Measured or estimated	gal	vehicle or fleet management records	fuel flow meters, fleet management system data, vehicle on board diagnostics, miles traveled & vehicle type, or similar	All deliveries for a batch	verify instrument calibrations as appropriate	meter, management system, OBD or other data records or logs, shipping documents	7.3.5.2 (Biomass Geological Storage); 3.2 (Transportation)	NA	
EFfuel, transportation, j	n/a - using distance/mass method	fuel emission factor for transportation	Under certain conditions	Yes	Carbon Emissions Calculation (if applying energy usage method)	Eq. 2 (Transportation)	Estimated	CO2e/unit (tonnes)	Argonne National Laboratory GREET Model, California Air Resources Board modified GREET model (CA-GREET), Ecoinvent database, US Federal Life Cycle Inventory database or LCA Commons, or from similar databases used in common LCA practices or tools	N/A	All trips for each batch	N/A	Choice and rationale for EF choice	7.3.5.2 (Biomass Geological Storage); 3.2 (Transportation)	NA	
Dj, conversion	n/a - processing site is the same as supplier site	Biomass transportation distance traveled - feedstock supplier to processing site	Under certain conditions	Yes	Carbon Emissions Calculation (if using distance-based method)	Eq. 3 (Transportation)	Measured or estimated	mi or km	shipping records (bill of lading) OR fleet management records OR weighscale tickets	on-line mapping systems using origin and departure from shipping documents, odometer readings	All trips for each batch	Review and check of shipping records and origin/destination	Shipping records	7.3.5.2 (Biomass Geological Storage); 3.3 (Transportation)	NA	
Wj, conversion	n/a - processing site is the same as supplier site	Mass of biomass transported from supplier to processing site	Under certain conditions	Yes	Carbon Emissions Calculation (if using distance-based method)	Eq. 3 (Transportation)	Measured	kg, tonne, lb	shipping records (bill of lading) OR fleet management records OR weighscale tickets	calibrated weigh scale	All deliveries for a batch	review weigh scale calibration certificate	Shipping records, weigh scale ticket	7.3.5.2 (Biomass Geological Storage); 3.3 (Transportation)	NA	
DBM-Injection	Measured via Google Maps	Biomass transportation distance traveled to injection site	Under certain conditions	Yes	Carbon Emissions Calculation (if using distance-based method)	Eq. 3 (Transportation)	Measured or estimated	mi or km	shipping records (bill of lading) OR fleet management records OR weighscale tickets	on-line mapping systems using origin and departure from shipping documents, odometer readings	All trips for each batch	Review and check of shipping records and origin/destination	Shipping records	7.3.5.2 (Biomass Geological Storage); 3.3 (Transportation)	fguSlGpL7GkMWt9kOL06E8RgA8QBZ7v_m_4daf8943e1b3.png	From Supplier Address, Park City, KS to Great Plains Facility, Hutchinson, KS
WBM-Injection		Mass of biomass transported from processing site to injection site	Under certain conditions	Yes	Carbon Emissions Calculation (if using distance-based method)	Eq. 3 (Transportation)	Measured	kg, tonne, lb	shipping records (bill of lading) OR fleet management records OR weighscale tickets	calibrated weigh scale	All deliveries for a batch	review weigh scale calibration certificate	Shipping records, weigh scale ticket	7.3.5.2 (Biomass Geological Storage); 3.3 (Transportation)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls and Batch Tracker packets	
EFTransportation, j	yes, using distance based method	the weight- and distance-based emission factor for transportation	Under certain conditions	Yes	Carbon Emissions Calculation (if using distance-based method)	Eq. 3 (Transportation)	Estimated	CO2e/unit (tonnes)	Argonne National Laboratory GREET Model, California Air Resources Board modified GREET model (CA-GREET), Ecoinvent database, US Federal Life Cycle Inventory database or LCA Commons, or from similar databases used in common LCA practices or tools	N/A	All trips for each batch	N/A	Choice and rationale for EF choice	7.3.5.2 (Biomass Geological Storage); 3.3 (Transportation)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls fguSlGpL7GkMWt9kOL06E8RgA8QBZ7v_m_4daf8943e1b3.png	Emission Factors Tab
kwhI,Injection		Electricity usage for biomass injection	Yes	Yes	Carbon Emissions Calculation	Eq. 2 (Energy use Accounting	Measured	kwh	Electricity usage records	electricity meters OR utility bills OR equipment time of use and power rating	Each batch	Appropriate calibration and maintenance of meters	Operator logs, plant data systems, or plant records	7.3.5.1 (Biomass Geological Storage); 3.2 (Energy Use Accounting)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls and Batch Tracker packets	Tonnage Tracking Columns H-M (combined with kwhp)
mfuel, Injection	n/a	mass of fuel used in biomass injection	Yes	Yes	Carbon Emissions Calculation	Eq. 3 (Energy use Accounting	Measured	gal	fuel usage records	fuel meters fuel container weight fuel purchases or utility bills equipment hours of operation (handling equipment only)	Each batch	Appropriate calibration and maintenance of scales or meters	Operator logs, plant data systems, or plant records	7.3.5.1 (Biomass Geological Storage); 3.3 (Energy Use Accounting)	NA	
EFelectricity, injection		electricity emission factor for injection process	Yes	Yes	Carbon Emissions Calculation	Eq. 2 (Energy use Accounting	Estimated	CO2e/kwh (tonnes)	Argonne National Laboratory GREET Model, California Air Resources Board modified GREET model (CA-GREET), Ecoinvent database, US Federal Life Cycle Inventory database or LCA Commons, or from similar databases used in common LCA practices or tools	N/A	Each batch	N/A	Choice and rationale for EF choice	7.3.5.1 (Biomass Geological Storage); 3.2 (Energy Use Accounting)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Emission Factors Tab
EFfuel, injection	n/a	fuel emission factor for injection processes	Yes	Yes	Carbon Emissions Calculation	Eq. 3 (Energy use Accounting	Estimated	CO2e/unit (tonnes)	Argonne National Laboratory GREET Model, California Air Resources Board modified GREET model (CA-GREET), Ecoinvent database, US Federal Life Cycle Inventory database or LCA Commons, or from similar databases used in common LCA practices or tools	N/A	Each batch	N/A	Choice and rationale for EF choice	7.3.5.1 (Biomass Geological Storage); 3.3 (Energy Use Accounting)	NA	

Parameter	Notes	Parameter Description	Required by the protocol	Required for Output Audit Verification?	Applicability	Equation	Parameter Type	Units	Data Source	Measurement Method	Monitoring Frequency	QA/QC Procedures	Required Evidence	Reference in Protocol	Evidence, Documents, or Files Reviewed	Verifier Findings and Notes
Product Stage Emissions		includes raw material sourcing, transport to facility and manufacturing	Yes	Yes	Embodied Carbon Emissions Calculation	Eq. 1 (Amortized Emissions)	Measured	tonnes	independently verified LCAs for the material or product completed; an environmental product declaration (EPD) for a material or product completed and independently verified	number/weight of each product or material used in the project facility and a corresponding EPD-based embodied carbon emission factor, OR emission factors from LCA life cycle databases, including USLCI database, Ecoinvent, ICE	each site	ISO 14040 or similar guidelines; ISO 14025, ISO 21930, EN 15804 or equivalent standards including product EPDs as well as industry-wide EPDs	Operator logs, plant data systems, or plant records	7.3.5.3 (Biomass Geological Storage); 3.0 & 3.2 (Embodied Emissions)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	LCI_ Evergreen Mixed Woody Tab
Construction Stage Emissions		includes transport to site and installation at site	Yes	Yes	Embodied Carbon Emissions Calculation	Eq. 1 (Amortized Emissions)	Measured	tonnes	independently verified LCAs for the material or product completed; or an environmental product declaration (EPD) for a material or product completed and independently verified	number/weight of each product or material used in the project facility and a corresponding EPD-based embodied carbon emission factor, OR emission factors from LCA life cycle databases, including USLCI	each site	ISO 14040 or similar guidelines; ISO 14025, ISO 21930, EN 15804 or equivalent standards including product EPDs as well as industry-wide EPDs	Operator logs, plant data systems, or plant records	7.3.5.3 (Biomass Geological Storage); 3.0 & 3.2 (Amortized Emissions)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	LCI_ Evergreen Mixed Woody Tab
End of Life Stage Emissions		includes demolition of building, transport to end of life, waste processing and final disposal or scenarios for these life cycle stages	Yes	Yes	Embodied Carbon Emissions Calculation	Eq. 1 (Amortized Emissions)	Measured	tonnes	independently verified LCAs for the material or product completed; an environmental product declaration (EPD) for a material or product completed and independently verified	number/weight of each product or material used in the project facility and a corresponding EPD-based embodied carbon emission factor, OR emission factors from LCA life cycle databases, including USLCI	each site	ISO 14040 or similar guidelines; ISO 14025, ISO 21930, EN 15804 or equivalent standards including product EPDs as well as industry-wide EPDs	Operator logs, plant data systems, or plant records	7.3.5.3 (Biomass Geological Storage); 3.0 & 3.2 (Embodied Emissions)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	LCI_ Evergreen Mixed Woody Tab
Storage and Monitoring Emissions	any emissions from any measurements not captured - outside site electricity meter	the total quantity of GHG emissions associated with storage monitoring operations allocated to a removal	Yes	Yes	Embodied Carbon Emissions Calculation	Eq. 1 (Amortized Emissions)	Measured	tonnes	independently verified LCAs for the material or product completed; an environmental product declaration (EPD) for a material or product completed and independently verified	Electricity and fuel usage records; electricity meters OR utility bills OR equipment time of use and power rating; fuel meters fuel container weight fuel purchases or utility bills equipment hours of	each site	Appropriate calibration and maintenance of scales or meters	Operator logs, plant data systems, or plant records	7.3.5.3 (Biomass Geological Storage); 3.0 & 3.3 (Embodied Emissions)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	LCI_ Evergreen Mixed Woody Tab
CO2eReplacement	lab	%wt of NPK in the biomass feedstock	Under certain conditions	Under certain conditions	Counterfactual Emissions	Eq. 3 (Biomass Feedstock Accounting)	Measured	wt%	Analytical determination of NPK content of biomass	ASTM D5373, Determination of Carbon, Hydrogen, and Nitrogen in Biomass, or equivalent	Each Batch	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	3.2.3 (Biomass Feedstock Accounting)	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Carbon content via combustion equivalent
	weight ticket	mass of the replacement product						kg	direct mass measurement	Calibrated Weigh Scale	Each Batch	Scales calibration certificate	Feedstock weigh scale tickets for each production batch, or other equivalent records to determine mReplacemt,p		2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls and Batch Tracker packets	Mass via combustion equivalent

Measurements - Additional Project Reqs.

Parameter	Notes	Parameter Description	Required?	Required for Output Audit?	Applicability	Required Evidence	Reference in Protocol or Standard	Evidence, Documents, or Files Reviewed	Verifier Findings and Notes
Conservative assumptions		Choosing input parameters that will purposefully result in a lower net CO2 Removal than if using the median input values	Yes	Yes	Baselines	Shared distribution of data and method for making assumptions and decisions	Standard - 2.5.2; Biomass Geological Storage - 7.2	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Carbon content calculation for loads without direct measurement.
No emissions reductions or avoidance		Emissions reductions are simply lowering or avoiding future GHG releases from a specific entity or project	Yes	Yes	Baselines	Only Carbon Removal is acceptable - all positive emissions must be subtracted from Removals	Standard - 2.5.2; Biomass Geological Storage - 7.2	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	All positive emissions accounted for and subtracted.
Financial Additionality		An evaluation of the likelihood that an intervention that causes a climate benefit above and beyond what would have happened in a no-intervention Baseline scenario was the result of revenues from carbon finance	Yes	If changed since Project Validation	Additionality	Removals are the main purpose and only source of revenue of the Project; OR demonstrating that economic barriers would prevent Project implementation in the absence of Carbon Finance; OR in the absence of carbon finance, Removals only in excess of this historical baseline may be considered financially additional	Standard - 2.5.3; Biomass Geological Storage - 6.4	No Change	
Environmental Additionality		An evaluation of the likelihood that an intervention causes a climate benefit above and beyond what would have happened in a no-intervention Baseline scenario	Yes	If changed since Project Validation	Additionality	Net negative climate impact when compared to the Counterfactual scenario	Standard - 2.5.3; Biomass Geological Storage - 6.4	No Change	
Regulatory additionality		An assessment that determines whether the Project activity is not required by an existing regulation or policy and therefore it goes above and beyond what would have happened in a no-intervention Baseline scenario	Yes	If changed since Project Validation	Additionality	The Project is not required by existing laws, regulations, policies, or other binding obligations, OR if the Project is legally required, the Project provides Removals that exceed the legal requirement	Standard - 2.5.3; Biomass Geological Storage - 6.4	No Change	
Biomass Feedstock Eligibility		Feedstock eligibility with respect to sustainability, leakage, and counterfactual scenarios	Yes	Yes	Eligibility	Documentation that demonstrates biomass feedstock eligibility, sourcing, counterfactual emission determinations	Biomass Geological Storage - 4.0; Biomass Feedstock Accounting - 2.1, 2.2	No Change	
Leakage		The increase or decrease in GHG emissions outside the geographic or temporal boundary of a project that results from that project's activities	Yes	Yes	Leakage	Shared assessment of potential increases in GHG emissions outside the defined project boundary, AND if there is leakage the Project outlines how it will be quantified and deducted from Removals	Standard - 2.5.4		Found to be immaterial
Reputability of sources		A source that would be widely considered trustworthy based on the process undertaken (e.g., peer review) or origin of the information (e.g., government body)	Yes	If changed since Project Validation	Default Factors, LCA, and Models	Proper citation of all sources, models, data, etc.	Standard - 2.5.5	No Change	
Data transparency		Open-ness about any non business-sensitive information that would be necessary in scientific replication of results	Yes	If changed since Project Validation	Default Factors, LCA, and Models	All models, and any modifications to them, their input parameters, or data used and validation results are clearly outlined	Standard - 2.5.5	No Change	
GWP		Global Warming Potential (relative to CO2, which has a value of 1)	Yes	If changed since Project Validation	Default Factors, LCA, and Models	Global Warming Potential (GWP) calculations use 100-yr GWP factors, based on the current volume of the IPCC Assessment Report	Standard - 2.5.6	No Change	
Consequential analysis		The analysis of specific Uncertainties, hazards and scenarios inherent in complex systems such as the natural and engineered environment, aiming to describe how systems-level environmentally relevant flows will change in response to possible decisions	Yes	If changed since Project Validation	Default Factors, LCA, and Models	The Project uses Consequential Analysis for its Life Cycle Assessment, OR the Project appropriately justifies the use of Attributional Analysis (e.g. on grounds of accuracy and feasibility)	Standard - 2.5.11	No Change	
Uncertainty		Lack of knowledge of the exact amount of CO2 removed by a particular process, Uncertainty may be quantified using probability distributions, confidence intervals, or variance estimates	Yes	Yes	Uncertainty	The Project outlines a procedure for incorporating Uncertainties into a Conservative estimate of Removals via a Conservative estimate of input parameters, variance propagation, OR Monte Carlo Simulations	Standard - 2.5.7 & Appendix A; Biomass Geological Storage - 6.5		
Durability (>1000 years required)		The amount of time carbon removed from the atmosphere by an intervention – for example, a CDR project – is expected to reside in a given Reservoir, taking into account both physical risks and socioeconomic constructs (such as contracts) to protect the Reservoir in question	Yes	If changed since Project Validation	Durability and Monitoring	The Project demonstrates a Durability of at least 1,000 years via containment mechanisms, where the conservatively-estimated engineering and/or scientific methods for containment exceed 1,000 years OR via scientifically falsifiable hypotheses that can be used to show there is no alternative destination for carbon storage other than the Reservoir in question	Standard - 2.5.8	No Change	

Parameter	Notes	Parameter Description	Required?	Required for Output Audit?	Applicability	Required Evidence	Reference in Protocol or Standard	Evidence, Documents, or Files Reviewed	Verifier Findings and Notes
Reversal risk		The escape of CO_2 to the atmosphere after it has been stored, and after a Credit has been Issued	Yes	If changed since Project Validation	Durability and Monitoring	The Project has undertaken a full risk assessment to identify all possible mechanisms that may lead to Reversals and subsequent decreases in Durability	Standard - 2.5.8	No Change	
Monitoring		Tracking a project in order to maintain awareness of changes and impacts over a certain period	Yes	If changed since Project Validation	Durability and Monitoring	There is a sufficient Monitoring Plan in place to quantify the amount of potential Reversal that may occur via each identified Reversal mechanism	Standard - 2.5.8	No Change	
Buffer Pool		A common and recognized insurance mechanism among Registries allowing Credits to be set aside (in this case by Isometric) to compensate for Reversals which may occur in the future.	Yes	If changed since Project Validation	Durability and Monitoring	The Project has categorized and justified an assessment of Risk of Reversal, following the guidance in the Risk of Reversal risk questionnaire, to determine the appropriate Buffer Pool Size	Standard - 2.5.8 & Appendix B	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	
Socioeconomic harm		Socioeconomic harm	Yes	If changed since Project Validation	Environmental and Socioeconomic Impacts	The Project has demonstrated that it will do no net environmental, social or economic harm AND the PDD includes a summary environmental impact assessment (if required)	Standard - 2.5.10; 3.2; 3.7; Biomass Geological Storage - 6.1; 5.0	No Change	
Environmental harm		Environmental harm	Yes	If changed since Project Validation	Environmental and Socioeconomic Impacts	The Project has demonstrated that it will do no net environmental, social or economic harm AND the PDD includes a summary environmental impact assessment (if required)	Standard - 2.5.10; 3.2; 3.7; Biomass Geological Storage - 6.1; 5.0	No Change	
Post-cessation plan		Plan for closing a specific site that aligns with local regulations and requirements	Yes	If changed since Project Validation	Environmental and Socioeconomic Impacts	The Project has defined a Closure Plan that outlines post-cessation actions that are needed by the Project Proponent	Standard - 2.5.10; 3.2; 3.7; Biomass Geological Storage - 5.0	No Change	
Stakeholder Input Process		Process for gaining input from entities and organizations with an interest in or impact from the project	Yes	If changed since Project Validation	Environmental and Socioeconomic Impacts	The Project defined and followed a Stakeholder Input Process which meets the requirements set out in the Standard	Standard - 3.5	No Change	
Grievance Mechanism		Process for addressing concerns from entities and organizations with an interest in or impact from the project	Yes	If changed since Project Validation	Environmental and Socioeconomic Impacts	The Stakeholder Input Process include a Grievance Mechanism for stakeholders to voice, process and resolve grievances	Standard - 3.5	No Change	
Site Safety Program		Site safety programs, especially as related to production and handling of biomass	Yes	If changed since Project	Environmental and Socioeconomic Impacts	Documentation of safety programs and compliance	Biomass Geological Storage - 5.0	No Change	
Legal ownership of Removals		Determination of the legal rights to Credits generated through CDR	Yes	If changed since Project Validation	Ownership	production and handling of biomass	Standard - 3.1; Biomass Geological Storage 6.3	No Change	ACS holds rights to cavern contents, Vaulted wholy owns ACS + Vaulted signs agreements with waste suppliers that stipuate Vaulted gets all carbon rights
Eligibility on Isometric Registry		Determination of the ability to list Credits generated through CDR on the Isometric Registry	Yes	If changed since Project Validation	Eligibility	The Project has confirmed that the activities of the Project are exclusively registered with the Isometric Registry, AND the Project uses the latest available version of a Certified Protocol (unless a grace period has been explicitly specified by Isometric), AND the Project meet all eligibility criteria defined by the selected Certified Protocol	Standard - 3.3	No Change	
Crediting Period		The period of time over which a Project Design Document is valid, and over which Removals may be Verified, resulting in Issued Credits	Yes	Yes	Crediting Period	The PDD specifies a Crediting Period which is no longer than the maximum period allowed by the Standard and the relevant Certified Protocol (5 years; unless otherwise specified)	Standard - 3.4	Isometric GHG Statement Report.docx	March 16, 2024-May 31, 2024
Regulatory Compliance		Adherance to all jurisdictional requirements	Yes	If changed since Project Validation	Regulatory Compliance	The Project confirms in the PDD that it is in compliance with regulations for all jurisdictions to which the Project is beholden	Standard - 3.6	No Change	Class V permits

Measurements – Durability in Salt Caverns

Parameter	Parameter Description	Monitoring phase	Required by the protocol	Required under certain conditions	Required for Output Audit?	Measurement Method	Monitoring Frequency	QA/QC Procedures	Required Evidence	Reference in Module	Evidence, Documents, or Files Reviewed	Verifier Findings and Notes
CBiomass, n	%wt of C in the biomass injectant	Operation	Yes		Yes	ASTM D5373, NREL Laboratory Analysis Procedure for Determination of Carbon and Hydrogen in Biomass, or equivalent	Minimum of 3 samples every 10 trucks of the same biomass type	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	3.1.1	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Carbon measured every 10th batch injected
pH	pH of formation fluid	Pre Injection	Yes		If changed since Project Validation	pH meter	Once	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	1	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
temperature	temperature of formation fluid	Pre Injection	Yes		If changed since Project Validation	temperature probe	Once	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	1	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
conductivity	conductivity of formation fluid	Pre Injection	Yes		If changed since Project Validation	ASTM Designation D1125-82	Once	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	1	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
Concentration Carbon in DIC and DOC	Concentration Carbon in DIC and DOC in formation fluid	Pre Injection	Under certain conditions	when a monitoring well is required/ avaliable	If changed since Project Validation	GC	Once	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	1	NA	
Hydrocarbon baseline	Estimate of hydrocarbons present in the reservoir prior to bio-oil injection.	Pre Injection	Under certain conditions	if injection into depleted hydrocarbon fields	If changed since Project Validation	e.g., Baseline geophysical logs	Once			1	NA	
d13 of Carbon in DIC and DOC	Concentration and d13 of Carbon in DIC and DOC in formation fluid	Pre Injection	Under certain conditions	when a monitoring well is required/ avaliable	If changed since Project Validation	IRMS/Cavity ring down mass spectrometry	Once	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	3.1.3, 3.2	NA	
Injection pressure	Surface injection pressure aligned with local requirements	Operation	Yes		Yes	As per UIC permit requirements	Continuous	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	3.1.1	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
Annulus Pressure	pressure between annulus and tubing aligned with local requirements	Operation	Yes		Yes		continuous			3.1.1, 3.1.2	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
Casing Pressure	Long String casing pressure aligned with local requirements	Operation	Yes		Yes		continuous			3.1.1	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
Internal Well Integrity (Corrosion monitoring)	Demonstration of internal mechanical integrity	Operation & Post Injection	Yes		If changed since Project Validation	As per UIC permit requirements			UIC Permit, Testing Data	3.1.2, 3.2	2024 AR -05 Final Report - Part 1 4.4.24.pdf 2024 AR-05 Final Report - Part 2 (Cavern Int. Test) 4.16.24.pdf	
External Well integrity	Demonstration of external mechanical integrity - annually	Operation & Post Injection	Yes		If changed since Project Validation	As per UIC permit requirements			UIC Permit, Testing Data	3.1.2, 3.2	2024 AR -05 Final Report - Part 1 4.4.24.pdf 2024 AR-05 Final Report - Part 2 (Cavern Int. Test) 4.16.24.pdf	
Pressure fall off test	Pressure fall off test	Operation & Post Injection	Yes		If changed since Project Validation	UIC pressure falloff testing guidelines	Quarterly	Per testing protocol	Data logs/Data Acquisition System Output	3.1.2, 3.2	2024 AR -05 Final Report - Part 1 4.4.24.pdf 2024 AR-05 Final Report - Part 2 (Cavern Int. Test) 4.16.24.pdf	
Biomass injection rate	Biomass injection rate	Operation	Yes		Yes	Flow meter	Continuous	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	3.1.1	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls	Monitoring of injected material measured daily and reported monthly, confirmed by sonar quarterly.
d^{13} Carbon signature	d13 Carbon signature of the compounds of the biomass	Operation	Under certain conditions	If gas analysis warrants	If changed since Project Validation	IRMS/Cavity ring down mass spectrometry	One sample per feedstock type	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	3.1.1	NA	
viscosity	viscosity of biomass slurry	Operation	Yes		Yes	ASTM D445-12, ASTM D7042-21a, Rheological characterization, or equivalent	One sample per injection batch	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	3.1.1	Not produced	Not produced
pH	pH of Biomass	Operation	Yes		Yes	pH meter	One sample per injection batch	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for audited samples, including supporting lab QA/QC results	3.1.1	Not produced	Not produced
biomass-brine ratio	Ratio or biomass-to-brine within the slurry	Operation	Yes		Yes		One sample per injection batch, unless a fixed ratio then monthly			3.1.1	Not measured	Excess brine used as needed for flow

Parameter	Parameter Description	Monitoring phase	Required by the protocol	Required under certain conditions	Required for Output Audit?	Measurement Method	Monitoring Frequency	QA/QC Procedures	Required Evidence	Reference in Module	Evidence, Documents, or Files Reviewed	Verifier Findings and Notes
biomass constiuents	biomass constituents e.g., oxygen and nitrogen	Operation	Yes		If changed since Project Validation		One sample per feedstock type			3.1.1	2024-05-31 CDR Tonnage Tracking with LCA - Kansas.xls and Batch Tracker packets	Only carbon measured, other elements not measured on this interval
Reservoir Temperature	Reservoir temperature profile	Operation & Post Injection	Yes		If changed since Project Validation	temperature sensor or logger	6 monthly	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	3.1.3, 3.2	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
Reservoir Pressure	Calculated Bottom Hole Reservoir Pressure	Operation & Post Injection	Yes		If changed since Project Validation	pressure sensor	6 monthly	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	3.1.3, 3.2	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
Fracturing monitoring	presences of pre-existing fractures and induced fracture stability	Pre Injection	Yes	As per UIC permit requirements	If changed since Project Validation	e.g., Step Rate Test, Seismics	Once			1, 2.2	2024 AR -05 Final Report - Part 1 4.4.24.pdf	Required every 5 years
Fracturing monitoring	presences of pre-existing fractures and induced fracture stability	Operation	Under certain conditions	As per UIC permit requirements	If changed since Project Validation	e.g., Step Rate Test, Seismics				3.1.3, 3.2	2024 AR -05 Final Report - Part 1 4.4.24.pdf	Required every 5 years
Gas composition	Gas composition analysis CO2, N, O2, CH4, or VOC levels in well headspace with resolution of at least 0.01%vol	Operation & Post Injection	Under certain conditions	when gas is detected and measurable	If changed since Project Validation	wellhead gas sampling; gas monitor if limits breached	Monthly (O), as specified in permit (PI)	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	3.1.3, 3.2	Not measured	LEL% levels not exceeded, composition not measured
pH	pH of formation water	Operation & Post Injection	Under certain conditions	when a monitoring well is required/ avaliable	If changed since Project Validation	pH meter	6 monthly (O), as specified in permit (PI)	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for auditied samples, including supporting lab QA/QC results	3.1.3, 3.2	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
temperature	temperature of formation fluid	Operation & Post Injection	Under certain conditions	when a monitoring well is required/ avaliable	If changed since Project Validation	temperature probe	6 monthly (O), as specified in permit (PI)	As per manufacturer calibration procedure	Data logs/Data Acquisition System Output	3.1.3, 3.2	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
conductivity	conductivity of formation fluid	Operation & Post Injection	Under certain conditions	when a monitoring well is required/ avaliable	If changed since Project Validation	ASTM Designation D1125-82	6 monthly (O), as specified in permit (PI)	ISO 17025 accredited laboratory	Analytical reports from qualified laboratory for auditied samples, including supporting lab QA/QC results	3.1.3, 3.2	KDHE Class V SW-12 Monitoring Form - March 2024.pdf	Measured everyday of injection, reported monthly
Seismic monitoring	Seismic monitoring	Operation & Post Injection	Yes		Yes	As per UIC permit requirements	Continuous		Data logs/Data Acquisition System Output	3.1.3, 3.2	Not Produced	
USDW quality	montioring of USDWs for increases in pressure and changes to chloride concentrations at a minimum	Operation & Post Injection	Under certain conditions	As per UIC permit requirements	If changed since Project Validation	As per UIC permit requirements			Analytical reports from qualified laboratory for auditied samples, including supporting lab QA/QC results	3.1.3, 3.2	NA - time frame too short	
biomass migration (fluid) monitoring	injected material size, extent and migration	Operation & Post Injection	Yes		If changed since Project Validation	As per UIC permit requirements			UIC Permit, Testing Data	3.1.3, 3.2	NA - over time frame	
Gas isotope stability	Stable isotope compositions of carbon containing species - usually measure by IRMS	Operation & Post Injection	Not required but helpful	when gas detected and useful	If changed since Project Validation	IRMS/ Cavity ring down mass spectrometry			Analytical reports from qualified laboratory for auditied samples, including supporting lab QA/QC results	3.1.3, 3.2	NA	
Porosity & permeability	Porosity & Permeability of sequestration zone strata	Pre Injection	Yes		If changed since Project Validation	As per UIC permit requirements			UIC Permit, Testing Data	1, 2.2	NA - no change	Conducted prior to operations
Porosity & permeability	Porosity & Permeability of confining layers	Pre Injection	Yes		If changed since Project Validation	As per UIC permit requirements			UIC Permit, Testing Data	1, 2.2	NA - no change	Conducted prior to operations
Reservoir size	Sequestration zone of sufficient volume	Pre Injection	Yes		If changed since Project Validation	As per UIC permit requirements			UIC Permit, Testing Data	2	2024 AR -05 Final Report - Part 1 4.4.24.pdf	Newly opened resevoir with 287390.2 bbls volume
Injectivity	Sequestration zone of sufficient injectivity to receive the total anticipated volume of biomass	Pre Injection	Yes		If changed since Project Validation	As per UIC permit requirements			UIC Permit, Testing Data	2	2024 AR -05 Final Report - Part 1 4.4.24.pdf	Newly opened resevoir with 287390.2 bbls volume

TABLE 3 BIOMASS FEEDSTOCK ACCOUNTING ELIGIBILITY ASSESSMENT FOR SUPPLIED MIXED WOODY WASTE

Criteria	Requirements	Finding	Evidence
Eligibility Criteria EC4*	Project Proponent paid positive amount for their feedstock, but this was paid to 3rd party and not the entity responsible for biomass growth or harvesting, if this 3rd party also didn't pay the producing/harvesting entity above total recovery and replacement cost.	TRUE	Attestation letter from current supplier stating that materials they receive are being diverted from landfill.
Eligibility Criteria EC10	Biomass that is expected to have decayed or where the most likely counterfactual fate would release the stored biogenic carbon sooner than 10 years from when project uses it, is eligible under this protocol and will not incur any counterfactual storage penalty.	TRUE	Attestation letter from current supplier stating that excess materials are burned to maintain space.
Eligibility Criteria EC11	Applicable to non-forestry feedstocks: The biomass feedstock was not grown for the purposes of carbon removal activities or energy production.	TRUE	Attestation letter from current supplier stating that materials they receive are being diverted from landfill.

* Feedstock meets Potential Market Leakage Impacts eligibility if any of Eligibility Criteria EC1- Eligibility Criteria EC9 are true.

APPENDIX 3: CHANGES TO SYSTEM/PROCESS

Figure A3-1. New Well Displacement Pump 01

Figure A3-2. New Well Displacement Pump 02.

Figure A3-3. SW-12 Wellhead manifold.

APPENDIX 4: VERIFIER QUALIFICATIONS

Supporting documentation, including verifier resumes, and verifier or corporate accreditations are also included in this appendix.

Verifier Qualifications	Criteria Met?	Evidence / Notes *(note how the criteria was met, specific documents - resume/CV, publications, certifications, etc.).*
Verifier has relevant technical knowledge of the type of technology being evaluated and carbon removal processes in general		
A) Does Verifier have:		
1. An in-depth technical knowledge of the technology type under verification;	☑	350Solutions is accredited to ISO/IEC 17020:2012 and ISO 14034 Environmental Technology Verification (ETV) as a Type A (third party) Inspection Body (ANAB Certificate Number: AI-2618). The technical scope of 350's accreditation includes verification of performance and environmental impact as it relates to design, materials, equipment, installation and operations of technologies in the categories of Energy, Clean Production and Process, and Air Pollution Monitoring and Abatement. As documented in 350Solutions' ETV Standard Operating Procedure (ETV QPM 350-223-03), and Quality Systems Procedures for verifier qualifications (QSP-350-005-02), 350Solutions conforms to the requirements of ISO 17020 Annex A with respect to verifier qualifications and procedures. These procedures and quality management programs are generally relevant to verification under the Isometric Standard. Note that verifications completed for Isometric are not equivalent to ISO 14034 verifications. 350 staff have participated in the evaluation and verification of novel technologies that sequester carbon via various methods, including biomass conversion to liquids, solids, and other products which are then permanantly stored in ways such as land application or geologic storage, conversion of captured CO2 into building materials and co-products, and the production of chemicals, fuels, and products via biomass pyrolysis and gasification. 350 also served as lead verifier for the Carbon XPrize competition and contributed to the development of procedures and processes for verification of relevant calculations, modeling, and statistical methods in order to assess team results and calculations of performance metrics and uncertainty. 350 has demonstrated knowledge of data quality and data validation approaches and execution in supporting verification of performance claims and results.
2. Knowledge of specific risk areas associated with performance of such technologies (i.e. common failure points, performance issues, barriers to scaleup);	☑	
3. Knowledge of the environmental implications related to the use of the technology from a life cycle perspective, such as impact of the technology on lifecycle CO2 emissions and carbon removal;	☑	
4. Knowledge of relevant applicable test methods and standards for evaluating performance or impact of the technology;	☑	
5. Knowledge of relevant calculation, modeling, and statistical methods in order to assess test results and calculations of performance metrics and uncertainty, as applicable;	☑	
6. Knowledge of data quality and data validation approaches, including QA/QC procedures, for example.	☑	
Verifier is a credible independent 3rd party		
B) Is Verifier:		
1. third-party body independent of the team registered for the Isometric Registry	☑	350Solutions is accredited to ISO/IEC 17020:2012 and ISO 14034 ETV as a Type A (third party) Inspection Body. As documented in 350Solutions ETV Policy Manual (ETV QPM 350-200-03), 350Solutions conforms to the requirements of ISO 17020 Annex A with respect to impartiality for Type A inspections, pursuant to ISO 14034 activities.
2. Not directly involved in the design, manufacture or construction, marketing, installation, use or maintenance of the specific technologies submitted to Isometric for verification, or represent the parties engaged in those activities.	☑	
3. Not part of a legal entity that is engaged in design, manufacture, supply, installation, purchase, ownership, use or maintenance of the items inspected.	☑	

Kevin McCabe
350Solutions, Advanced Mechanical Engineer/ETV Verifier

EDUCATION
M.S. Mechanical Engineering (Material Science), Northeastern University, 2006
B.S. Physics & Chemistry, Northeastern University, 2003

Relevant Experience
Kevin McCabe is a Mechanical Engineer with 15 years of data processing experience and 11 years' experience in technology research and development, process operations, laboratory analytical work, and catalyst development. He is also a lead verifier of environmental technologies applying the ISO 14034 standard to performance verifications at a wide range of scales.

He is fully proficient in engineering modeling capabilities including ASPEN and COMSOL. He has extensive experience as an analytical engineer collecting, calculating, and evaluating data; while improving data quality measures to correct errors. As a lead operator of pilot scale demonstration units, he was responsible for following pilot plant operations through a series of detailed steps or processes. While a research technician he was part of a team developing novel catalysts for use in fuel cells and batteries.

Recently, Mr. McCabe served as lead verifier in support of the NRG-Cosia Carbon XPRIZE competition. Following ISO 14034 protocol, the performance of ten CO_2 capture and conversion technologies were independently evaluated and verified at pilot scale demonstrations while utilizing CO_2 in flue gas. His specific roles in supporting this project included review of technology specifications and commissioning, development of verification plans, field verification of performance, and development and submittal of ISO conformant verification reports and statement.

RESEARCH AND PROFESSIONAL EXPERIENCE:
08/2019-Present: **Advanced Mechanical Engineer – *350Solutions***
Currently, he supports environmental technology verification (ETV) activities for 350Solutions as a lead project and technology engineer. Over the past two years he has led performance verification of numerous carbon conversion technologies at both laboratory and pilot scale. He served as technical lead on verifications for various CO_2 conversion technologies based on mineralization, catalysis, and other conversion approaches.

2010-2019: **Advanced Mechanical Engineer – *Southern Research***
Mr. McCabe's specific duties included technical and task management; supervision of project and/or testing staff; supporting senior process and other engineers; process modeling including techno-economic and life cycle analyses (TEA/LCA); design of operating procedures and test protocols; specification and selection of equipment for process development units and testing systems; collection and interpretation of pilot plant and laboratory data; interacting with clients; preparing comprehensive reports; and maintaining effective quality assurance of all samples and relevant data. In recent years Mr. McCabe has conducted TEA/LCA analyses on a range of technology development programs including:

- Gasification/Pyrolysis/Direct Liquefaction
- Steam and/or Auto-thermal Reforming
- Fischer-Tropsch Catalytic and Mixed Alcohol Conversions
- Thermo-chemical solar storage systems
- Mineral extraction from geothermal brines and produced waters
- Catalytic conversion of sugars to carbon nano-fiber precursor
- Waste heat energy conversion

Research Technician: Responsibilities include bench scale catalyst synthesis; optimization of these methods for commercial production; characterization and development of novel catalytic processes; catalyst formulations; and coatings to advance catalyst science in a team environment.

Senior Research Analyst: Using SPSS managed large databases for clients; performed statistical research; generated data packages; merged, maintained, and QA'ed all data submissions; ensured data privacy requirements were met.

LILY SCHACHT
Carbon Removal Verification Engineer, 350Solutions

EDUCATION:
MS, Environmental Engineering, University of Wisconsin – Madison, 2019
BS, Chemical, Energy, and Environmental Engineering, Washington University in St. Louis, 2017

EXPERIENCE SUMMARY:
Lily Schacht is an Environmental and Chemical Engineer with experience in process engineering, environmental chemistry, analytical methods, and life cycle analysis (LCA). At 350Solutions, Lily works on verifying carbon dioxide removal (CDR) technologies, with a focus on mineralization-based pathways, including enhanced weathering, direct air capture, and ocean alkalinity enhancement. Previously, Lily led agronomic research at an enhanced weathering CDR supplier where she organized field trials across multiple states to quantify carbon removal and crop yield changes after rock application. Before that, Lily developed rapid prototyping instrumentation to optimize a biomineralization process in concrete production and aided in scaling up the process to pilot-scale. Lily also built environmental impact models for process variable sensitivity analysis of demo-scale manufacturing processes. These models were used to drive the direction of research and development to minimize product life cycle impacts. Throughout her career, Lily has developed analytical chemistry methodologies for both liquid- and solid-phase analyses.

RESEARCH AND PROFESSIONAL EXPERIENCE:

March 2024 – Present: Carbon Removal Verification Engineer, 350Solutions
Verify CDR technologies on behalf of registries and the XPRIZE Carbon Removal challenge. Specializes in mineralization pathways, including mineralization kinetics, measurement methods, and open-system modeling.

Nov 2022 – Feb 2024: Researcher, Lithos Carbon
Quantified carbon removal rates and agronomic impacts of enhanced weathering on cropland across six US states; Evaluated chemical analysis methods for precision relative to cost.

Nov 2023 – Jan 2024: Independent Consultant, Keel Labs
Built an environmental impact model to evaluate potential material and process changes; Recommended areas for reducing material usage up to 80%

Dec 2020 – Oct 2022: Research Scientist II, Biomason
Guided experimentation and data analysis throughout all R&D teams to inform techno-economic analysis (TEA) and LCA; built and led the carbonate biomineralization prototyping workstream for rapid iteration; developed real-time measurement techniques for critical process parameters in solid state

SELECTED PUBLICATIONS & PRESENTATIONS:

- **Schacht, L.**, Baum, M., Liu, H., & Yap, M. (2023) Scaling Enhanced Rock Weathering: Agronomic Impacts at Field-Scale [Abstract]. ASA, CSSA, SSSA International Annual Meeting, St. Louis, MO.
- **Schacht, L.** and Ginder-Vogel, M. Arsenite Depletion by Manganese Oxides: A Case Study on the Limitations of Observed First Order Rate Constants. *Soil Syst.* 2018, 2(3), 39. https://doi.org/10.3390/soilsystems2030039

350Solutions, Inc. Corporate Experience

350Solutions serves as an independent expert in cleantech, low carbon, and environmental technologies. We provide an unbiased assessment of innovative technologies. 350Solutions is accredited through ANAB under ISO 17020 as an independent inspection body to provide independent technology evaluation services using the ISO 14034 ETV process. In addition, 350Solutions staff include a Certified Measurement and Verification Professional (CMVP for IPMVP) and a North Carolina Registered Professional Engineer (P.E.).