# O.C.O Leeds Output Audit Report

## For Puro.Earth

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|---|---|
| $CO_2$ Removal Supplier | O.C.O Technology Limited |
| Removal Method | Carbonated Materials |
| Production Facility | O.C.O Aggregate Manufacturing: Leeds Facility – ID No. 625222 |
| Production Facility Addresses | Leeds: Hub 45<br>37 Knowsthorpe Gate<br>Leeds, UK LS9 0NP |
| Net Volume of $CO_2$ Removal | 1,706 CORCs |
| Removal Period | February 1 – March 31, 2025 |
| Auditors | 350Solutions<br>Lily Schacht |
| Report Date | June 23, 2025 |
| Version | v1.1 |

# Contents

| PRODUCTION FACILITY & OUTPUT AUDIT REPORT | | |
|---|---|---|
| Company O.C.O Technology Limited | Company Contacts:<br>Dr. Peter Gunning<br>Stephen Roscoe | Audit Team:<br>Lily Schacht<br>Bill Chatterton* |
| Removal Method: Carbonated Materials | | |
| Report Date: June 23, 2025 | | |
| Document No: 350VR-OCO-PU2504 | | |
| Rev: 1.1 | | |

** primary contact/lead author*

# 1. Introduction

350Solutions, Inc. was contracted to perform an audit of carbon dioxide removal credit (CORC) claims for O.C.O Technology Limited's carbonated aggregate production process. 350Solutions declares that we are an impartial auditor, free from any conflicts of interest, capable, and qualified to complete this audit according to Puro Standard and related Validation and Verification Body Requirements.

In December 2022, 350Solutions conducted a Production Facility audit of the process, lifecycle $CO_2$ emissions assessment (LCA), and other administrative details to verify compliance with the requirements of the Puro.Earth Puro Standard General Rules (Version 3.1) and Carbonated Materials Methodology (Edition 2022, v 1.0) [1], [2]. The Production Facility audit remains valid until December 2027. This follow-up output audit was conducted to verify O.C.O's reported CORCs for the Leeds facility over the period of February 1 through March 31, 2025. The verification was conducted through a detailed document review and audit.

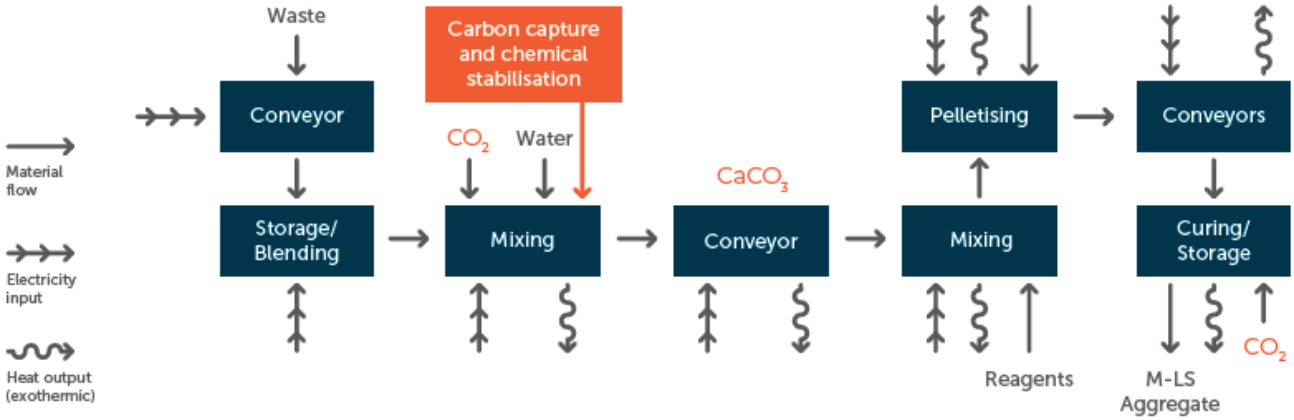
**Table 1. 2024 Q4 O.C.O Leeds Output Audit Summary**

| Verification Summary | |
|---|---|
| **$CO_2$ Removal Supplier** | O.C.O Technology Limited |
| **Removal Method** | Carbonated Material: Production of carbonated aggregate from waste materials |
| **Verification Type** | Removal supplier output audit; Puro Standard General Rules (v3.1) and Carbonated Materials Methodology (v2) |
| **Production Facility Name and Identification Number** | O.C.O Aggregate Manufacturing Facility:<br>Leeds – Facility ID No. 625222 |
| **Production Facility Locations** | Hub 45, 37 Knowsthorpe Gate, Leeds, UK LS9 0NP |
| **Verified CORC Factor** | 56.4 kg $CO_2$-eq/t aggregate product |
| **Verified CORCs** | 1,706 |
| **Audit Kickoff Date** | May 16, 2025 |
| **Audit Report Date** | June 23, 2025 |

# 2. Technology Description

The O.C.O Technology (O.C.O) process and technology uses carbon dioxide to treat various waste materials via Accelerated Carbonation Technology (ACT). O.C.O produces a lightweight carbonated aggregate for use in construction applications, such as in precast concrete block and ready-mixed concrete. O.C.O currently operates several sites in the UK treating air pollution control residue (APCr) primarily from waste-to-energy plants and producing aggregate that meets EN13242 and EN13055 requirements. The aggregate production process utilizes $CO_2$ from biogenic or other sources injected during the accelerated carbonation step and also absorbs and reacts with significant amounts of $CO_2$ in ambient air during on-site curing and storage. For CORC purposes, only $CO_2$ from biogenic sources, or absorbed directly from the atmosphere during curing is credited. $CO_2$ is permanently sequestered in the aggregate product in the form of carbonates. The process is summarized in Figure 1.

**Figure 1. O.C.O Technology Carbonated Aggregate Process.**




O.C.O operates production facilities in the U.K. (Avonmouth, Brandon, Leeds, Wretham) utilizing the same general process, inputs, and outputs in each location. O.C.O Manufactured LimeStone (M-LS) aggregate is currently sold primarily as construction material to concrete block makers, ready-mix concrete producers, and for pavement, earthworks (i.e. foundation fill), and similar applications.

## 2.1. Process Inputs & Outputs

The O.C.O aggregate manufacturing process uses similar inputs as a concrete batching process, with the primary exception being the use of air pollution control residue (APCr) as a primary feedstock, which the O.C.O process treats and stabilizes in the aggregate carbonate matrix that forms. Primary inputs include APCr, water, $CO_2$, sand, and other aggregates or residues, such as limestone dust or scalpings (crushed rock). The process uses electricity for operation of equipment, and requires heavy equipment for material handling, which require diesel fuel use.

The O.C.O process produces very little to no waste products and has very limited emissions of any kind from the facility. Any waste produced on site is typically recycled and used in the mix in small quantities, as they are often components of feedstock or product. There are no air emission points, with the primary potential emissions being fugitive dust, which is controlled and monitored at the sites, and water vapor emitted as bound water in the raw material is released during the

carbonation reaction. All $CO_2$ inputs are absorbed and reacted in the Stage 1 process, which is controlled and monitored by pressure in the sealed mixer to ensure $CO_2$ is not injected until prior injection has been reacted.

Table 2 summarizes the observed inputs and outputs from the process and typical rates from supplied operational data.

**Table 2. Verified Production Facility Inputs & Outputs**

| Input or Output | Item | Verified Amount Over Monitoring Period | Notes (Specifications, source, etc.) |
|---|---|---|---|
| Inputs | APCr (tonne) | 14,409 | O.C.O tests each APCr delivery to ensure it is within specifications to enable aggregate production. |
| | $CO_2$ (tonne)<br>- Biogenic injected<br>- Fossil injected<br>Ambient $CO_2$ absorbed during curing | <br>447<br>0<br>3,681 | $CO_2$ values provided for reporting period are the total $CO_2$ delivered to O.C.O, all injected $CO_2$ was biogenic sourced. |
| | Water ($m^3$) | 4,837 | Utility metering data |
| | Cement (tonne) | 3,059 | Data recorded using process control output files associated with production facility weigh scales |
| | Limestone dust (tonne) | 9,336 | |
| | Other waste materials (sand, C&D debris, scalpings, recycled glass, etc.) (tonne) | 4,696 | |
| | Raw material supply inputs (extraction, handling, transportation emissions) | Included in Production & Operation $CO_2$ emissions below | Emissions are from raw material extraction and production processes (OneClick EPD software used for EPD emission factors and calculation) as well as transport of materials to O.C.O. EPD independently verified by EPD Hub |
| | Production inputs:<br>- materials handling equipment (diesel)<br>- site electricity use | <br>9,464 liters<br><br>21,425 kWh | No additional energy inputs are required. All electricity and diesel usage is based on utility bills or purchase records. |
| | $CO_2$ present in feedstock ($E_{priorcarbon}$) | 12.8 kg $CO_2e$ per tonne aggregate | Based on monthly analysis of APCr feedstock material and rate. |
| Outputs | Aggregate product output (tonne) | 30,252 | Aggregate product output is based on delivered product weighed as it leaves the plant gate on calibrated weigh scales. |
| | $CO_2$ stored in aggregate ($E_{stored}$) | 4,128 $tCO_2e$ (136 kg $CO_2e$ per tonne aggregate produced) | Based on measured carbonate content of M-LS aggregate (monthly), as detailed in document the uploaded Carbon Assessment Datasheet |
| | Production and operation $CO_2$ emissions output ($E_{production}$) | 2,422 $tCO_2e$ (80 kg $CO_2e$ per tonne aggregate produced) | Includes all raw material extraction and transportation and aggregate production process. |
| | Net $CO_2$ emissions | 1,706 $tCO_2e$ | $E_{stored} - E_{production}$ |

| | | | |
|---|---|---|---|
| | | (-56.4 kg $CO_2e$ per tonne aggregate produced) | |

# 3. Audit Summary

## 3.1. Audit Approach

A planned series of audit activities were conducted by 350Solutions to independently validate and verify production and output data, and CORC claims for the reporting period. The audit was conducted following the specifications of Puro General Rules (Version 3.1) and Carbonated Materials Methodology (Edition 2022, v 1.0). Specific audit activities conducted are summarized in Table 3. A completed Puro Carbonated Materials Methodology Audit Checklist used during the audit is attached to this report as Appendix 1. Auditor qualifications are attached as Appendix 2.

**Table 3. Audit Activities**

| Date(s) | Verification Activity | Verification Tasks | Documents Reviewed |
|---|---|---|---|
| **June 9, 2025** | Introductory Document Review | - Review of operational and procedural changes<br>- Review of LCA and supporting documentation<br>- Review of Puro CORC calculations<br>- Review of raw material sources and sustainability<br>- Review of system inputs and outputs<br>- Review evidence of product output<br>- Review of product properties<br>- Review of product end use<br>- Review of equipment and calibrations | Baseline.pdf<br>field-values.csv<br>CO2 Removal Data - CO2 Removal Data.csv<br>Carbon Assessment Datasheet.xlsx<br>Product Despatch Report - Leeds Q1 - Product Despatch Report.csv<br>Diesel<br>Utilities.csv<br>2A5 Renewable_Energy_Certificate<br>Electricity (renewable)<br>Solar power<br>Water.png |
| **June 9 – 19, 2025** | Data Review | - Review of LCA and supporting documentation<br>- Review of Puro CORC calculations<br>- Review of raw material sources and sustainability<br>- Review of carbon content of input materials and output aggregate<br>- Review of system inputs and outputs<br>- Review evidence of product output<br>- Review of product properties<br>- Review of product end use | Leeds Aggregated Off Site Deliveries Q1.xlsx<br>OCO Leeds Q1 Data - Off Site Deliveries.csv<br>Hope EPD.pdf<br>Transport.png<br>Off Site Deliveries 06-04-2025 21-08-49<br>Limestone.png<br>Rock Crushing.png<br>Ecoinvent information.png<br>1B2 BES6001 Sustainable Sourcing Certificate.pdf<br>1A1 CO2 Supplier 2 Contract.pdf<br>1A1 CO2 Supplier Contract.pdf<br>Off Site Deliveries 06-04-2025 21-08-49.xlsx<br>Electricity (gas).png<br>Electricity (mixed).png<br>Ladywell Q4 2024.xlsx<br>St Nicholas Court Farms CO2 Data 2024.xlsx<br>CORC Report Summary - Carbonated Materials - OCO, Leeds, Q1 '25 (1)<br>250505 LCA Report.pdf<br>3B1 Terms and Conditions of Sale.pdf<br>05A Permanence Risk Assessment<br>3C1 Aggregate Customers<br>3C3 BlockMix - Sales Factsheet |

| | | | |
|---|---|---|---|
| | | | 3C4 6F - Sales Factsheet<br>3C5 UKCA Blockmix<br>3C6 UKCA 6F<br>1C2 O.C.O Methodology for CO2 Removal v3.pdf<br>1C3 Acid Digestion Method (Section 2.2).pdf<br>OCO LCA Model - Leeds - Q1 2025 (1).xlsm |
| **June 19-23, 2025** | Report Development | - Compose Verification Report<br>- Internal quality control | *No additional documents reviewed following data review* |

## 3.2. Verified Output & CORCs

Table 4 includes the specific CORCs claimed by O.C.O. and verified by 350Solutions during the output audit process.

**Table 4. Verified CORCs for O.C.O Leeds Facility**

| Performance Metric Name / Description | Claimed Value | Verified Value | Monitoring Period |
|---|---|---|---|
| **Net $CO_2$ Removal Factor*** | 56.4<br>kg $CO_2$/ tonne aggregate | 56.4<br>kg $CO_2$/ tonne aggregate | February 1 – March 31, 2025 |
| **Aggregate Output** | 30,252 tonnes | 30,252 tonnes | |
| **Biogenic $CO_2$ Injected** | 447 tonnes | 447 tonnes | |
| **Ambient $CO_2$ absorbed during curing**** | 3,681 tonnes | 3,681 tonnes | |
| **Total CORCs***** | 1,706 CORCs | 1,706 CORCs | |

** $CO_2$ Removal factor is the net value of $CO_2$ removed in the aggregate product based on the O.C.O M-LS Environmental Product Declaration. All of $CO_2$ injected during the reporting period was of biogenic source.*

*** Determined using the average measured carbonate content of M-LS aggregate and the mass of biogenic $CO_2$ injected.*

**** CORC calculations are based on the net $CO_2$ emission rate determined and verified in the valid Environmental Product Declaration (EPD) for the reporting period, and the average measured carbonate content of M-LS aggregate. CORC values are calculated based on this factor and the total aggregate product delivered during the reporting period. The values of inputs during the reporting period are verified and reported here for completeness and to cross check versus the EPD.*

# 4. Audit Findings

## 4.1. Summary of Audit Findings

350Solutions has reviewed and audited the documentation of the technology, the instrumentation, the procedures, performance and collected data and has found that the data presented in the Puro Audit Package:

☒ ***Meets the requirements of the Puro General Rules V3.1 and Carbonated Materials Methodology V2***

☐ ***Meets the requirements of the Puro General Rules V3.1 and Carbonated Materials Methodology V2 with minor modifications***

☐ ***Does Not Meet the requirements of the Puro General Rules V3.1 and Carbonated Materials Methodology V2***

350Solutions utilized a reasonable level of assurance in performance of the outputs audit. A review of O.C.O's "Disclosure since last audit" find no major changes to supplier processes or eligibility criteria. A summary of specific findings associated with each requirement of the Puro Standard and Carbonated Materials Methodology and any identified issues with the audit are summarized below.

**Table 5. Audit Findings**

| Puro Standard CM Method. Section Ref. | Audit Verification Topic | Findings |
|---|---|---|
| ***1.1.1*** | *$CO_2$ Source* | **Acceptable.** O.C.O utilized biogenic $CO_2$ during the reporting period (no $CO_2$ injected was fossil sourced). A significant portion of the $CO_2$ in the product occurs via absorption from ambient atmosphere and reaction in the aggregate during the curing and storage process on-site. |
| *1.1.2*<br>*5.2.1*<br>*5.2.2* | *Sustainable Raw Materials* | **Acceptable.** O.C.O utilizes waste material (APCr) as a primary input, serving as a certified End-of-Waste treatment facility. In addition, O.C.O has obtained BES 6001 certification for Responsible Sourcing of Construction Materials for other inputs. |
| *1.*<br>*3.1.1*<br>*3.1.2*<br>*3.1.3*<br>*5.2.1*<br>*5.3.1*<br>*5.3.2*<br>*5.3.3* | *Net-Negative LCA* | **Acceptable**. O.C.O has demonstrated an appropriate basis for CORCs according to the Puro Methodology. The LCA was completed and independently verified as part of the independently verified EPD development, and utilizes the appropriate standard (ISO 14040/14044), system boundary (cradle to gate – excluding distribution use and end-of-life), cut-off approach for secondary materials, and results in a net-negative LCA, with -56.4 kg $CO_2$ removed per tonne of aggregate (after accounting for prior carbon present in the APCr feedstock material). |
| *1.2.4* | *Output Quantification* | **Acceptable.** All reported aggregate production is based on deliveries at the gate, as measured on a calibrated weigh scale at the facility. All shipped aggregate product is accounted for in dispatch records, which form the basis for the claimed production and CORCs. O.C.O also documents raw material usage and production via plant SCADA systems, which can be used for cross-check purposes. Water, electricity, and diesel fuel use are determined by either on-site meters, utility bills, or purchase receipts, respectively.<br><br>O.C.O has a valid EPD for the M-LS aggregate product. All LCA inputs in the EPD are complete and analysis performed in compliance with the Puro methodology. |
| *2.1.3*<br>*5.4.1* | *Product usage* | **Acceptable.** The carbonated aggregate produced by O.C.O is utilized in a variety of construction processes. O.C.O maintains a complete list of customers and a summary of applications of the aggregate. In addition, O.C.O certifies that the product meets EN13242 and EN 13055 standards for specific aggregate types for use in certain construction materials. |
| *2.2.5* | *Demonstrated Additionality* | **Acceptable.** O.C.O has provided financial models and financial records demonstrating the need for carbon finance. Specifically, the primary counterfactual for the O.C.O process is the treatment and landfilling of the APCr residues. Companies that perform this process are typically able to provide lower tipping fees than what O.C.O charges for treatment, which is |

| | | |
|---|---|---|
| | | in large part due to the additional costs of operating the O.C.O process compared to traditional landfilling. To remain competitive with the counterfactual, O.C.O requires carbon finance to enable tipping fee reductions for APCr, to secure their primary input. In addition, with increasing operating costs (electricity, CO2), and low value of aggregate product, the carbon finance revenues support financial results that significantly improve options for future investment and scaling. |
| *4. 5.3.2* | *CORC Calculation Methodology* | **Acceptable.** O.C.O follows the CORC quantification methodology in the CBM Methodology. Note that O.C.O now uses direct measurement of carbonate content of M-LS to quantify $CO_2$ uptake. Direct measurement of carbon content of APCr waste feedstock material is used to deduct prior carbon from the end-product carbon content. |
| *5.5.1* | *Statement re: Double Counting* | **Acceptable.** O.C.O is aware of end-user customer practices and assures no-double counting is taking place. O.C.O has provided written confirmation of use of product. O.C.O utilizes language in its terms and conditions that state that the carbon credits associated with the product do not transfer with the product purchase and credit ownership may be negotiated separately. |

Additional details regarding audit activities, documents reviewed, and observations during the audit process are summarized in Appendix 1.

### 4.2. Audit Issues

No audit issues are noted.

### 4.3. Recommendations for Improvement

No recommendations for improvement are noted at this time.

## 5. Revision History

| Version | Date Issued | Noted Changes |
|---|---|---|
| **Draft v1.0** | June 20, 2025 | Initial Draft |
| **Final v1.1** | June 23, 2025 | Updated dates following internal review |

## 6. Auditor Signatures

Lily Schacht

Digitally signed by Lily Schacht
Date: 2025.06.25 15:56:51 -04'00'

Lily Schacht (Lead Auditor)
Sr. Carbon Removal Verification Engineer
350Solutions, Inc.

Bill Chatterton
June 25, 2025

Bill Chatterton (Quality Assurance)
Carbon Removal Verification Manager
350Solutions, Inc.

# 7. References

[1] Puro.Earth, Puro Standard General Rules, Version 3.1. https://puro.earth/documents/

[2] Puro.Earth, *Carbonated Materials Methodology (Edition 2022, v2).*, https://puro.earth/methodologies/

# Appendix 1: Puro.Earth Carbonated Materials Methodology Audit Checklist

| Guideline Reference | Requirement | Requirement Met Y/N | Compliance Evidence Provided Insert evidence used to verify requirement | Verification Remarks Insert auditors comments | Value Insert numerical value or description (if applicable) | Units Insert unit (if applicable) |
|---|---|---|---|---|---|---|
| **Standing Data Confirmation - The following standing data has been collected from Puro and checked for consistency against other evidence:** | | | | | | |
| Annex B - 1.2.5 | Verification of the CO2 Removal Supplier that is registering Production Facility | Y | N/A | No change since production facility audit | | |
| | A certified trade registry extract (business license/registration, etc.) for the CO2 Removal Supplier | Y | N/A | No change since production facility audit | | |
| | Evidence of the location of the Production Facility | Y | N/A | No change since production facility audit | | |
| | Evidence of the Volume of Output for the full calendar year prior to registration | Y | N/A | No change since production facility audit | | |
| | Evidence of the Removal Method(s) for which the plant is eligible to receive CORCs | Y | N/A | No change since production facility audit | | |
| | Evidence of the date on which the Production Facility became eligible to receive CORCs | Y | N/A | No change since production facility audit | | |
| | If the Production Facility has benefited from public support, evidence to show this | Y | N/A | No change since production facility audit | | |
| **Eligibility Checklist** | | | | | | |
| Annex B - 1 | The production facility is technologically capable of producing carbonated building elements | Y | N/A | No change since production facility audit | | |
| | Production of carbonated building elements is based on mineral carbonation (typically via formation of CaCO3 or MgCO3, with low reversal risk) and overall net CO2 removal. | Y | N/A | No change since production facility audit | | |
| Annex B - 1.1 | The carbon dioxide mineralised in the carbonated building material shall be of biogenic origin or from direct capture from the ambient atmosphere (CO2 from fossil fuels or cement production is not eligible) | Y | N/A | No change since production facility audit | | |
| | The raw material used in the carbonated building element production is of eligible type and that EU, other national, or local legislation is followed in its sourcing and extraction | Y | N/A | No change since production facility audit | | |

| Guideline Reference | Requirement | Requirement Met Y/N | Compliance Evidence Provided Insert evidence used to verify requirement | Verification Remarks Insert auditors comments | Value Insert numerical value or description (if applicable) | Units Insert unit (if applicable) |
|---|---|---|---|---|---|---|
| Annex B - 2.1 | The point of creation of the CO2 removal certificate is the production of the carbonated building element that has absorbed CO2 at the eligible production facility | Y | N/A | No change since production facility audit | | |
| | The producer of the carbonated building element is the CO2 Removal Supplier | Y | N/A | No change since production facility audit | | |
| | The carbonated building element that possesses the CO2 absorbing characteristics is used in construction to replace currently used concrete elements that are manufactured using conventional technologies | Y | N/A | No change since production facility audit | | |
| Annex B - 1.2.3; General Rules - 2.1.3 | CO2 Removal Supplier shall be able to demonstrate additionality, meaning that the project must convincingly demonstrate that the CO2 removals are a result of carbon finance. Even with substantial non-carbon finance support, projects can be additional if investment is required, risk is present, and/or human capital must be developed. To demonstrate additionality, CO2 Removal Supplier must:<br>- Provide full project financials and counterfactual analysis based on Baselines that shall be project-specific, conservative and periodically updated.<br>- Show that the project is not required by existing laws, regulations, or other binding obligations. | Y | N/A | No change since production facility audit | | |
| **Production Facility Checklist (Desktop, Verbal, or Site Visit Confirmation)** | | | | | | |
| Annex B - 1.2.2; General Rules - 2.1.2 *(Env. & Social Safeguards)* | Evidence of proper environmental permitting and practices (e.g. environmental impact statement, air permit, wastewater permit, proper recylcing or disposal of solid wastes) | Y | N/A | No change since production facility audit | | |
| | Evidence of meeting industry-standard safety practices, including documentation of safe performance (such as annual accident reporting) | Y | N/A | No change since production facility audit | | |

| Guideline Reference | Requirement | Requirement Met Y/N | Compliance Evidence Provided Insert evidence used to verify requirement | Verification Remarks Insert auditors comments | Value Insert numerical value or description (if applicable) | Units Insert unit (if applicable) |
|---|---|---|---|---|---|---|
| | **Evidence, including records or policies, of addressing social and environmental issues, including community input regarding operations, response to complaints, or other approaches or evidence** | Y | N/A | No change since production facility audit | | |
| **Annex B - 3 *(Lifecycle GHG Emissions)*** | **CO2 Removal Supplier provides a LCA (LCA report or environmental product declaration)** | Y | Alcove; M-LS EPD | LCA built in Alcove based on EPD | | |
| | **LCA follows general guidelines of ISO 14040 and ISO 14067 rules for product LCA (where carbonated building material is the product and LCA is cradle to gate)** | Y | Alcove; M-LS EPD | LCA meets ISO14040 and 14067 requirements | | |
| | **The LCA activity boundary includes raw material used: CO2 emissions from extraction and production of the raw material used for the production of the carbonated elements** | Y | Alcove | Emissions for raw materials are accounted for. Emissions for waste materials use cut-off approach | | |
| | **The LCA activity boundary includes CO2 emissions from transporting the raw material to the production facility where the carbonated building elements are produced** | Y | Alcove | Transportation emissions are included | | |
| | **The LCA includes all GHG emissions associated with production at the production facility** | Y | Alcove; M-LS EPD | Fuel and electricity use are based on utility bills and all GHGs are accounted for | | |
| | **In case of waste or secondary materials being used in the production of the carbonated building material, it is recommended to apply the cut-off approach for waste, recycled, and secondary products (see Annex B Section 3.1.5** | Y | Alcove | Cut-off approach is used | | |
| | **The activity boundary excludes: transport of elements to construction site(s), construction activities, and end of life (e.g., emissions from demolition or end of life activities)** | Y | Alcove; M-LS EPD | LCA is cradle-to-gate | | |
| **Annex B - 1.2.1, 5 *(Production Facility Audit Proofs and Site Visit)*** | **Confirm the process that is in place to quantify emissions from the extracting, handling, and transport of raw materials, including documentation from such activities and emission factors utilized.** | Y | Alcove | EcoInvent emissions factors include extraction and handling. Transportation is accounted for separately | | |
| | **The LCA specifics and emissions boundary are consistent with observations on site, including inclusion of all inputs and outputs, energy used, wastes emitted, and production processes** | Y | N/A | No change since production facility audit when site visit was completed | | |
| | **Proof that the production process and technology used for the manufacturing of the carbonated building element results in a net CO2-negative** | Y | Alcove; M-LS EPD | Product is net-negative | | |

| Guideline Reference | Requirement | Requirement Met Y/N | Compliance Evidence Provided Insert evidence used to verify requirement | Verification Remarks Insert auditors comments | Value Insert numerical value or description (if applicable) | Units Insert unit (if applicable) |
|---|---|---|---|---|---|---|
| | **product (that is, the product stores more CO2 than the processes for producing it and the raw materials used). Note: The above items may be demonstrated via a a third party EPD or LCA** | | | | | |
| | **The carbon content of the carbonated building element product is documented via laboratory analysis or other third party scientific analysis (Annex B Section 5.2) (this should also account for any carbon content in raw materials)** | Y | Alcove; Carbon Assessment Datasheet | Reported values are based on measurements and have been corrected to remove carbon present in raw materials | Feb - 13.8%<br>Mar - 13.5% | % |
| | **The quantity of the carbonated building element produced and sold is quantified and documented in a reliable manner** | Y | Alcove | Based on product weighed leaving production facility | 30,252 | tonnes |
| | **Relevant meters are in place and they are calibrated for measuring carbonated material product output, CO2 input, and raw material consumption;** | Y | N/A | No change since production facility audit. Carbonate content is determined by titration, not inline meters | | |
| | **The emissions from the extracting and transporting of the raw material are estimated and calculated in a reliable manner (section 5.2.), with documentation of emission factors used, including scope of such emission factors.** | Y | Alcove | EcoInvent documentation provided for all emissions factors | | |
| | **The energy use of the Production Facility can be quantified and the emissions from the process calculated** | Y | Alcove | Fuel and electricity use are based on utility bills and all GHGs are accounted for | | |
| | **The Removal Supplier provides a statement that the carbonated building material product will not be sold as carbon negative if the CO2 removal certificate (CORC) for the product is removed and sold to another stakeholder not associated with the product.** | Y | Marketing materials | Carbon is labeled as carbon negative with a footnote that the carbon credits associated must be purchased through Puro | | |
| | **Disclaimers are provided by the Removal Supplier and any user in any marketing claims that indicate carbon net negativity, removal, or similar. Disclaimer states that the carbon credit associated with the product is managed in PuroEarth's registry.** | Y | Marketing materials | Carbon is labeled as carbon negative with a footnote that the carbon credits associated must be purchased through Puro | | |
| | **Proof of product quality with respect to construction specifications and end uses, such as lab tests of product composition or product performance specifications** | Y | N/A | No change since production facility audit | | |
| | **The auditor goes through the Quantification of CO2 Removal requirements with the CO2 Removal Supplier, so that the Supplier is able to calculate the CO2 Removal independently in its Output Report** | Y | CORC Summary Report; Alcove | Supplier calculated CORCs using the CORC Summary Report. Total CORCs in | | |

| Guideline Reference | Requirement | Requirement Met Y/N | Compliance Evidence Provided Insert evidence used to verify requirement | Verification Remarks Insert auditors comments | Value Insert numerical value or description (if applicable) | Units Insert unit (if applicable) |
|---|---|---|---|---|---|---|
| | | | | Summary Report matched total CORCs in Alcove | | |
| **Quantification and Calculation Checklist - Ouput Audit** | | | | | | |
| **Annex B - 4** | **The producer of the carbonated building element (Removal Supplier) provides data and documentation on the production volume (in kg) of the carbonated elements produced in the production process of the eligible production facility.** | Y | Alcove | | | |
| | **The CORC pre-issuance buffer is set to zero (0%) in this methodology** | Y | N/A | No pre-issuance was used | | |
| **Annex B - 4.1** | **CORCs = Estored - Eproduction** | Y | Alcove LCA framework | | 1,706 | tonnes CO2e |
| **Annex B - 4.2** | **Estored = $Q_{CBE}$ x $A_{CO2}$** | Y | Alcove LCA framework | | 4,128 | tonnes CO2e |
| | **QCBE = the amount of carbonated building material, in metric tonnes, produced by the supplier. It is calculated by the supplier, and appropriate documentation must be available (e.g., number of units produced, weight of units produced** | Y | Alcove LCA framework | | 30,252 | tonnes |
| | **ACO2 = actual amount of carbon dioxide sequestered in tonnes CO2 per tonne product. It is based on measurements or on other scientifically sound methods verified by a qualified third-party auditor** | Y | CORC Summary Report; Alcove | | 0.06 | CORCs/tonne product |
| **Annex B - 4.3** | **Eproduction = GHG emissions from all activities involved in production of carbonated building material** | Y | CORC Summary Report; Alcove | | 2422.00 | tonnes CO2e |
| | **Eproduction activities are are grouped as: sourcing of CO2, sourcing of raw meterials, production of building materials** | Y | Alcove LCA framework | Grouping is done appropriately | | |
| | **For all Eproduction activities included, a full scope of emissions is provided, i.e., including all life cycle stages (manufacturing, use and disposal) of the processes involved.** | Y | Alcove LCA framework | All life cycle stages are included for relevant projects | | |

# Appendix 2: Verifier Qualifications

**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.).

**Lily Schacht**
**Senior 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

**William Chatterton**
**350Solutions**
**Senior Verification Manager**

**EDUCATION**
B.S. Environmental Science, SUNY at Plattsburgh, 1982
A.A.S. Environmental Technology, Paul Smith College, 1979
Certified Measurement and Verification Professional (CMVP), 2019

**OVERVIEW AND EXPERTISE**
William Chatterton is an Environmental Scientist with over 30 years' experience in demonstration, evaluation, and performance verification of technologies addressing environmental issues, advanced energy production and use, and carbon removal. His skills include management, design, and execution of technology demonstration and verification projects, with particular expertise in measurement, reporting, and verification (MRV) of technology performance. He serves as a Senior Verification Manager at 350Solutions and manages projects and programs for commercial and government clients in these areas. During his previous 20 years at Southern Research Institute, Mr. Chatterton managed and supported programs designed to integrate, demonstrate, and evaluate technology performance in the advanced energy and environmental mitigation fields. Technology demonstrations and evaluations that he has been involved with include technologies designed to promote sustainable energy sources, increase energy use and efficiency, mitigate GHG and other emissions, and in most cases provide other social and economic benefits to potential users.

At 350Solutions, he has led efforts toward 350Solutions becoming the first US-based technology evaluation firm accredited to conduct Environmental Technology Verifications under the international standard ISO 14034 – an international standard issued in 2016 to unify the general approach for the evaluation of innovative technologies with potential beneficial impact on the environment.

Mr. Chatterton has had technical roles in several projects focused on identifying and evaluating carbon dioxide (CDR) removal technologies. Under these projects, he verifies the efficacy, performance, scalability, and sustainability of a range of carbon removal technological approaches. Each project culminated in verification statements and reports that summarized verification findings, presented verified performance data, and identified risks associated with broad implementation of the technologies.

**PROFESSIONAL EXPERIENCE**
**350Solutions: 08-2019 – Present**
**Senior Verification Manager:** In this role, Mr. Chatterton manages and executes technology performance demonstrations and verifications of emerging technologies including carbon removal, advanced energy, emissions mitigation, and transportation technologies for commercial clients and U.S. governmental agencies. These performance evaluations generally involve evaluation of commercial feasibility, economic impacts (installation, operating, and capital costs, simple payback, and return on investment), environmental impacts (primarily greenhouse gas and criteria pollutant emission reductions), and technology performance. He also manages and monitors 350Solutions' quality management programs and ISO accreditations.

Recently, he has led diligence and verification activities of CDR technologies for an advance market commitment consortium that aims to accelerate the development of carbon removal technologies by guaranteeing future demand for them. Under a recent project, he verified the efficacy, performance, scalability, and sustainability of two leading enhanced rock weathering (ERW) technologies in the Southern US.

He has also led or supported several technology verifications and performance audits of CDR technologies for one of the world's leading crediting platforms for engineered carbon removal. Technologies verified have included biochar, geologic storage, ERW, and carbonated materials CDR systems.

Previously, Mr. Chatterton 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.

**Southern Research Institute: 1999 - 2019**
**Program Manager, Energy & Environment Technologies:** As Program Manager, Mr. Chatterton has managed and executed several technology performance demonstrations and verifications of emerging energy (efficiency and green building) and transportation technologies, primarily for U.S. governmental agencies, energy research associations, and state energy agencies. These performance evaluations have involved evaluation of commercial feasibility, economic impacts (installation, operating, and capital costs, simple payback, and return on investment), environmental impacts (primarily greenhouse gas and criteria pollutant emission reductions), and technology performance. He has also directed field tests at industrial or commercial sites of oil and gas extraction and processing, power generation, advanced energy, green building, and mobile source technologies. Technology performance assessments typically include management of multiple team efforts and result in peer reviewed deliverables such as test plans and reports and other outreach activities.

**Project Manager:** Managed projects for both private and governmental clients primarily in support of EPA's Environmental Technology Verification (ETV) Greenhouse Gas (GHG) Center. Technology demonstrations focused on energy efficient, GHG relevant, and environmentally sustainable technologies including advanced power generation systems (CHP and micro-CHP), fuel cells, the oil and gas industry, and transportation technologies (on- and non-road retrofits and emerging technologies). As a senior project manager at Southern, he has been involved with performance verification of numerous GHG mitigation technologies and several distributed generation electrical generators, many in NYS. His support of these verifications has included lead or technical support on test plan development, design and implementation of field-testing activities, data evaluation and presentation, and reporting of results. He has managed performance evaluations of four alternative energy cogeneration systems including microturbine, internal combustion, and fuel cell-based systems, all fueled with biogas. Under EPA's ETV Program, assisted with the formation of and participated in two Stakeholder Groups – The Oil and Gas Industry Stakeholder Group, and the Advanced Energy Stakeholder Group.