

Verification Report

For Isometric

CDR Supplier	Planetary
CDR Pathway	Ocean Alkalinity Enhancement (OAE)
Project	Nova Scotia Mineral OAE
Location	Tufts Cove Generating Station 315 Windmill Rd Dartmouth, Nova Scotia 44.674946, -63.595478
Verifiers	350Solutions, Inc. Raleigh, NC, USA Lily Schacht and Tim Hansen
Reporting Period	February 1, 2024 – March 31, 2025
Net CDR	625.64 tonnes CO ₂ e
Report Date	June 9, 2025
Version	V1.3

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Acronym and Chemical Definitions

CDR	Carbon dioxide removal
CO₂	Carbon dioxide
CO₂e	Carbon dioxide equivalents
CO₃²⁻	Carbonate ion
DIC	Dissolved inorganic carbon
ECCO	Estimating the circulation and climate of the ocean (far-field model)
FAR	Forward action request
GHG	Greenhouse gas
GLEC	Global logistics emissions council
H₂CO₃	Carbonic acid
HCO₃⁻	Bicarbonate ion
MgCO₃	Magnesium carbonate
MgO	Magnesium oxide
OAE	Ocean alkalinity enhancement
PDD	Project design document
ROMS	Regional ocean modeling system (near-field model)
S	Salinity
SSR	Sources, sinks, and reservoirs of greenhouse gasses
T	Temperature
TA	Total alkalinity
TSS	Total suspended solids

ISOMETRIC STANDARD VERIFICATION REPORT

Company: Planetary	Company Contact: Will Burt*	VVB: 350 Solutions Lily Schacht* Tim Hansen
Removal Method: Ocean Alkalinity Enhancement (OAE)		
Report Date: June 9, 2025		
Document No: 350-ISO2403-VR1		
Revision: V1.3		

*primary contact/lead author

1. Verification Summary

Table 1. Verification Summary

Project Proponent	Planetary Technologies
Other Project Participants	None
Project Name	Nova Scotia Mineral OAE Project
Isometric Project Code	F5X7
Removal Method	Ocean Alkalinity Enhancement from Coastal Outfalls
Legal Ownership of CDR	Planetary Technologies
Crediting Period	February 1, 2024 – January 31, 2029
Reporting Period	February 1, 2024 – March 31, 2025
Greenhouse Gas Statement ID	ggs_1JT8ZEWQM1S0XFDA
Report Date	June 9, 2025
Net Carbon Dioxide Removal	625.64 tonnes CO ₂ e
Project Location	Tufts Cove Generating Station 315 Windmill Rd Dartmouth, Nova Scotia 44.674946, -63.595478
Audit Type	Isometric Standard Verification in accordance with the following standard, protocol, and modules: Isometric Standard V1.6 Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 Dissolved Inorganic Carbon Storage in Oceans V1.0 Air-Sea CO ₂ Uptake V1.0 Rock and Mineral Feedstock Characterization V1.0 Energy Use Accounting V1.2 Transportation Emissions Accounting V1.1 Embodied Emissions Accounting V1.0

Isometric contracted 350Solutions to perform a project verification of the greenhouse gas (GHG) statement of Planetary Technologies' Nova Scotia Mineral Ocean Alkalinity Enhancement (OAE) Project for the reporting period February 1, 2024 – March 31, 2025. The alkalinity addition for this reporting period occurred February 1, 2024 – January 31, 2025. The GHG statement is based on crediting of air-sea CO₂ uptake through March 31, 2025. Future reporting periods will include additional CO₂ uptake caused by the alkalinity dosed February 1, 2024 – January 31, 2025. The

validation was completed by 350Solutions in March 2025 and remains valid until January 31, 2029. The validation report can be found on the Isometric Registry [here](#).

350Solutions affirms that Planetary has the quantified GHG removal using appropriate equipment, procedures, and protocols for the addition of mineral alkalinity and subsequent air-sea CO₂ exchange in accordance with the requirements of the applicable Isometric standards, protocols and modules.

The carbon removals for the reporting period are provided in Table 2. These values have been verified by 350Solutions.

Table 2. Verified Total Removals by Planetary for Reporting Period Ending March 31, 2025

Removal ID	Sequestration Start Date	Sequestration End Date*	Net tonnes CO ₂ e removed
rmv_1JT8YBX8Y1S0RFYS	Feb 1, 2024	March 31, 2025	625.64

* Sequestration resulting from feedstock dosed between February 1 and March 31, 2025 is not included in this reporting period.

The quantity of 625.64 tonnes of net carbon removals has been verified with a reasonable level of assurance and are eligible for crediting under the referenced Isometric Standard and Protocol.

Verifier Information		
Verification Body	Verifier	Verification ID No.
350Solutions, Inc.	Lily Schacht	350VR-ISO2043-VR1

Lily Schacht
 Digitally signed by Lily Schacht
 Date: 2025.06.09 15:16:00 -04'00'
Signed: Lily Schacht (Verifier)



Timothy A. Hansen
 Digitally signed by Timothy A. Hansen
 Date: 2025.06.09 15:19:16 -04'00'
 Tim Hansen (QA)

2. Verification Details

2.1. Objectives

A planned series of verification activities (Table 3) was conducted by 350Solutions to reach a conclusion about the accuracy of the GHG statement and compliance with the criteria listed in Section 3.2 of this document.

2.2. Responsibilities

The project proponent, Planetary Technologies, is responsible for the fair presentation of the PDD in accordance with Isometric criteria. It is the responsibility of 350Solutions to express an opinion as to whether the GHG statement and supporting documents support verification of the claimed carbon removals.

2.3. Level of Assurance & Materiality

The verification was completed with a reasonable level of assurance. The materiality threshold of 5%, considering the totality of all omissions, errors, and misstatements, was applied to this audit.

2.4. Validation and Verification Body details

350Solutions Inc. declares that we are an impartial verifying body, free from any conflicts of interest, capable, and qualified to complete this validation and verification for the current operational period according to the Isometric Standard and applicable protocols and modules.

350Solutions is an accredited inspection & verification body by ANAB under ISO 17020 for completion of ISO 14034 Technology Verifications and was the first accredited entity in North America for ISO 14034. 350Solutions is based out of Raleigh, North Carolina, USA. The Technical Lead for the Nova Scotia Mineral OAE project validation is Lily Schacht. Veronica Tamsitt from Submarine Scientific was subcontracted by 350Solutions to assist in model verification using the Air-Sea CO₂ Exchange module. Quality assurance was provided by Tim Hansen. Complete verifier qualifications are included in Appendix 3.

2.5. Approach

The verification process activities are described in Table 3. Appendix 1 contains the list of findings identified throughout the validation and verification process. The list of files that were reviewed are listed in Appendix 2.

Table 3. Validation and Verification Activities

Date(s)	Activity	Tasks	Documents Reviewed
May 2, 2025	Review of reporting period modifications to PDD	- Review of GHG statement	- ggs_1JT8ZEWMQ1S0XFDA
May 2 – May 6, 2025	Review of current validation and GHG statement applicability	- Review of Validation Report - Identification of major and minor process steps, measurements, and calculations - Review of relevant Standard, Protocol, and Modules	- 350VR-ISO2403 - Criteria listed in Section 3.2 - Nova Scotia Mineral OAE PDD
May 5 -6, 2025	Verification of Removals	- Compilation of verification issues and recommendations in log of findings - Review of Planetary responses and record resolutions in log of findings - Review of measurements and calculations - Review of monitoring data - Review of GHG statement - Write verification report	- See Appendix 2
May 7 – 12, 2025	Quality assurance and revisions	- Internal review - Review by Isometric - Review by Planetary	- N/A

		- Revisions based on internal and external review	
May 12 – June 9, 2025	Update uncertainty quantification	- Determine appropriate uncertainty quantification - Revise report to reflect complexities in uncertainty quantification	- TC24 CDR quantification – May25

3. Technical Aspects

3.1. Project Description

Planetary Technologies doses alkaline feedstock into coastal outfalls to increase the local alkalinity of the seawater, called ocean alkalinity enhancement (OAE). This alkalinity neutralizes acidic dissolved carbon dioxide (H_2CO_3) that is present in seawater by converting it into carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) ions that are already abundant in the ocean. As ocean carbon dioxide (CO_2) is consumed by this process, the ocean absorbs CO_2 from the atmosphere to bring the air and ocean back into chemical equilibrium. Assuming steady state, the mean seawater residence time of alkaline dissolved carbon ions (CO_3^{2-} and HCO_3^-) charged-balanced by cations other than H^+ is about 100,000 yrs.

The Nova Scotia Mineral OAE Project takes place in Dartmouth, Nova Scotia, Canada on the site of Nova Scotia Power's Tufts Cove Generating Station. Planetary's feedstock for this project is a byproduct of magnesia production, that is primarily made up of magnesium oxide (MgO) and magnesium carbonate (MgCO_3). The feedstock is shipped from Spain and temporarily stored in a nearby warehouse or in an onsite shipping container.

Seawater is pulled from the return line of the power plant's cooling loop into the mixing tank and mixed with the feedstock to form a slurry (Figure 1). The slurry stirs for 30 – 60 minutes, then is mixed with additional seawater and dispensed in the outfall with the remaining cooling loop water.

Gross carbon dioxide removal (CDR) is quantified using near- and far-field modeling using the feedstock dosing record as the input. The feedstock dosing record is used as an input to a coastal 150 m horizontal resolution physical (Regional Ocean Modeling System or ROMS) and biogeochemical model (based on Fennel et al., 2006, 2008) of the Halifax Harbor. A 1D alkalinity release model is used to parameterize alkalinity input to the ROMS model with a 2-phase (particulate and dissolved) proxy.

The unequilibrated alkalinity that leaves the regional domain through the open boundaries is used as input to a global $1/3^\circ$ horizontal resolution data assimilative ocean physical and biogeochemical model (ECCO LLC270 physics with the MITgcm gchem and DIC packages). CDR in ECCO is quantified as the difference in cumulative air-sea CO_2 flux between the dosing and baseline simulations. The gross CDR is the sum of the CDR calculated in the ROMS and ECCO models.

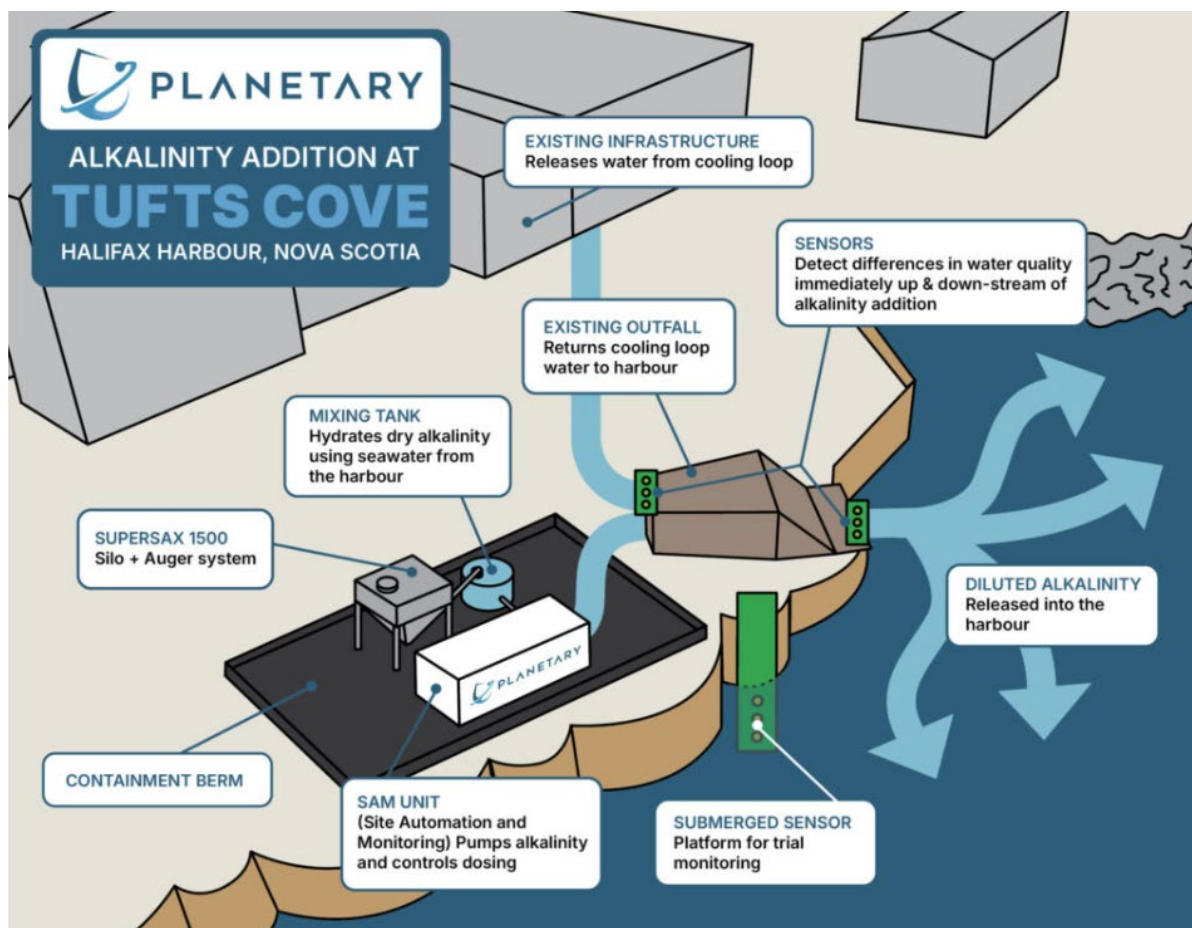


Figure 1. Overview of Planetary Process at Tufts Cove. Beginning on October 15, 2024, feedstock was dispensed directly into the mixing tank, rather than using the Supersax 1500. Credit: Planetary

Planetary has several monitoring locations to ensure the added alkalinity does not create an unsafe perturbation in the outfall plume. There are two multiparameter sondes that continuously measure pH, total suspended solids (TSS), temperature (T), and salinity (S) before and after the alkalinity is added to the cooling loop water. This is supplemented by weekly bottle samples to measure total alkalinity (TA) and confirm TSS, S, and pH measurements and data collected from a monitoring system at a mooring next to the outfall with several continuously monitored parameters. See Table 7 for the complete list of monitored parameters.

3.2. Protocols and Modules Applied

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

- Isometric Standard V1.6 [1]
- Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 [2]
- Dissolved Inorganic Carbon Storage in Oceans V1.0 [3]
- Air-Sea CO₂ Uptake V1.0 [4]
- Rock and Mineral Feedstock Characterization V1.0 [5]

- Energy Use Accounting V1.2 [6]
- Transportation Emissions Accounting V1.1 [7]
- Embodied Emissions Accounting V1.0 [8]

3.3. Project Boundary

The greenhouse gas sources, sinks, and reservoirs within the system boundary for Planetary’s Nova Scotia Mineral OAE Project are listed in Table 4.

Table 4. GHG Sources, Sinks, and Reservoirs

Activity	SSR	Quantification Method
Project Establishment	Initial surveys and feasibility studies	No initial surveys or feasibility studies attributed to this project
	Equipment & materials manufacture and transport	Material-based emissions factors (e.g., 10 kg of polyethylene) from expense reports for equipment and initial consumables purchased
	Construction and installation	No permanent construction occurred for the project, existing infrastructure is used
Operations	Energy use	Fuel for telehandler measured directly. Electricity either measured directly or calculated based on equipment specs before the power meter was operational (Jan 2025)
	Feedstock manufacturing and transport	Feedstock meets the definition of a waste material by Section 7.2.1 of the OAE protocol. Electricity for feedstock packaging is included, along with the emissions associated with the packaging material. Transportation emissions are calculated using GLEC distance-based emissions factors
	Consumables	Material-based emissions factors (e.g., 10 kg of polyethylene) from expense reports
	Waste processing	Pallets are recycled and bulk bags are landfilled. Transportation emissions are accounted for.
	MRV	Fuel for sampling boat is measured directly. Electricity for sensing equipment is included in operational electricity.
	Staff travel	Calculated based on individual reporting or expense reports
	Surveys	Included in MRV
	CO ₂ stored	Near-field (ROMS) and far-field (ECCO) modeling. See Section 3.1.
	Maintenance of project site	All purchased materials included in consumables. Electricity for site metered.
End-of-Life	End-of-life emissions	Included in project establishment
	Ongoing sampling and monitoring for MRV	N/A – project is ongoing so sampling and monitoring will be accounted for in subsequent reporting periods

	Ongoing surveys	N/A – project is ongoing so surveys will be accounted for in subsequent reporting periods
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3.4. Changes since Validation and Previous Verification(s)

This project was initially validated on March 21, 2025 and remains valid through January 31, 2029. This is the first verification. During validation, Planetary demonstrated use of experimental mooring-tethered pCO₂ and total alkalinity (TA) sensors. These sensors are in development by third parties and were not operational for periods during the reporting period. As a result, the data was not submitted for verification. This is an acceptable deviation because the mooring measurements located within the mixing zone are not required by the OAE protocol. The required monitoring at the edge of the mixing zone is satisfied by boat surveys.

4. Crediting Details

4.1. Reporting Period

This is the first reporting period for this project, spanning February 1, 2024 to March 31, 2025.

4.2. Crediting Period

This project was initially validated on March 21, 2025, with a crediting period of February 1, 2024 to January 31, 2029. This is the first crediting period for this project.

5. Validation and Verification Summary

5.1. Accuracy of the Statement

The values represented in the GHG statement have been evaluated, cross-referenced with the presented evidence, and confirmed. Confirmation of the GHG statement has been based on the following efforts:

1. Recalculation of removals, including:
 - a. Recalculation of Gross CDR from ROMS model output at end of Jan '25 derived from the difference in the cumulative air-sea CO₂ flux in the baseline and dosing simulations
 - b. Recalculation of Gross CDR from ECCO model output (2007 ensemble run) at end of March '25 derived from difference in the cumulative air-sea CO₂ flux in the baseline and dosing simulations, and from the difference in DIC inventory between the baseline and dosing simulations at the end of the ECCO model experiment
2. Recalculation of error propagation (uncertainty) of net CDR calculation
3. Review of monitoring data to check for large disturbances or regulatory exceedances
4. Review of supporting data for operations emissions during the reporting period
5. Review of analytical data quality, methods, and uncertainty analysis
6. Review of feedstock characterization
7. Review of environmental and social safeguarding practices

Issues identified during the verification process are listed in Appendix 1.

Each term in the net CDR calculation was recalculated where possible, or the approach or justification reviewed, where direct recalculation was not possible. The terms and corresponding values for this reporting period are listed in Table 5. For additional detail, see the Calculation view for this reporting period on the Isometric Registry.

Table 5. Net CDR Calculation for the Reporting Period from February 1, 2024 to March 31, 2025

Parameter	Value (tonnes CO ₂ e) ^{1,2}	Source
CO₂e_{Removal}, RP	625.64	OAE Protocol Equation 1
CO₂e_{Stored}, RP	881.77	Air-Sea CO ₂ Uptake Module Equation 3
Total dosed alkalinity	545.39 tonnes OH ⁻	(Mass of feedstock dosed) * (mass fraction of alkalinity in feedstock)
Mass of feedstock added	1103.22 tonnes feedstock	Weighed supersacks
Mass fraction of alkalinity in feedstock (measured)	494.36 kg OH ⁻ /tonne feedstock	Calculated from final weighted-average of total chemical composition data
Efficiency of CO₂ uptake	0.0016 tCO ₂ e/kg OH ⁻	Modeled CDR divided by (preliminary mass fraction of alkalinity in feedstock)*(feedstock dosed)
Modeled CDR	870.76	ROMS + ECCO
Near-field CDR	519.12	ROMS
Far-field CDR	351.64	ECCO
Mass fraction of alkalinity in feedstock (estimated)	488.19 kgOH ⁻ /tonne feedstock	Calculated from initial total chemical composition data
CO₂e_{Emissions}, RP	151.33	OAE Protocol Equation 6
CO₂e_{Establishment}, RP	9.21	Modeled based on material use
CO₂e_{Operation}, RP	138.34	Alkalinity production and transport, personnel transport and accommodations, operations and monitoring
CO₂e_{End-of-Life}, RP	3.77	Modeled based on material use
CO₂e_{Leakage}, RP	0	No leakage expected – See Table 6
Uncertainty Discount	104.80	Propagated uncertainty from gross CDR and LCA

¹ Values have been rounded and may not add up without error.

² Units are tonnes CO₂e unless otherwise noted.

Planetary calculated the uncertainty discount through error propagation of the individual terms in the CO₂e_{Removal} equation. The uncertainty due to interannual variability in the ROMS and ECCO model output were quantified separately using their respective ensembles. Uncertainty in the near-field domain (ROMS) may be caused by temporal or spatial variability. Unequilibrated alkalinity may either be subducted (and not returned to the ocean surface) or be transported to the far-field domain (ECCO). The output of the ROMS model that is input into ECCO is a depth-profile of alkalinity export that would capture subducted unequilibrated alkalinity, so Planetary claims that the uncertainty in ROMS is primarily temporal. The unequilibrated alkalinity leaving the ROMS domain is still expected to equilibrate in ECCO, just over a longer period than the residence time of the near-field domain. Thus, the uncertainty in ROMS and ECCO are not independent, and

standard error propagation formulas are not suitable. However, assuming independence results in the most conservative estimate of uncertainty. Because neither the verifiers nor Planetary could determine a quantitative method to account for the covariance using either statistical or conceptual methods, independence was assumed in the calculation of uncertainty for this reporting period. A less conservative approach to uncertainty quantification may be used in future reporting periods if sufficient justification is provided.

5.2. Validation and Verification Opinion

350Solutions has reviewed the documentation of the technology, the instrumentation, the procedures, and performance and has found that the data presented in the GHG Statement and its supporting documents:

☒ ***Meets the requirements of the Isometric Standard V1.6.0 and Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 for Verification***

☐ ***Meets the requirements of the Isometric Standard V1.6.0 and Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 with minor modifications for Verification***

☐ ***Does Not Meet the requirements of the Isometric Standard V1.6.0 and Ocean Alkalinity Enhancement from Coastal Outfalls V1.0 for Verification***

Our opinion is provided with a reasonable level of assurance of Planetary's operations at Tufts Cove Power Generating Station and associated activities (alkalinity sourcing, ocean monitoring).

Notice: 350Solutions, Inc. declares that we are an impartial auditor, free from any conflicts of interest, capable, and qualified to complete this audit according to the Isometric Standard and related Validation and Verification Body Requirements. Verifications and audits conducted by 350Solutions are based on an evaluation of technology performance and CO₂ removal claims via site visit observations and review of data submitted by the audited company. Audits are completed in accordance with rules and methodologies specified by Isometric and utilizing the appropriate quality assurance procedures established under the 350Solutions accredited ISO 17020/14034 Quality Management Program, noting that this verification is not a fully compliant ISO 14034 verification. 350Solutions makes no expressed or implied warranties as to the performance of the technology and does not certify that a technology will always operate at the levels verified, nor that it meets all state, local, or federal legal requirements.

5.3. Summary of Validation and Verification Findings

Table 6 contains a summary of findings for each section of the Isometric Standard and any additional requirements imposed by the relevant protocol and module(s).

Table 6. Eligibility criteria for Isometric's Standard, protocol, and modules relevant to Planetary's Nova Scotia Mineral OAE Project

Reference	Criteria	Findings
Isometric Standard		
2.5.1	<i>Boundaries</i>	Acceptable. No change since validation.
2.5.2	<i>Baselines</i>	Acceptable. No change since validation.
2.5.3	<i>Additionality</i>	Acceptable. No change since validation.
2.5.4	<i>Market Leakage</i>	Acceptable. Planetary's feedstock consumption for this reporting period represents 2% of the supplier's 2023 total production (the most recent year with complete data). The feedstock producer typically sells ~5% of the product

		produced, as it has little commercial value. The remaining material is stockpiled indefinitely.
2.5.5	<i>Life cycle assessment</i>	Acceptable. Approach and emissions factors previously validated.
2.5.7	<i>Uncertainty</i>	Acceptable. Gross CDR uncertainty estimated using model ensemble, uncertainty on emissions estimated using a Monte Carlo approach in SimaPro.
2.5.8	<i>Monitoring</i>	Acceptable. Monitoring took place as planned other than optional parameters collected on the tethered mooring (pCO ₂ and TA).
3.7	<i>Environmental and socio-economic safeguarding</i>	Acceptable. Environmental safeguarding through monitoring, as described above, and previously conducted ecological impact studies. Stakeholder engagement was continuous throughout reporting period. 2024 Impact Report published on Planetary website to communicate project results to the public.
Ocean Alkalinity Enhancement from Coastal Outfalls		
4	<i>Applicability</i>	Acceptable. No change since validation.
8.2	<i>Gross CDR Calculation</i>	Acceptable. Gross CDR calculation based on modeling of air-sea CO ₂ uptake.
9.2	<i>Buffer Pools</i>	Acceptable. Very low risk of reversal.
10	<i>Pre-deployment Requirements</i>	Acceptable. Requirements confirmed during validation.
Air-Sea CO₂ Uptake		
3.1	<i>Model configuration requirements</i>	Acceptable. No change since validation.
3.1.4	<i>Model output provided</i>	Acceptable. Model output provided to recalculate Gross CDR.
4.0	<i>Quantification of model uncertainty</i>	Acceptable. No change since validation.
4.1	<i>Meet requirements for model validation</i>	Acceptable. No change since validation.
5.0	<i>Required records and documentation.</i>	Acceptable. Provided all model files and code needed to repeat the simulation and results from model sensitivity tests and assessment of uncertainty.
Rock and Mineral Feedstock Characterization		
3.1	<i>Analytical Methods</i>	Acceptable. No change since validation.
3.2	<i>Sample Preparation and Handling</i>	Acceptable. No change since validation.
3.3	<i>Physical Characterization</i>	Acceptable. No change since validation.
3.4	<i>Geochemical Characterization</i>	Acceptable. No change since validation.
OVERALL ELIGIBILITY		
Reporting Period		ELIGIBLE February 1, 2024 – March 31, 2025

5.4. Monitoring Requirements

Table 7. Monitoring Requirements

Input / Output Stream	Sub-Process	Required Data (Measurement or estimate)	Units	Exceedance or significant perturbation during reporting period?
Ocean outfall	Up- and downstream outfall sensing	Upstream seawater pH	pH units	[Note 1]
		Upstream seawater TSS	mg/L	[Note 1]
		Upstream seawater temperature	°C	[Note 1]
		Upstream seawater salinity	PSU	[Note 1]
		Downstream seawater pH	pH units	No
		Downstream seawater TSS	mg/L	No
		Downstream seawater temperature	°C	No
		Downstream seawater salinity	PSU	No
Bulk Ocean	Ocean monitoring - Moored Sensors	Ocean and air pCO ₂	ppm	[Note 2]
		Ocean pH	pH units	No
		Ocean temperature	°C	No
		Ocean TSS	mg/L	No
		Ocean salinity	ppt	No
		Ocean total alkalinity	μmol/kg	[Note 2]
		Ocean chlorophyll <i>a</i>	mg/L	No
Bulk Ocean	Ocean monitoring - Boat sampling	Vertical profiles - Ocean pH, TSS, dissolved oxygen, temperature, salinity	pH units, mg/L, % saturation, °C, PSU, μmol/m ² /s	No
		Bottle samples - Ocean alkalinity, pH, TSS, salinity, trace metals	μmol/kg, pH units, mg/L, PSU, mg/L	No
		Sediment grabs - Sediment metals content	mg/kg	No

Notes:

- 1 – Upstream measurements are used to calculate the change caused by Planetary’s operations. They cannot exhibit disturbances attributable to Planetary.
- 2 – pCO₂ and TA sensors on the mooring are experimental sensors. Data was not reliable and was not included in this verification. None of the mooring data is required by the protocol so this is an acceptable deviation.

5.5. Verification Limitations

No forward action requests (FARs) were identified during the verification process. All FARs identified previously noted during the validation process have been addressed.

6. Revision History

Version	Date Issued	Noted Changes
Draft Version 1.0 (v1.0)	May 7, 2025	Initial Version
Draft Version 1.1 (v1.1)	May 9, 2025	Edits based on internal QA review
Draft Version 1.2 (v1.2)	June 6, 2025	Edits to clarify uncertainty quantification method and to match the calculation tree on Isometric's registry
Final Version 1.4 (v1.3)	June 9, 2025	Edits based on external review

7. References

- [1] Isometric, "Isometric Standard v1.6.2." Accessed: Apr. 30, 2025. [Online]. Available: <https://registry.isometric.com/standard/1.6.2>
- [2] Isometric, "Ocean Alkalinity Enhancement from Coastal Outfalls." Accessed: Nov. 20, 2024. [Online]. Available: <https://registry.isometric.com/protocol/ocean-alkalinity-enhancement/1.0>
- [3] Isometric, "Dissolved Inorganic Carbon Storage in Oceans v1.0." Accessed: Nov. 20, 2024. [Online]. Available: <https://registry.isometric.com/protocol/dic-storage-in-oceans/1.0>
- [4] Isometric, "Air-Sea CO₂ Uptake - V1.0." Accessed: Mar. 14, 2025. [Online]. Available: <https://registry.isometric.com/protocol/air-sea-gas-exchange/1.0>
- [5] Isometric, "Rock and Mineral Feedstock Characterization V1.0." Accessed: Jan. 06, 2025. [Online]. Available: <https://registry.isometric.com/protocol/rock-and-mineral-feedstock-characterization/1.0>
- [6] Isometric, "Energy Use Accounting v1.2." Accessed: Dec. 09, 2024. [Online]. Available: <https://registry.isometric.com/protocol/energy-use-accounting/1.2>
- [7] Isometric, "Transportation Emissions Accounting v1.1." Accessed: Nov. 20, 2024. [Online]. Available: <https://registry.isometric.com/protocol/transportation>
- [8] Isometric, "Embodied Emissions Accounting v1.0.3." Accessed: Nov. 20, 2024. [Online]. Available: <https://registry.isometric.com/protocol/embodied-emissions/1.0>

Appendix 1: Log of Findings

All material clarifications, misstatements, and omissions have been resolved. Clarifications have been removed from this log as they do not represent issues with the documents provided.

ID No	Type	Date Issued	Finding/Issue	Audit Evidence	Protocol Reference	Response from Supplier	Conclusion/Resolution from 350	Date Resolved
Validation - 1	Forward Action Request	21-Mar-25	The PDD provides full LCA calculation description and monitoring plan, providing adequate documentation of approach for LCA and data use, but a full LCA including uncertainty was not provided due to status of project development.	2024 TC Inventory Planetary; Planetary PDD 2024 Complete	7.4	LCA provided for verification	LCA provided	5-May-25
Validation - 2	Forward Action Request	21-Mar-25	The PDD provides a description of the planned uncertainty analysis and sensitivity analysis with adequate documentation of the approach, but full analyses not provided due to status of project development.	Planetary PDD 2024 Complete	5.5	Uncertainty analysis provided for verification	Uncertainty analysis meets requirements	5-May-25
Validation - 3	Forward Action Request	21-Mar-25	The PDD provides a description of the planned modeling approach, but all model files and code needed to repeat the simulation, 2D maps of the air-sea CO ₂ flux, 3D output of DIC, and results from model sensitivity tests and assessment of uncertainty not provided due to status of project development.	Planetary PDD 2024 Complete	Air-sea CO ₂ Uptake Module 3.1.4, 5.0	Model files provided for verification	Model files support gross CDR claim	5-May-25
2	Omission	11-Apr-25	Model config files/code for the specific ROMS configuration that shows processing of the forcing/bathymetry data files, model parameters, etc. not provided.	Ocean Model Input Folder	Air-Sea CO ₂ Uptake Module 5.0	Preprint provided to satisfy requirements	Files provided	30-Apr-25
5	Omission	22-Apr-25	Please provide the code for the Equation 3 calculations	Copy of Isometric CDR quantification - Apr25	Air-Sea CO ₂ Uptake Module 3.1.4	Also now added to the Inventory calculations folder of the shared drive.	File provided	23-Apr-25

10	Omission	5-May-25	When will the embodied emissions be fully amortized? Can you provide a table of expected lifespan by product? The amortization timeline must be shorter than the project lifetime.	TC24 LCA Emissions Statement	7.4.4.1	The TC inventory shows all the durable lifetimes for all products in column "S" of the site and monitoring activity tab, wherever a supplier could not provide one we defaulted to 5 years unless it was obvious that the item would not survive that time. The total embedded emissions for those items is shown in the "Project Establishment" tab of the Impact, Uncertainty, and Emission Factor doc shared here as well. The total is 77,252 kgCO ₂ e, and we apply an annual penalty of 9213 kgCO ₂ e which works out to an average of ~8.5 years across all the establishment components.	Support for amortization scheme provided	6-May-25
17	Omission	6-May-25	Make sure raw monitoring data and calibrations are accessible to Isometric	N/A	10.0	Complete Monitoring & EnviroSafety folder from the final XPrize submission (Feb 2nd folder) now uploaded to the Isometric shared drive. Link here 04 - Monitoring & EnviroSafety (Feb 2)	Confirmed Isometric can access	7-May-25

18	Misstatement	6-May-25	It is okay not to submit the pCO2 and TA sensor data from the mooring because it isn't required, but it must be listed as a deviation in the GHG statement because the PDD says you will measure those parameters	GHG Statement, 2024-2025 Tufts Cove Operational Report	10.2	Data gaps in pCO2 and TA from the ocean mooring are now listed in the 'summary of changes' section of the GHG Statement, and they are listed as having no impact in the 'impact of changes' section.	Required changes made	8-May-25
19	Omission	6-May-25	Please share the raw MITgcm format ECCO files	3.5 export_ecco_ocean_carbon_inventory - shared.py	Air-Sea CO2 Uptake Module 4.0	added the 2007 raw ECCO DICCFLX (surfDaig.*) and ocean DIC (PTRACER01.*) fields to the shared drive	Files provided	7-May-25

Appendix 2: Files Reviewed

src_1JT8Z1N5E1S0W3BJ_TC24 LCA Emissions Statement.docx
src_1JT8Z1XKG1S0Q1YH_TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
src_1JT8Z23DZ1S0J0HG_TC24 LCA Emissions Statement.docx
src_1JT8Z2R7R1S00M04_TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
src_1JT8Z45YH1S0VJK3_TC24 CDR quantification - May25.docx
src_1JT8Z4GS41S0XTXC_TC24 CDR quantification - May25.docx
src_1JT8Z56DK1S0037N_TC24 Daily Tonnage Dosed.xlsx
src_1JT8Z5K4A1S02BHY_TC24 EQOH_data_2024 to Jan 2025.xlsx
src_1JT8Z62NE1S04KW7_TC24 CDR quantification - May25.docx
src_1JT8Z6SZE1S06W6G_TC24 CDR quantification - May25.docx
src_1JT8Z77KM1S094GS_TC24 LCA Emissions Statement.docx
src_1JT8Z7JQQ1S0BCV2_TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
src_1JT8Z9DY81S0DN5B_TC24 LCA Emissions Statement.docx
src_1JT8Z9V3X1S0FXFM_TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
src_1JT8ZAPYX1S0J5SX_TC24 LCA Emissions Statement.docx
src_1JT8ZB4XJ1S0ME46_TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
src_1JT8ZBFJG1S0PPEF_TC24 LCA Emissions Statement.docx
src_1JT8ZC0AW1S0RYRR_TC24 Impact, Uncertainty, and Emissions Factors — May25.xlsx
src_1JT8ZC9TX1S0V731_TC24 CDR quantification - May25.docx
TC24 Isometric GHG Statement Report.docx
ROMS_h2_015a8v1_airseafux.nc
ROMS_h2_015a8v1_tracers_202412.nc
File List
ocean_mooring_sonde_20240729-20240805.csv
effluent_20240916-20240923.csv
ocean_mooring_sonde_20240701-20240708.csv
ocean_mooring_sonde_20240923-20240930.xlsx
ocean_mooring_sonde_20250127-20250203.csv
effluent_metals.csv
ocean_metals.csv
effluent_20240722-20240729.csv
ocean_mooring_sonde_20240819-20240826.xlsx
ocean_mooring_sonde_20250120-20250127.csv
effluent_20241216-20241223.csv
effluent_20250113-20250120.csv
sediment_metals.csv
effluent_20240902-20240909.csv
ocean_mooring_sonde_20240902-20240909.csv
effluent_20240715-20240722.csv
ocean_mooring_sonde_20240819-20240826.csv

ocean_mooring_sonde_20250106-20250113.csv
effluent_20241007-20241014.csv
effluent_20240826-20240902.csv
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ocean_mooring_sonde_20240805-20240812.csv
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effluent_20250106-20250113.csv
ocean_mooring_sonde_20240708-20240715.csv
ocean_mooring_sonde_20240715-20240722.csv
ocean_mooring_sonde_20240909-20240916.csv
ocean_mooring_sonde_20241104-20241111.csv
effluent_20241230-20250106.csv
ocean_mooring_sonde_20240923-20240930.csv
effluent_20241014-20241021.csv
effluent_20241223-20241230.csv
effluent_20240923-20240930.csv
effluent_20240729-20240805.csv
effluent_20241111-20241118.csv
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ocean_ctd.csv
mooring_bottle.csv
effluent_bottle.csv
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dosing_20240805-20240812.csv
ocean_mooring_sonde_20241125-20241202.csv
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dosing_20240930-20241007.csv
dosing_20241118-20241125.csv
ocean_bottle.csv
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Feb02 - Monitoring data submission.pptx
dosing_20241230-20250106.csv
dosing_20240826-20240902.csv
dosing_20241007-20241014.csv
dosing_20240923-20240930.csv
dosing_20240729-20240805.csv
dosing_20241223-20241230.csv
dosing_20240812-20240819.csv
dosing_20241202-20241209.csv
dosing_20241216-20241223.csv
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TC24_ecco_cdr_summary.xlsx
readme.txt
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OLD

ECCO_dic_baseline_200702_20080302_v2.nc

PTRACER01.0000416100.meta

PTRACER01.0000411720.meta

PTRACER01.0000425160.meta

PTRACER01.0000405150.meta

PTRACER01.0000418290.meta

PTRACER01.0000420480.meta

PTRACER01.0000409530.meta

PTRACER01.0000413910.meta

PTRACER01.0000402960.meta

RAW.meta

PTRACER01.0000424860.meta

PTRACER01.0000407340.meta

PTRACER01.0000400770.meta

PTRACER01.0000398580.meta

DXV.meta

DXF.meta

DYU.meta

RAS.meta

PTRACER01.0000396720.meta

RAC.meta

RhoRef.meta

ECCO_co2flux_dose_200702_v2.nc

surfDiag.0000409752.meta

surfDiag.0000420768.meta

surfDiag.0000398736.data

surfDiag.0000400968.meta

DXC.data

DYF.data

surfDiag.0000416376.meta

PHrefF.data

surfDiag.0000418536.meta

XG.data

surfDiag.0000411984.meta

PHrefC.meta

RF.meta

DXG.data

XC.data

RC.data

ECCO_co2flux_baseline_200702_v2.nc

Depth.data

RAZ.data

RAS.data

RAC.data
DXV.data
DXF.data
DYU.data
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ECCO_dic_dose_200702_20091005.nc
ECCO_co2flux_baseline_200702.nc
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surfDiag.0000403128.data
YG.meta
DYC.meta
surfDiag.0000423000.meta
DYG.meta
DRC.data
YC.meta
DRC.meta
DRF.meta
hFacW.meta
RhoRef.data
surfDiag.0000425016.meta
Depth.meta
hFacC.meta
RC.meta
surfDiag.0000414144.meta
surfDiag.0000405360.meta
surfDiag.0000407520.meta
hFacS.meta
surfDiag.0000425160.meta
surfDiag.0000403128.meta
RAZ.meta
surfDiag.0000398736.meta
XG.meta
DXC.meta
DXG.meta
DRF.data
ecco_raw_carbon_inventory_TC24_Halifax_20120201_20140302.csv
OLD ecco_raw_carbon_inventory_TC24_20000201_20021005.xlsx
DYF.meta
OLD ecco_raw_carbon_inventory_TC24_20010131_20031005.csv
OLD ecco_raw_carbon_inventory_TC24_20030201_20051005.csv
XC.meta
OLD ecco_raw_carbon_inventory_TC24_20120201_20141005.csv
PHrefF.meta

available_diagnostics.log
OLD ecco_raw_carbon_inventory_TC24_20070201_20091005.csv
RF.data
OLD ecco_raw_carbon_inventory_TC24_20000201_20021005.csv
PTRACER01.0000416100.data
surfDiag.0000414144.data
surfDiag.0000425160.data
surfDiag.0000407520.data
PTRACER01.0000411720.data
surfDiag.0000405360.data
PTRACER01.0000407340.data
PTRACER01.0000398580.data
ECCO_co2flux_dose_200702.nc
surfDiag.0000420768.data
surfDiag.0000409752.data
surfDiag.0000411984.data
surfDiag.0000418536.data
surfDiag.0000416376.data
ecco_raw_carbon_inventory_TC24_Halifax_20070201_20080302.csv
PHrefC.data
ecco_raw_carbon_inventory_TC24_Halifax_20010131_20020302.csv
ecco_raw_carbon_inventory_TC24_Halifax_20000201_20020302.csv
3.6 export_roms_ocean_carbon_inventory - shared.py
roms_ocean_tic_inventory_TC24_Halifax_20230701_20241231.csv
ecco_raw_carbon_inventory_TC24_Halifax_20030201_20040302.csv
3.5 export_ecco_ocean_carbon_inventory - shared.py
roms_ocean_co2flux_inventory_TC24_Halifax_20230701_20241231.csv
PTRACER01.0000425160.data
PTRACER01.0000409530.data
PTRACER01.0000405150.data
surfDiag.0000400968.data
PTRACER01.0000396720.data
ECCO_volumes.nc
YC.data
DYG.data
DYC.data
surfDiag.0000423000.data
RAW.data
YG.data
PTRACER01.0000402960.data
PTRACER01.0000422670.data
PTRACER01.0000424860.data
hFacC.data

PTRACER01.0000420480.data
PTRACER01.0000418290.data
PTRACER01.0000400770.data
hFacS.data
PTRACER01.0000413910.data
hFacW.data
Planetary_regulatory_pathway_Tufts_Cove.pdf
Copy of Planetary Environmental Analysis_approval_13Dec22.pdf
Planetary - First Amending Agreement_signed_22May24.docx (1).pdf
Planetary Nova Scotia Power License Agreement 6521.9676 dual signature (2).pdf
Copy of DG_Amendment_approval_17Ma24.pdf
Copy of DG_Amendment_Cover Letter_27May24.pdf
Copy of DG_Approval_cover_letter_05Sep23.pdf
Copy of DG_Approval_document_05Sep23.pdf
Copy of NS_ECC_Request for Additional Information Letter_12Jul23.pdf
Copy of Dangerous Goods Application acknowledgement_#2023- 3366981-00.pdf
Copy of Planetary Environmental Analysis_091322.pdf
Copy of Enclosure 5 - Planetary_Technologies_TC_contingency_plan_15Aug23_v3_signed.pdf
Copy of Planetary_Technologies_2023-3366981-00_amendment_request_v2_29Feb24.pdf
Copy of Enclosure 1 - Application_2023-3366981_additional_information_21Aug23.pdf
Copy of Planetary_OAE_DG_application_07Jun23.pdf
Copy of Application_2023-3366981_additional_information_20Jul23.pdf

Appendix 3: 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>

Tim Hansen, P.E.
Founder and CEO, 350Solutions

EDUCATION:

B.S., Chemical Engineering, University of Virginia, 1993

M.S., Engineering Science, Thayer School of Engineering, Dartmouth College, 1995

EXPERIENCE SUMMARY:

Mr. Hansen has 28 years of experience in management of energy and environmental technology development and demonstration projects and programs, as well as multimedia environmental engineering efforts. The majority of his recent work has focused on the evaluation of carbon removal (CDR) technologies, including validation of projects and verification of credits for multiple CDR pathways. Mr. Hansen's primary technical focus has been the management and technical performance of large technology evaluation programs in the advanced energy, transportation, and climate change areas, with a specific focus on verification of innovative low-carbon and carbon removal technologies.

RESEARCH AND PROFESSIONAL EXPERIENCE:

2019-Present Founder – CEO, 350Solutions, Inc.

Owns and operates a small cleantech engineering consulting business focused on the independent evaluation of new cleantech and low-carbon innovations and their impacts, with a current focus on carbon removal technologies. Provides independent technology verification, carbon removal credit verification, engineering consulting, testing and evaluation, techno-economic assessment, and other support to companies developing, using, or investing in new low-carbon technology innovations.

2012-2019: Director - Energy and Environment, Southern Research

Managed scientific and technical staff performing research, development, and evaluation of innovative clean energy technologies. Projects range from \$25,000 to \$6 million in size. Technical focus areas included biofuels and biochemicals, carbon capture and utilization, and renewable energy.

PROJECT EXPERIENCE:

Mr. Hansen has executed several independent technology performance verifications of emerging climatetech and carbontech innovations, as CEO of 350Solutions, Director of Energy & Environment at Southern Research, and Director of the U.S. EPA's Greenhouse Gas Technology Center. Mr. Hansen has recently focused on carbon removal technologies, completing verifications of carbon removal credit projects (biochar, carbonated materials, biomass injection) for registries, due diligence audits of enhanced weathering, DAC, direct ocean capture, and CO₂ to polymer technologies for credit offtake buyers, and leading development of independent methodologies for bio-oil sequestration for a novel CDR registry. Mr. Hansen has completed clean technology evaluations for various commercial and government clients, involving evaluation of commercial feasibility, economic and environmental impacts, and technology performance. Mr. Hansen has evaluated and verified technologies for the XPRIZE Carbon Removal in 2022 and 2024 and served as the contracted Measurement and Verification Program Lead for the NRG COSIA Carbon XPrize. Mr. Hansen served as U.S. Technical Expert for the development and implementation of ISO 14034 – Environmental Technology Verification.

RECENT PUBLICATIONS:

- Hansen, et al. Pilot Scale Demonstration & Independent Verification of Carbon Utilization Technologies for the NRG COSIA Carbon XPRIZE. TechConnect Briefs 2019. June 17, 2019.
- Tim Hansen, Kevin McCabe, Bill Chatterton, Michael Leitch, Integrating the ISO 14034 standard as a platform for carbon capture and utilization technology performance evaluation, *Clean Energy*, Volume 5, Issue 4, December 2021, Pages 600–610, <https://doi.org/10.1093/ce/zkab033>

VERONICA TAMSITT

EDUCATION

Ph.D. Oceanography, Scripps Institution of Oceanography, UC San Diego, 2018

Thesis: Aspects of the three-dimensionality of the Southern Ocean Overturning Circulation

B.Sc. Oceanography with Honors, University of Washington, 2012

Thesis: Nitrous Oxide in the eastern tropical North Pacific

EXPERIENCE

Submarine PBC – Remote

2023 –

Co-founder and Head of Oceanography

University of South Florida – St Petersburg Florida/Remote

2021 – 2023

Research Scientist

University of New South Wales and Centre for Southern Hemisphere Oceans Research CSIRO Oceans and Atmosphere – Australia / Remote

2018 – 2021

Postdoctoral Research Associate

Scripps Institution of Oceanography, UCSD – San Diego, CA

2012 – 2018

Graduate Student Researcher

Stable Isotope lab, University of Washington,

Department of Oceanography – Seattle, Washington

2010 – 2012

Undergraduate Student Researcher

SELECTED PUBLICATIONS

Dawson, H. R., England, M. H., Morrison, A. K., **Tamsitt, V.**, & Fraser, C. I. (2024). Floating debris and organisms can raft to Antarctic coasts from all major Southern Hemisphere landmasses. *Global change biology*, 30(8), e17467.

Bach, L. T., **Tamsitt, V.**, Baldry, K., McGee, J., Laurenceau-Cornec, E. C., Strzepek, R. F., ... & Boyd, P. W. (2023). Identifying the Most (Cost-) Efficient Regions for CO₂ Removal With Iron Fertilization in the Southern Ocean. *Global Biogeochemical Cycles*, 37(11).

Tamsitt, V. (2023). New insights into air-sea fluxes and their role in Subantarctic Mode Water formation. *Philosophical Transactions of the Royal Society A*, 381(2249).

Xie, Y., **Tamsitt, V.**, & Bach, L. T. (2022). Localizing the southern ocean biogeochemical divide. *Geophysical Research Letters*, 49(8), e2022GL098260.

Bach, L., **V. Tamsitt**, J. Gower, C. L. Hurd, J. A. Raven, P. W. Boyd (2021). Testing climate intervention with ocean afforestation using the Great Atlantic Sargassum Belt. *Nature Communications*, 12(1), 1-10.

V. Tamsitt

(2018). Moving Windows to the Deep Ocean. *Nature Climate Change*, 8(11), 941-942

Tamsitt, V., H. Drake, A. K. Morrison, L. D. Talley, C. O. Dufour, A. R. Gray, S. M. Griffies, M. R. Mazloff, J. L. Sarmiento, J. Wang, And W. Weiher, (2017). Spiraling Pathways Of Global Deep Waters To The Surface Of The Southern Ocean. *Nature Communications*, 8, 172.

SELECTED CONFERENCE & WORKSHOP PRESENTATIONS

V. Tamsitt, 2022. *Invited panelist on marine Carbon Dioxide Removal permanence*, Ocean Carbon and Biogeochemistry Marine Carbon Dioxide Removal Measurement Reporting and Verification (mCDR MRV) Workshop, University of Rhode Island, USA

V. Tamsitt, 2022. *New understanding of air-sea fluxes and their role in water mass formation*, Invited oral presentation, Royal Society Discussion Meeting on Southern Ocean heat and carbon uptake, London, UK

GRANTS AND FUNDING

Collaborative Research: Diagnosing the role of ocean eddies in carbon cycling from a high resolution data-assimilating ocean biogeochemical model

NSF Office of Polar Programs, co-Investigator changed to Principal Investigator

Amount: \$288,000 | Duration: 2022 - 2025

The Role of Cyclonic Upwelling Eddies in Southern Ocean CO₂ Flux

NSF Office of Polar Programs, co-Investigator

Amount: \$1.1M | Duration: 2021 - 2024

Biogeochemical Argo synthesis products of oxygen, nitrate, and pH for increased community utilization of autonomous profiling observations

NOAA Climate Program Office, co-Investigator

Amount: \$130k | Duration: 2021- 2024